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Industrial Engineering and Environmental Protection
IIZS
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PROCEEDINGS

VII International Conference – Industrial Engineering And Environmental Protection (IIZS 2017)

Zrenjanin, 12-13th October 2017.

University of Novi Sad
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VII International Conference Industrial Engineering and Environmental Protection (IIZS 2017)

Proceedings

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INTRODUCTION

Departments of Mechanical engineering at Technical Faculty "Mihajlo Pupin", Zrenjanin, organized six international conferences:
1. »PTEP 2011 - Process Technology and Environmental Protection»,
2. «IIZS 2012 - Industrial Engineering and Environmental Protection»,
3. «IIZS 2013 - Industrial Engineering and Environmental Protection»,
4. «IIZS 2014 - Industrial Engineering and Environmental Protection»,
5. «IIZS 2015 - Industrial Engineering and Environmental Protection»,
6. «IIZS 2016 - Industrial Engineering and Environmental Protection».

Industrial engineering is a field of technique, which includes the processes and procedures, plants, machinery and equipment used in manufacturing final products in different industries. The task of industrial engineers is that on the basis of theoretical and practical knowledge, solve specific problems in engineering practice, and the development of technology in the field of industrial production process.

The theme of scientific conference «IIZS 2017», covers the fields of industrial engineering, which are defined in the program of the conference, such as: Industrial Engineering, Environmental Protection Engineering and Occupational Safety, Process Technique, Energetics, Designing and maintenance.

The main goals of the conference can be indentified here: innovation and expansion of knowledge engineers in industry and environmental protection; support to researchers in presenting the actual results of research projects, establishing new contacts with leading national and international institutions and universities; popularization of the faculty and its leading role in our society and the immediate environment, in order to attract quality young population for studying at our faculty, cooperation with other organizations, public companies and industry; initiative for collecting ideas in solving specific practical problems; interconnection and business contacts; introducing professional and business organizations with results of scientific and technical research; presentation of scientific knowledge and exchange of experiences in the field of industrial engineering.

We express gratitude to:

- The partners of the conference – „Aurel Vlaicu" University of Arad, Faculty of engineering, Arad, Romania; University «St. Kliment Ohridski«, Technical faculty, Bitola, Macedonia; University Politehnica Timisoara, Faculty of engineering, Hunedoara, Romania; University of East Sarajevo, Faculty of mechanical engineering East Sarajevo, B&H, Republic of Srpska; University of agriculture, Faculty of agricultural engineering, Krakow, Poland; Technical university-Sofia, Plovdiv branch**,** Faculty of mechanical engineering, Plovdiv, Bulgaria; University of Niš, Faculty of mechanical engineering, Niš, Serbia,
- The management of Technical Faculty «Mihajlo Pupin», University of Novi Sad,

for supporting the organization of the conference «IIZS 2017». We are also grateful to all the authors who have contributed with their works to the organization of the scientific meeting «IIZS 2017».

We would like our Conference to become a traditional meeting of researchers, every year. We are open and thankful for all useful suggestions which could contribute that the next, International Conference - Industrial Engineering and Environmental Protection, become better in organizational and program sense.

President of the Organizing Committee
Prof. Ph.D Dragiša Tolmač

Zrenjanin, 12 - 13th October 2017.

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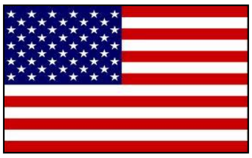
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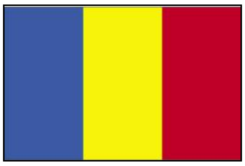
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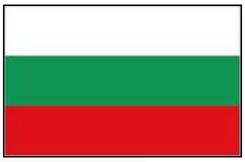
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Session 1.

Industrial Engineering

ANALYZING POSSIBILITIES OF IMPROVING MACHINING PROCESS PLANNING AND OPTIMIZATION BY APPLYING FEATURE TECHNOLOGIES AND SIMULATION TECHNIQUE

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Abstract: Main activities of the technological preparation of production refer to the process planning and optimization. Process plans as the most significant objects of optimization in production systems are characterized by variant solutions in all stages, from the selection of raw material and manufacturing technologies, types and sequences of processes and machining operations, types and characteristics of manufacturing resources, machining parameters and strategies, with machining time, cost, accuracy and surface quality as main objective functions of process planning optimization.
Main goal of this paper is to analyze the possibilities of improving technological preparation of production, or precisely, to improve process planning and optimization of manufacturing process plans through the application of feature technologies and the considered simulation technique. The application of feature technologies will be analyzed from the aspect of possible integration of product design and process planning, while the application of the simulation technique within the CAD/CAM system will test the influence of variants of machining operations and machining strategies on the process planning optimization from the aspect of machining time.
Key words: process planning, optimization, feature technologies, simulation technique

INTRODUCTION

Two basic activities within the product development are product design and product manufacturing which ought to be integrated and connected at the greatest possible extent. Technological preparation of production represents the main integration component or "the bridge" between these two activities, that should meet design requirements of product designers on one hand, and to adopt manufacturing possibilities of production on the other hand [1]. Main activity of the technological preparation refers to the manufacturing process planning and optimization. The imperative of modern global production is to generate rational and optimal process plans, in accordance with the basic optimization criteria such as productivity, cost-effectiveness, machining accuracy and surface quality [2].
Process planning represents the complex multi-dimensional problem that depends on the input data and set requirements according to the observed product/s, as well as the techno-economic conditions and subjective preferences of the product designer. The most important input data for process planning are product drawings which possess information about materials, dimensions, machining accuracy, surface quality, production volume and available manufacturing resources, such as raw materials, machines, tools, fixtures, measuring instruments etc. Accordingly, various process plans can be predicted for the same manufacturing conditions and which can be evaluated using various optimization criteria [3].
In today's manufacturing conditions, modern CAD programming systems based on feature technologies, or the application of features in modeling, are mainly used for product design and for defining technological documentation. However, the attention of product designers is focused on realizing functional characteristics of products and parts, whereby they use features in modeling which generally do not match the typical manufacturing features. By that, the process planning, as well as the integration of CAD, CAPP and CAM systems is more difficult to achieve [4].
According to above mentioned, the first task of this paper is related to the analysis of possibilities of modeling products by applying features that match with manufacturing features which are used in machining processes. In this way, it is intended to facilitate the manufacturing process planning, as well as the integration of activities of product design and process planning through direct application of features from CAD systems to machining process within CAM systems.

Defining machining time and cost represents the basis for the selection of optimal process plan within production systems. Process planning optimization from the aspect of machining time represents a direct impact on the increase in productivity, utilization of manufacturing resources and reduction in manufacturing cost, as well as on meeting given deadlines and delivery dates [5].
Based on this information, the second task focuses on the analysis of the possibility of optimizing process plans using the simulation technique within the appropriate CAPP system through variant machining operations, machining parameters and machining strategies. Three test examples are defined in order to verify the defined tasks.

APPLYING FEATURE TECHNOLOGIES AND THE SIMULATION TECHNIQUE IN TECHNOLOGICAL PREPARATION OF PRODUCTION

Numerous methods and techniques are applied when developing systems of technological preparation of production, that is, CAPP systems and its integration with other functions of a production system. Based on the literature information [6, 7, 8], it is concluded that these systems are mostly based on the application of feature-based technologies, CAx systems and simulation techniques, knowledge bases, artificial neural networks, genetic algorithms, fuzzy logics, Internet technologies, agent-based methods, STEP/STEP-NC standard, etc. This paper analyzes the application of the feature technology and simulation technique as techniques for improving certain activities of technological preparation of production, primarily process planning and optimization.

Features as elements of integration of process planning and production (CAD, CAM, CAPP)

A term “feature” can be found in many different terms in domestic literature, such as a characteristic, property, form, shape, etc., while in the literature from the field of process planning and optimization mostly used terms are “manufacturing feature”, or just “feature” [1, 8].
According to one definition, “feature” represents a semantic group or atom of modeling, determined by a set of parameters that is used for describing an object which cannot be further decomposed from the aspect of one or more activities related to product design and application [9]. Feature-based methodologies were primarily the central part of the integration of CAD/CAM systems, when more intensive development of CAPP systems made these methodologies the basis for the integration of CAD/CAPP/CAM systems [3, 6].
Model of features should contain a sufficient amount of information for the requirements of manufacturing process planning. Generally, there are two types of features that are used within the process planning [8]:

- Geometric (design) features
- Manufacturing (machining) features

Features used in the product design significantly differ from the manufacturing features that are used for manufacturing process planning. One of the consequences of this difference is the different approach in product design and manufacturing process planning. Figure 1 represents the difference in this approach, in which it can be noticed that the product designer uses ribs as typical features because they are functional, while the process planner on the other side observes a raw material (a stock part) that will be machined, so that both a slot and a step are equally significant as machining elements and which are represented with appropriate manufacturing features.

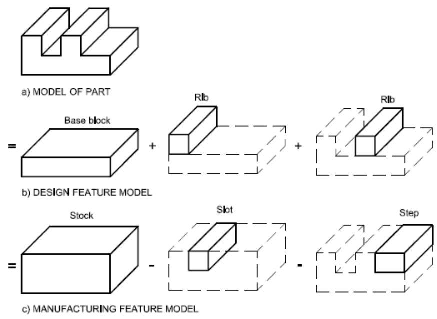


Figure 1. Different approach in product design and manufacturing process planning [10]

As a consequence of the aforementioned, mapping geometrical (functional) domain to manufacturing domain is required and is called the feature recognition (or manufacturing recognition). Manufacturing features, in contrast to features, apart from geometrical also contain manufacturing data. Process plans are defined by machining of specific manufacturing features, or in other words, defined by specific machining operations, cutting tools, machining strategy, cutting parameters etc. [11].
Manufacturing features can be grouped in many different ways, but the most common way is grouping by feature representation:

- Surface feature for Boundary Representation (B-rep)
- Volumetric feature for Constructive Solid Geometry (CSG)

Figure 2 represents a product example planned by using features and defined by surface and volumetric manufacturing features for its machining. Manufacturing features are commonly defined as the elements of tool path profile during its machining.

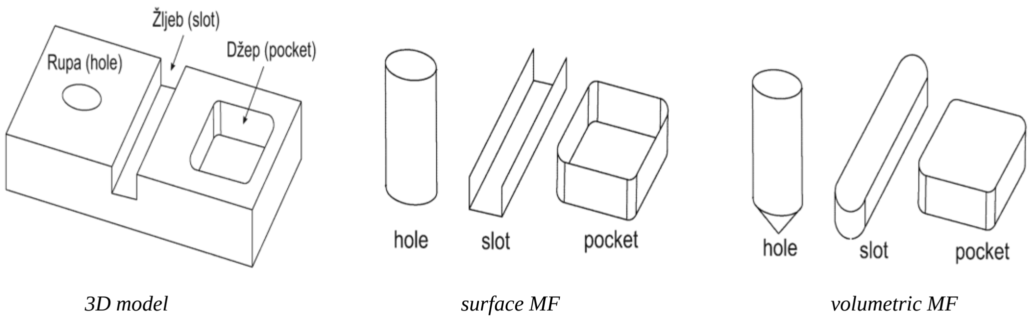


Figure 2. Surface and volumetric manufacturing features for a given product [10]

There are many different classifications of manufacturing features in the literature, which are often of an internal character. The most comprehensive classification is given within the STEP ISO 10303 standard and the appropriate application protocol AP224 [12]. Author in [13] grouped the following features in STEP-NC program for machining operations and processes of milling: planar face, pocket, slot and round hole. This is represented in the Figure 3. Figure 4 represents the examples of features and specific machining operations that can be realized in the 2,5D module of SolidCAM software system which is also used as a software tool for later verification of the given tasks of this paper.

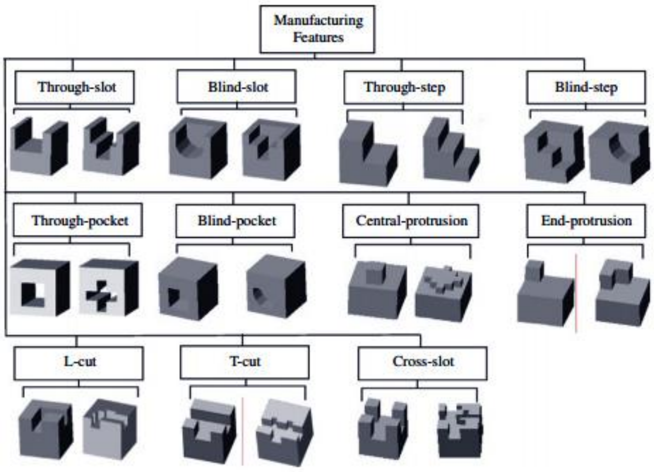


Figure 3. Classification of manufacturing features for milling operations in STEP-NC [12, 13]

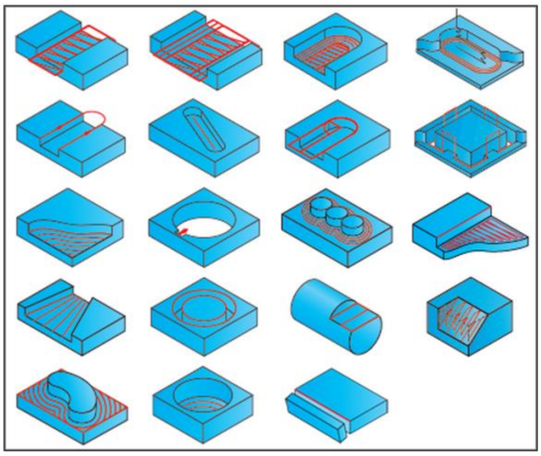


Figure 4. Examples of features and machining operations in the 2,5D module of SolidCAM

Model of manufacturing feature as a basic input data for process planning can be generated in many different ways, based on design approach [8]:

- Design by feature - DBF,
- Automated feature recognition – AFR, and
- Interactive form feature definition

Applying the simulation technique in manufacturing process planning

In technics, a term “simulation” is most often understood as a technique of development and realization of a model of a real object or system, with the purpose of studying behavior of that system without disturbing its environment. Simulation represents a process which is a copy or a parallel of a real process. Simulation also includes a wide range of methods and applications that mimic the real system’s behavior. They are mostly executed by computers or appropriate software systems and simulation systems. Modern simulation can be represented as an experiment conducted on a computer. Three basic elements of a simulation are: a real system, a model and a simulation itself [15].
Modern CAD/CAM software systems which enabled a simulation of machining processes are of a special importance in process planning for realization in CNC manufacturing systems with familiar technical-manufacturing performances, as well as when setting the concept of development of new flexible manufacturing and machining systems [15]. By simulating machining processes, or precisely tool paths, prevention of possible tool collisions with fixtures, machine-tool parts or workpieces is prevented. Within the simulation of machining processes, by applying mathematical models of optimization it is possible to determine optimal tool path, and optimal sequence and types of machining operations on the basis of manufacturing time obtained from simulation [1, 8].

CASE STUDIES

Process planning using feature technologies

The basic input data are the product drawing–housing, production volume (160 parts/series) and the selected material, AlSi12. For the purpose of rational process planning, aluminum alloy casted block is selected as a raw material with 60mm thickness according to JUS.C.C2.101 standard. The block is cut to the required measure in the first process operation, and in the second it is roughly machined by milling in order to achieve the dimensions 300x200x50 mm. According to the defined problem of this chapter, when modeling, features are defined so that they match with manufacturing features, which greatly simplifies manufacturing process planning, primarily the definition of sequences of machining operation. Figure 5 represents the features of the given housing model. Table 1 defines these features more precisely with the following names defined within the CAD software.

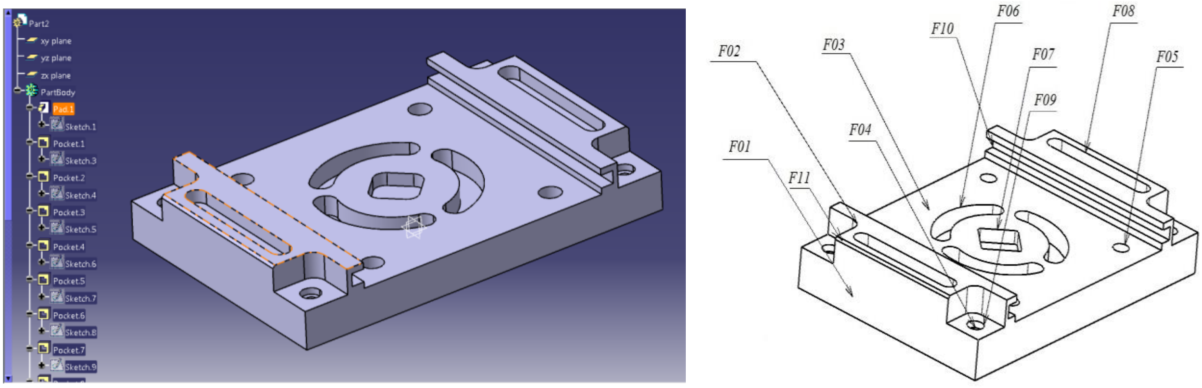


Figure 5. 3D housing model with the defined manufacturing features

The following case study will consider the third process operation which mainly refers to the milling and drilling operations which are performed on the 2,5D CNC machining center for milling. Machining operations shown in the Table 2 are selected for performing these process operations for manufacturing the given housing part. By the way, each feature is machined with the certain machining operation or a group of machining operations. Table 2 also gives the list of tools for specific machining operations with the defined designations of tool manufacturers.

Figure 6. shows the selected sequence of machining operations for the given process operations. After all the machining operations are defined, simulation of machining of the given housing within the CAM system is performed which shows the tool paths of all machining operations which clearly express the absence of collision, Figure 7. After the satisfying simulation results, postprocessing of the CL Data and generating of post processing information for the specific CNC machine is performed and the corresponding times of machining operations and process operations are obtained.

Table 1. Machining operations for the specific features with cutting tools for the milling process

Feature	*Operation Name*	*Operation ID*	*Tool ID*	*Tool Name*	*Catalogue designation*
F02	*Milling open pocket*	*Z1*	*T1*	*Slot milling cutter Ø10*	*R216.24-10050EAK22P*
F03	*Milling open pocket*	*Z2*	*T3*	*Milling cutter Ø75,5*	*R216.24-06050CAK13P*
F04	*Spot drilling 4xØ4* *Drilling 4xØ8*	*Z3* *Z4*	*T4* *T5*	*Core drill Ø4* *Drill Ø8*	*Ø4, JUS K.03.061* *R840-0800-30-A0A*
F05	*Spot drilling 4xØ4* *Drilling 4x Ø16.5* *Milling thread 4xM18x1,5*	*Z3* *Z4* *Z5*	*T4* *T6* *T8*	*Core drill Ø4* *Drill Ø16,5* *Tap M18x1,5*	*Ø4, JUS K.03.061* *R840-1650-30-A0A* *R217.15C160150AC30N*
F06	*Spot drilling 3xØ4* *Drilling 3x Ø7* *Milling slot 3x*	*Z3* *Z4* *Z6*	*T4* *T11* *T2*	*Core drill Ø4* *Drill Ø7* *Slot milling cutter Ø6*	*Ø4, JUS K.03.061* *R840-0700-30-A0A* *R216.24-06050CAK13P*
F07	*Spot drilling Ø4* *Drilling Ø7* *Milling pocket*	*Z3* *Z4* *Z7*	*T4* *T11* *T2*	*Core drill Ø4* *Drill Ø7* *Slot milling cutter Ø6*	*Ø4, JUS K.03.061* *R840-0700-30-A0A* *R216.24-06050CAK13P*
F08	*Spot drilling 2xØ4* *Drilling 2xØ7* *Milling slot 2x*	*Z3* *Z4* *Z8*	*T4* *T11* *T2*	*Core drill Ø4* *Drill Ø7* *Slot milling cutter Ø6*	*Ø4, JUS K.03.061* *R840-0700-30-A0A* *R216.24-06050CAK13P*
F09	*Boring hole 4xØ15*	*Z9*	*T7*	*Countersink Ø15*	*CMT 317.150.11*
F10	*Milling t-slot*	*Z10*	*T9*	*T-Slot milling cutter*	*R331.35-040A16EM*
F11	*Milling chamfer*	*Z11*	*T10*	*Angle milling cutter*	*R215.84-01000-AC25G*

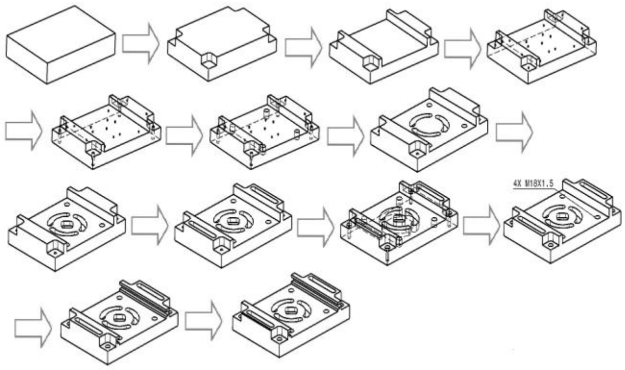


Figure 6. Sequence of machining operations for the milling process

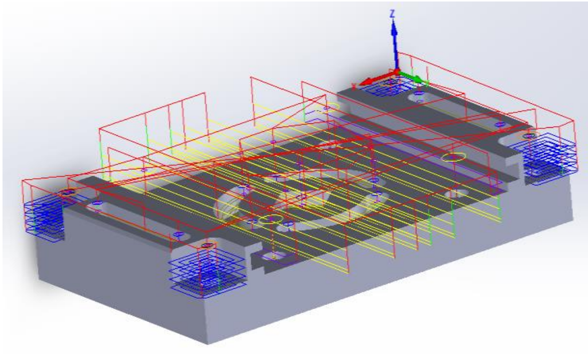


Figure 7. Simulation of the machining process

Optimizing manufacturing process plan by using the simulation technique within the SolidCAM

Within the given case study, the examples of optimizing manufacturing process planning from various aspects of variant solutions will be considered, whereby the adopted objective function will be the minimal machining time, or in other words, maximal productivity.

Influence of variants of machining operations and machining strategy

This example considers the influence variant solutions of machining operations and machining strategy on the machining time for the part made of steel C45 (Č.1530), and for the selected prismatic part (raw material), Figure 8.

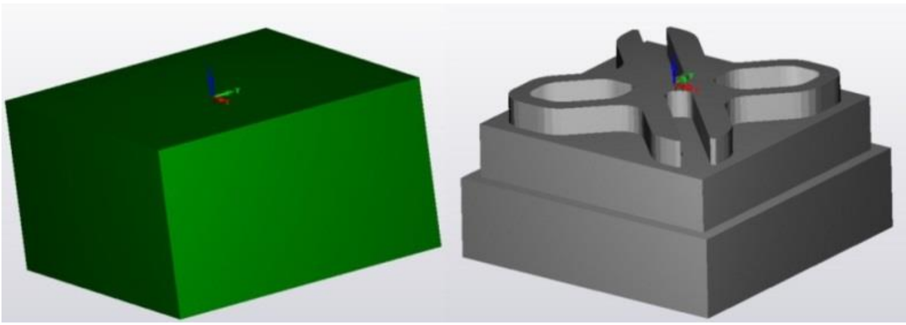


Figure 8. A raw material and a workpiece made of C45

Two machining variants with the following machining operations are set: machining of the pocket, and machining of the outer profile. The first machining operation is the same for both variants, while the other operations differ according to the machining strategies:

- Variant I – machining in more axial depth of cuts, whereby the tool descends to the certain depth and machines the part at one level and then at the each subsequent level of depth.
- Variant II - the milling cutter descends to the final depth and performs the complete machining of the face surface.

The selected tool for the machining is CoroMill-universal milling cutter with 8mm in radius, with the catalogue designation R216.34-08050EBC19P, according to the catalogue Sandvik Coromant.
The difference between these two variants is represented on the example of machining the pockets, i.e. for the selected machining strategy. Profile depth of 10 mm is machined in the equal cuts for the first variant, while the maximal cutting depth is set to 3 mm. In the second case, the cutting tool performs the machining of the final depth. Figure 9 shows the simulation of tool path and machining time for the variant I, while the same is shown for the variant II in Figure 10.

Based on the obtained results it can be concluded that the variant of machining with the final depth has the shorter machining time than the other, variant of machining in more cuts across depth. Thus, the milling process using the variant II is 54,3% faster than the process using the variant I.

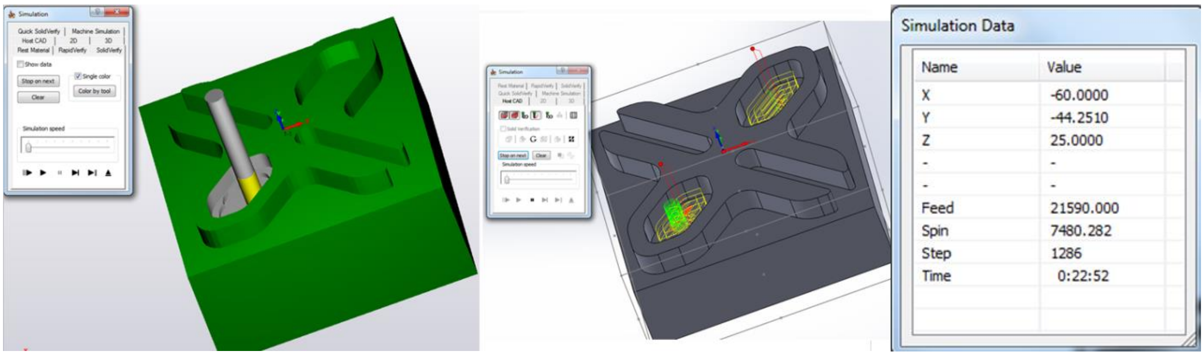


Figure 9. Simulation of the pocket milling operations and machining process time for the variant I

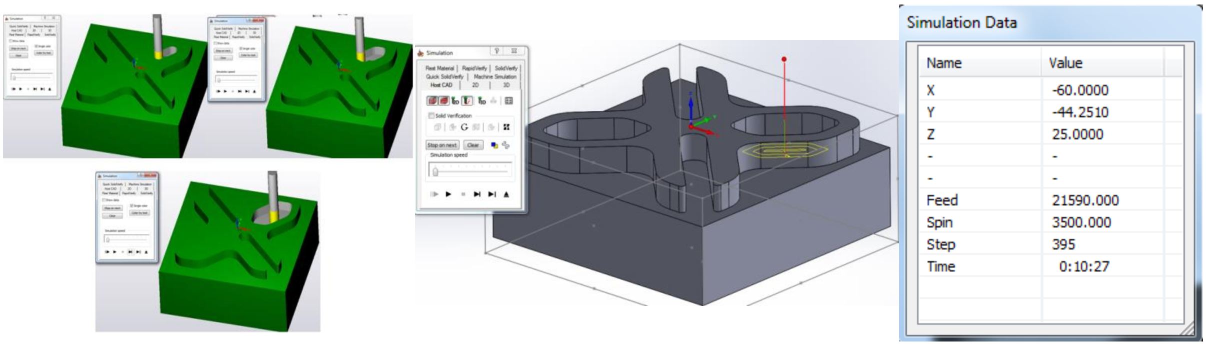


Figure 10. Simulation of pocket milling operations and machining process time for the variant II

Influence of variants of sequences of machining operations

The considered computer experiment refers to the optimization of selected optimal sequence of machining operations for the represented mold part (Figure 11) within the milling process and by using the simulation technique within the CAM system. Machining time is again used as an objective function. Adopted raw material (Figure 11 left) is the alloy 16MnCr5 (1.7131) according to the DIN, i.e. steel 4320 with the given hardness of 180HB. Within the planning of milling process for the given mold, the following machining operations are defined:

- A) Milling of the upper surface
- B) Profile milling of the face surface
- C) Rough machining of the pocket
- D) Final machining of the pocket
- E) Machining of the open slot

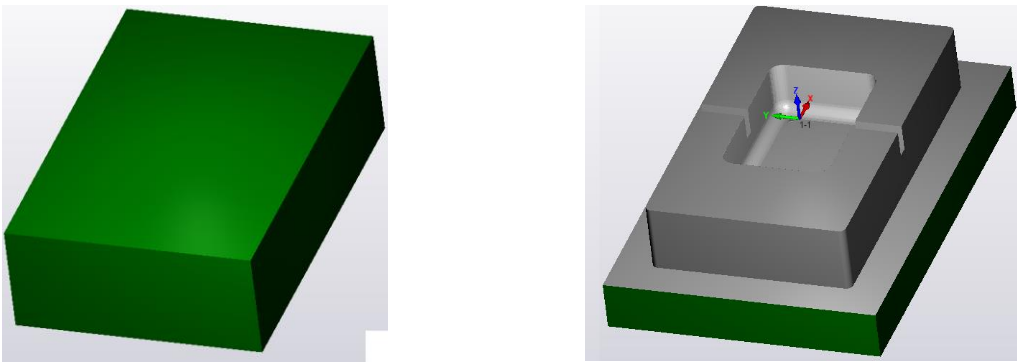
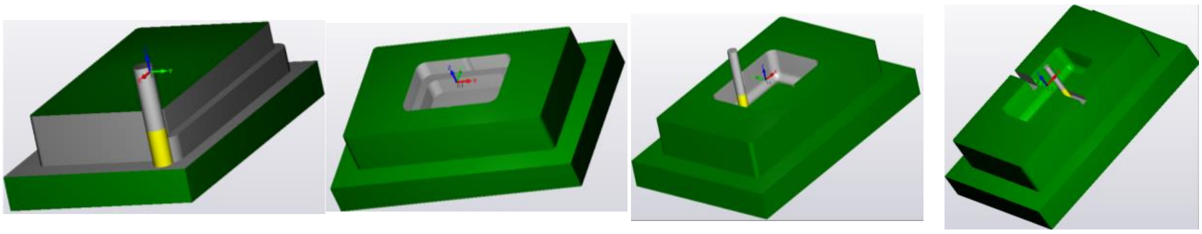


Figure 11. A raw material and a workpiece for the milling process

The following Figure 12. shows the results from the simulation of these machining operations. For performing these operations five different variants of sequences of machining operations are set and shown in the Table 2 with the machining times obtained from the simulation.



Operation B | Operation C | Operation D | Operation E

Figure 12. Output from the simulation of milling operations for the housing part

Table 2. Set variants of operation sequences with given machining times obtained from simulation

Variant 1	Variant 2	Variant 3	Variant 4	Variant 5
A B C D E	B A C D E	B A E C D	C D B A D	C D E A B
Time: 49 min 50sec	Time: 49 min 58sec	Time: 49 min 58sec	Time: 50 min 29sec	Time: 50 min 41sec

The shortest machining time is achieved with the variant I of machining sequence which lasts for 49 min. and 50 seconds, while the longest machining time is achieved with the variant V which lasts for 50 min. and 41 second. The time difference between the variant I and variant V is 51 second which can be very significant in serial production and for machining more complex product parts.

CONCLUSION

In this paper, the possibility of improving process planning and optimization by using the modern techniques based on feature technologies and simulations is considered. The first part of the paper gives the theoretical basis for these two techniques with an emphasis on their application on the defined tasks of technological preparation of production.

The first task of the research that was focused on the integration of product design and process planning on the basis of features is verified on the example of milling process of a housing model. For this purpose, during the process of modeling, features that match with manufacturing features suitable for machining are used, which significantly facilitates manufacturing process planning, specifically the part that refers to defining machining operations. In the manufacturing process planning, machining operations or groups of machining operations are defined for each feature on the product part including corresponding tools and cutting conditions, with the simulation of machining process and generation of postprocessing information within the CAM system.

The second task of this research was referred to the analysis of possibilities of optimizing machining time for manufacturing process plans using the simulation technique. This task was verified on the two cases, whereby the first case represented the variants of machining strategies while the second one was concerned with the sequence of machining operations with the application of the simulation technique in the SolidCAM system. The other example takes into account precedence constraints between machining operations which were not in the scope of this research.

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OPTIMAL PATH DETERMINATION IN A STRATEGIC MAP OF INDUSTRIAL ENTERPRISES

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Abstract: Business management in modern business conditions implies the determination of business goals that will link the company's business strategy, provide relevant information about the process's performance within competitive strategies and point to the areas where improvements are needed. The business goals priority on each BSC perspective is determined by rank and measure of belife that a business goal can be found in the first place.
Key words: BSC, industrial company, FDM, business goals

INTRODUCTION

Business management in modern business conditions implies the determination of business goals that will link the company's business strategy, provide relevant information about the process's performance within competitive strategies and point to the areas where improvements are needed [1]. Increasing the effectiveness of business goals should lead to an increase in the efficiency of the company's operations as a whole, which is one of the basic requirements of the ISO 9000: 2008 standard. The type and number of business goals are determined by management teams and experts-most often according to the results of good practice and / or requirements of the stakeholders. The uncertainty in the relative importance of each pair of business goals on each BSC perspective, and the uncertainty in the strengths of the relationships that exist between business goals that are in two consecutive BSC perspectives, is described by linguistic statements. These linguistic statements are modeled with a triangular of fuzzy numbers. The theory of the fuzzy sets better than other mathematical theories describes the linguistic statements and can simulate the human way of thinking in the decision-making process, in the presence of inaccurate, approximative and unclear data [2]. The relative importance of each pair of business goals, at each level, is determined by a computer program that is based on the Delfi method. The priority of business goals, on each BSC perspective, is determined by rank and measured belief value that a business goal can be found in the first place. The determination of ranks and belief measures is based on the application of a method for comparing the triangular of the fazzy numbers, developed in the literature. Defining business goals that is needed to be improved by applying appropriate management methods is obtained by applying a genetic algorithm, which is one of the most widely used heuristic methods in practice. It is believed that every solution obtained in an exact manner is less burdened with the subjective attitudes of the decision-makers and therefore can be considered to be more precise. The relative importance of business goals on each BSC perspective is determined by the fazzy matrix of the relative relation of the importance of business goals. The elements of this matrix are linguistic statements that are modeled by a triangular of fazzy numbers. Developed software is based on the proposed phase of the Delphi method by which the relative importance of business goals on the BSC is determined, for each perspective. The ranking of business goals, based on some relative importance, is determined on each perspective of the strategic map. The ranking of business objectives in each perspective corresponds to the rank of triangular of the fuzzy numbers, obtained by applying one of the phase ranking methods [2,3]. Values of business objectives are set intermittently.

DETERMINING THE BUSINESS GOALS EFFICIENCY

Estimation of the degree of realization of business goals in each perspective, as well as the assessment of the effectiveness of the business objectives defined on each perspective was obtained using the BSC (Balanced Scorecard) software [4,5,6], as is shown in Figure 1.

Name	Progress
Balanced Scorecard	64,56 %
Financial Perspective	71,06 %
F1	69,32 %
F2	70,89 %
F3	72,97 %
Customer Perspective	63,26 %
C1	53,33 %
C2	67,5 %
C3	64,47 %
C4	65,3 %
C5	72,67 %
C6	56,3 %
Internal Processes Perspective	60,18 %
I1	61,64 %
I2	63,86 %
I3	61,18 %
I4	57,6 %
I5	58,9 %
I6	57,88 %
Learn and Growth Perspective	61,14 %
LG1	63,16 %
LG2	69,74 %
LG3	60,76 %
LG4	59 %
LG5	58,4 %
LG6	55,8 %

Figure 1. Evaluation of the degree of realization of business goals in each perspective, as well as the assessment of the effectiveness of business goals that are defined in every perspective for industrial enterprises

In the financial perspective, the goals: *Increasing Company Liquidity* (F1), *Increasing Profits* (F2) and *Reducing Costs* (F3) show us that industrial enterprises should work to raise their own productivity and product quality, according to defined criteria and standards. Changed conditions and the profile of the world market require that modern companies should develop their market and competitive position through stronger international orientation, rather than relying on classic forms of business and that its possibilities are limited in new conditions [7]. Increasing *Company Liquidity* (F1), *Increase in Profit* (F2) and *Cost Reduction* (F3) bring new challenges in developing an international business system and engaging modern companies, depending on the direction and degree of their integration with the world market in terms of improving quality, increased profitability and competitiveness.

Financial perspective is a consequent picture of all activities of other perspectives and a clear definition of the links between activities, processes and perspectives achieves the organization's sustainable success. Logically, as the cost reduction is directly proportional to the increase in profit, and indirectly it affects the reduction of liabilities, i.e. the increase in liquidity. So, it is often noteworthy that a better result of a business with a higher profit.

In the customer's perspective, *Increasing consumer satisfaction* (C5) and *Reducing the number of complaints* (C2) is a prerequisite for the development of a company, because the production and sales organization must be in line with the market situation. Over time, the sales activity itself, which can grow or decline, can be expanded or narrowed, and the market itself can be completely changed. *Increasing consumer satisfaction* (C5) and *Reducing the number of complaints* (C2) in production organizations can be set up differently, which depends on the type and quantity of products sold, the skills of employees, the adopted concept, the expectations and the customer's request, the definition and definition need and so on. The most important task of the company in fulfilling these goals is the timely and maximum favorable sale of manufactured goods. This task consists of a whole range of other, specific tasks, which execution begins with the preparation of the sale. Among the sales jobs, important tasks are related to bidding. The offer is one of the first concrete activities of the company, and the contracting of interest contacts with the future customer is due, because precisely because of that, the quality of products is increasingly becoming the decisive element for price formation. The interest of consumers and producers for the quality of products and services is enhanced. It is also imposed by intensified competition in the international market. Achieving the highest quality, with the labor and materials savings, as well as the provision of quality services and services, increases the competitiveness of the company. This perspective is the central polygon of the quality system. All requests are turned to the customer and all targets are in the end user's service. Industrial enterprises that meet customer needs become self-sustaining, and sustainable success is the goal of employee satisfaction, and a successful strategy.

In the perspective of internal processes, the highest value is *Technology development* (I2), *ICT support* (I1) and *Quality assurance* (I3). This fact clearly emphasizes the importance of rapid response to signals from the market. *Response time* is a key indicator. The driver of the improvement is the application of digital technologies, reducing the time of production, etc. It means that the norm of time, through customer satisfaction, affects the financial perspective. Production control and development are the main drivers of improvement. They point to the stability in the movement of strategy realization. Obviously, how much quality triggers improvements and has the greatest potential.

In the internal processes perspective, business goals are essentially related to changing market and other business conditions of the company, as well as the computerization of the entire IT system. This can lead to the strengthening new and advanced industrial products based on high technology and their clear separation from the old, traditional branches primarily through the profitability rate. Bearing in mind the previous perspective, it can be said that knowledge and experience transfer flows are integral to the production function and that the increase in these transfers is increasingly taking their place in practice. Also, it is important to emphasize here that these goals show that direct investment in the modernization of old technologies and the application of new technologies is needed; reduction of technical and commercial losses in order to reduce costs and preserve the reputation of the buyer and the business morality of the company, etc. *Enhancing the knowledge and competence of employees* (LG2), *Improving the quality management system* (LG1) and *Efficient transfer of knowledge and employee experience* (LG3) in the perspective of learning and development points to a driving mission of this perspective. The step with the scientific and technological development trend must be maintained, and this is achieved by knowledge. This means that a level of qualification structure and the possibility of continuous education is very important for a group of industrial enterprises. It is necessary to conduct continuous assessment of employees' competencies taking into account visits to seminars, participation in conferences and congresses, writing works, solving problems in production, participation in development projects, etc. [8]. Intellectual work gives the greatest contribution to the newly added value and therefore, the basic question is how to measure it and stimulate it as a driver of improvement.

Tabel 1. ABC classification

Goals	The value of the classification criterion	Relative values of the classification criterion	Cumulative values of the classification criterion	Goals	The value of the classification criterion	Relative values of the classification criterion	Cumulative values of the classification criterion
F3	0,7297	0,0463	0,0463	I3	0,6118	0,0388	0,5941
C5	0,7267	0,0461	0,0924	LG	0,6114	0,0387	0,6328
F	0,7106	0,0451	0,1375	LG3	0,6076	0,0385	0,6713
F2	0,7089	0,0449	0,1824	I	0,6018	0,0382	0,7095
LG2	0,6974	0,0442	0,2266	LG4	0,59	0,0374	0,7469
F1	0,6932	0,0439	0,2705	I5	0,589	0,0373	0,7842
C2	0,675	0,0428	0,3133	LG5	0,584	0,0370	0,8212
C4	0,653	0,0414	0,3547	I6	0,5788	0,0367	0,8579
C3	0,6447	0,0409	0,3956	I4	0,576	0,0365	0,8944
I2	0,6386	0,0405	0,4361	C6	0,563	0,0357	0,9301
C	0,6326	0,0401	0,4762	LG6	0,558	0,0354	0,9655
LG1	0,6316	0,0400	0,5162	C1	0,5333	0,0338	1
I1	0,6164	0,0391	0,5553				

ABC analyzes provide three classification groups, each with different management activities. The advancement strategy consists of the management activities that need to be undertaken in order to improve the level of achievement of objectives and their effectiveness. ABC classification results give importance to management activities. In the case of industrial enterprises, Group C consists of 2 goals, which corresponds to about 5% of the cumulative value of the classification criterion. They are the most important in implementing the promotion strategy. In this case, Group C consists of LG6 and C1. The next 15% of the cumulative value of the classification criterion corresponds to Group B objectives. Group B goals are of medium importance in terms of implementing the promotion strategy. In our case, Group B goals are: I6, I4 and C6. All other targets belong to Class A, consisting of 20 goals and they constitute about 80% of the cumulative value of the classification criterion. A Group A goals are least important when an improvement strategy is implemented.

In addition, the most important activities of the management and their order of undertaking are briefly given. The most important activities of management in small and medium-sized enterprises are: (1) *Increasing the motivation of employees* (LG6): (a) *Training and training opportunities* (b) *Special recognition and higher autonomy in work* (2) *Increasing the quality of service provision to customers* (C1): (b) *Reducing the number of complaints* (3) *Production control* (I6): (a) *Increase in research activity in the field of innovation through studies and product projects* (b) *Application of modern computer and electronic systems* (4) *Product development* (I4): (a) the use of resources and interactions with the market, competitors and other environmental factors; (b) the adoption of new technical and technological solutions to the production process; service (C6): (a) create conditions for ensuring the continuity of improvement (b) utilize the unused potential in the sphere of product quality and service and improvement of services.

DETERMINING THE OPTIMAL PATH IN STRATEGICAL MAP OF THE COMPANY

The strengths of the relationships that exist between business objectives that lie in different perspectives of the strategic map of the considered industrial enterprises are assessed based on the knowledge and experience of the management team formed at the level of a whole group of industrial enterprises considered.

Tabel 2. Management team Fuzzy estimates

LG1:I1= $\tilde{\Omega}_2$	LG2:I5= $\tilde{\Omega}_1$	LG4:I3= $\tilde{\Omega}_2$	LG6:I2= $\tilde{\Omega}_2$	I1:C6= $\tilde{\Omega}_4$	I3:C4= $\tilde{\Omega}_1$	I5:C2= $\tilde{\Omega}_6$	I6:C6= $\tilde{\Omega}_5$	C4:F2= $\tilde{\Omega}_6$
LG1:I2= $\tilde{\Omega}_4$	LG2:I6= $\tilde{\Omega}_2$	LG4:I4= $\tilde{\Omega}_1$	LG6:I3= $\tilde{\Omega}_1$	I2:C1= $\tilde{\Omega}_3$	I3:C5= $\tilde{\Omega}_5$	I5:C3= $\tilde{\Omega}_3$	C1:F1= $\tilde{\Omega}_6$	C4:F3= $\tilde{\Omega}_7$
LG1:I3= $\tilde{\Omega}_3$	LG3:I1= $\tilde{\Omega}_5$	LG4:I5= $\tilde{\Omega}_1$	LG6:I4= $\tilde{\Omega}_6$	I2:C2= $\tilde{\Omega}_4$	I3:C6= $\tilde{\Omega}_4$	I5:C4= $\tilde{\Omega}_2$	C1:F2= $\tilde{\Omega}_5$	C5:F1= $\tilde{\Omega}_7$
LG1:I4= $\tilde{\Omega}_2$	LG3:I2= $\tilde{\Omega}_6$	LG4:I6= $\tilde{\Omega}_2$	LG6:I5= $\tilde{\Omega}_6$	I2:C3= $\tilde{\Omega}_5$	I4:C1= $\tilde{\Omega}_2$	I5:C5= $\tilde{\Omega}_5$	C1:F3= $\tilde{\Omega}_5$	C5:F2= $\tilde{\Omega}_6$
LG1:I5= $\tilde{\Omega}_1$	LG3:I3= $\tilde{\Omega}_4$	LG5:I1= $\tilde{\Omega}_3$	LG6:I6= $\tilde{\Omega}_3$	I2:C4= $\tilde{\Omega}_3$	I4:C2= $\tilde{\Omega}_1$	I5:C6= $\tilde{\Omega}_5$	C2:F1= $\tilde{\Omega}_6$	C5:F3= $\tilde{\Omega}_4$
LG1:I6= $\tilde{\Omega}_3$	LG3:I4= $\tilde{\Omega}_3$	LG5:I2= $\tilde{\Omega}_5$	I1:C1= $\tilde{\Omega}_4$	I2:C5= $\tilde{\Omega}_5$	I4:C3= $\tilde{\Omega}_6$	I6:C1= $\tilde{\Omega}_3$	C2:F2= $\tilde{\Omega}_7$	C6:F1= $\tilde{\Omega}_5$
LG2:I1= $\tilde{\Omega}_5$	LG3:I5= $\tilde{\Omega}_6$	LG5:I3= $\tilde{\Omega}_6$	I1:C2= $\tilde{\Omega}_6$	I2:C6= $\tilde{\Omega}_2$	I4:C4= $\tilde{\Omega}_2$	I6:C2= $\tilde{\Omega}_7$	C2:F3= $\tilde{\Omega}_4$	C6:F2= $\tilde{\Omega}_6$
LG2:I2= $\tilde{\Omega}_4$	LG3:I6= $\tilde{\Omega}_4$	LG5:I4= $\tilde{\Omega}_1$	I1:C3= $\tilde{\Omega}_6$	I3:C1= $\tilde{\Omega}_7$	I4:C5= $\tilde{\Omega}_3$	I6:C3= $\tilde{\Omega}_6$	C3:F1= $\tilde{\Omega}_4$	C6:F3= $\tilde{\Omega}_5$
LG2:I3= $\tilde{\Omega}_3$	LG4:I1= $\tilde{\Omega}_5$	LG5:I5= $\tilde{\Omega}_3$	I1:C4= $\tilde{\Omega}_5$	I3:C2= $\tilde{\Omega}_4$	I4:C6= $\tilde{\Omega}_5$	I6:C4= $\tilde{\Omega}_6$	C3:F2= $\tilde{\Omega}_6$	
LG2:I4= $\tilde{\Omega}_6$	LG4:I2= $\tilde{\Omega}_3$	LG6:I1= $\tilde{\Omega}_6$	I1:C5= $\tilde{\Omega}_1$	I3:C3= $\tilde{\Omega}_6$	I5:C1= $\tilde{\Omega}_5$	I46:C5= $\tilde{\Omega}_7$	C4:F1= $\tilde{\Omega}_5$	

Further, the procedure for determining the overall strength of the relationship between the two business objectives is shown.

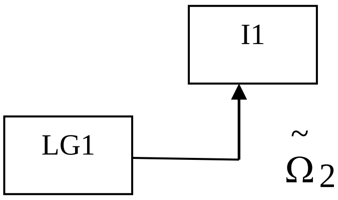

Figure 2. Relation between two business goals

$w(LG1)=(0.52,0.68,1)$, $w(I1)=(0.49,0.65,0.87)$, $\tilde{\Omega}_2=(0,0,0.4)$, $LG1I1\tilde{\Omega}_2=0.54$

Using the GA method (Genetic Algorithm), the optimal path in the strategic map of the industrial enterprise was determined using the Mathlab software shown in Figure 3.

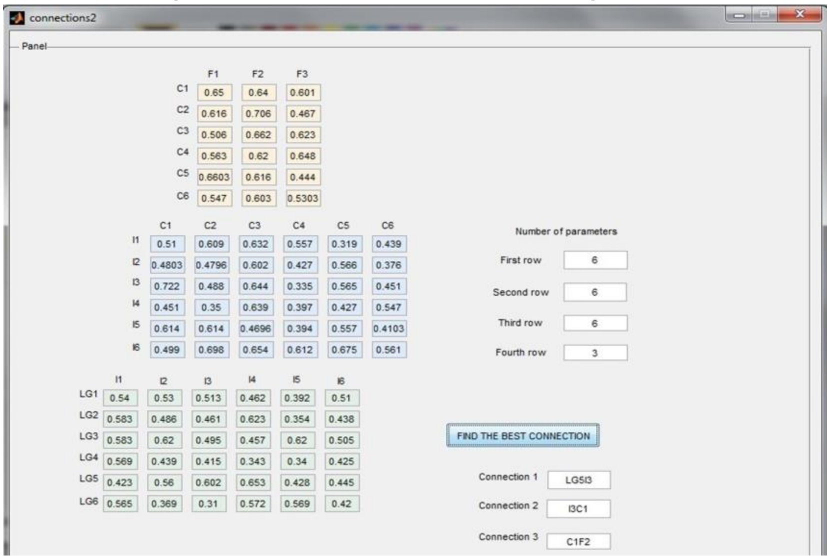

Figure 3. Optimal paths in an industrial enterprise strategic map

Based on the results obtained, it can be clearly seen that the optimal pathway includes the following business goals: *Employee Development and Advancement* (LG5), *Quality Assurance* (I3), *Increased Quality of Service Provision* (C1) and *Profit Increase* (F2).

On the basis of everything stated in the burning part of the text, it can be concluded that the optimal path in the strategic map of the industrial enterprise is expected. This conclusion is imposed because all business goals, that make an optimal path or high ranking (LG5 and I3), are one of the leading goals (C1 and F2) in their perspective. Also, the management team needs to pay particular attention to focusing on business goals on the optimal path of an industrial enterprise and to take measures to increase the level of achievement of these goals. Business-related measures *Increasing the quality of service delivery to customers* (C1) and *Increasing profits* (F2) and their realization are listed above.

In order increase the level of achievement of the business goal of *Employee Development and Advancement* (LG5) the management team should take the following measures: (a) respecting business ethics and orderly behavior of management and employees in the organization; (b) defining clear roles and responsibilities; (v) secure awareness and freedom (g) support and provide resources necessary for the work (d) feedback and motivation for employees (e) education and learning necessary skills (e) introduce a system of rewards and career advancement (f) provide ability to meet the financial needs of workers and managers; and) provide communication channel effectiveness.

The management team should take the following measures to increase the level of achievement of the business goal - *Quality Assurance* (I3): (a) the correct business policy and accuracy in the work; (b) quality control of input materials (using laboratories for testing materials); (v) product control in progress (g) final control; (d) documenting, implementing and maintaining a quality management system as a means of ensuring compliance of products and services with established requirements (where it is necessary to continuously monitor the process of production (so as to achieve dynamic control and reduce the percentage of scrap on finished products); improve its efficiency in accordance with the requirements of ISO 9001: 2008) and (j) top management should analyze and evaluate the effectiveness of the process and, on the basis of the obtained results, implement improvements and make preventive and corrective measures.

CONCLUSION

Small and medium-sized enterprises are the drivers of economic development and they represent the main bearers of economic and social development. They represent the most vital and economically most effective part of every economy. With this in mind, it is necessary to find an optimal combination of small, medium and large enterprises that is able to best meet the economic and social goals of a country. Small, medium and large enterprises stand in both competing and complementary relationships and together give synergetic effects in the economy [9]. In this regard, the revitalization and expansion of existing enterprises, while encouraging the creation and commercialization of entrepreneurial initiatives, define the preconditions for future economic development.

Management measures (revenue increasing, property reduction, reduction of costs and their combination, etc.) are mostly determined by the company's resources and the degree of business distance of the business from the turntable. In a crisis situation, it is necessary to systematically and objectively evaluate all the possibilities, bearing in mind the tax and balance consequences, as well as the expected effect to the business of the company [10]. The choice depends on the current and future company's strategy, as well as on the possibility of top management. If the initial management measures motivate employees and short-term improvements in business are achieved, it is possible to overcome the crisis situation with great certainty [11]. Also, an adequate value analysis is needed, which is the process of identifying and eliminating unnecessary costs, in particular products or services. Thus, when formulating the strategy, competition should be considered, competitive advantages, market segmentation based on specific product features and pay attention to the stages in the evolution of products and markets.

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ONTOLOGY FOR PERSONALIZATION E-LEARNING PROCESS IN ENGINEERING EDUCATION

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Abstract: This paper describes a modeling ontology framework for personalized e-learning process in engineering education. Propsed model is based on doamin MAU ontology. This ontology is the target created for Moodle LMS system. The main goal of this paper is to enable dynamic mechanisms for dynamic personalization process of student's learning according to the adaptation criteria based on MAU ontology. Selected criteria for adaptative systems is based on the Felder-Silverman learning style model (FSLSM). Also, this work describes real time monitoring of students activities and their interactions in Moodle System. For this purpose everal semantic modules (plug-ins) have been implemented for Moodle platform.
Key Words: Semantic Web, Ontologies, Moodle, personalzation, Learning style, semantic rules.

INTRODUCTION

On the Internet, there is currently a huge number of pages, or the vast majority of them are in a format that is readable only by humans. As a result, the software agents can not understand and process this information, and therefore a large part of the potential of the web has so far remained unused. The term Semantic Web is an upgrade of the existing architecture of the World Wide Web, which improves the quality of enriching the content of the formal semantics. This means that the content is tailored for use by the computer (processing, sharing, reuse), as opposed to content that is intended only for use by men. This will allow agents semantic reasoning based on the semantics of web content. Semantic models data sources are the implicit meaning of data specifying the terms and relationships within the data on the web [23].
The term Semantic Web was introduced in 2001 by the [4] with the aim to establish a website that will not only interconnected documents, but will also discover the significance of the information in those documents. In other words, the Web is being transformed from a series of interconnected but semantically isolated sets of data into one huge database for storage, manipulation and retrieval of data. On the other hand, have provoked a large number of complex challenges. The authors of many studies in this area are currently actively working to respond to these challenges, putting the focus on creating the basic architecture, the development of effective and expressive ontology language construction technique for effective data mapping and learning ontology [10]. For the Semantic Web development it is important to define a large number of standards and technologies that are primarily engaged in International Organization for Standardization Web *W3C (World Wide Web Consrtium).*
Ontologies can be used in different domains with no restrictions on the modes and contexts of use. Key advantages of the using ontology [11], [12], [21]: the possibility of identical interpretation of the structure and meaning of information by human and software agents, the possibility of reuse of domain knowledge, the ability to create explicit assumptions about the domain, the possibility of separating domain

knowledge from the operational knowledge, ability to analyze domain knowledge, better understanding, knowledge creation, collaborative learning, problem problems, search or recommendation developing ability peer review and reusability, as well as the knowledge sharing knowledge of a particular domain which is achieved using common concepts and vocabulary among the various educational systems.

MATERIAL AND METHODS

There are many different definitions of the Semantic Web, and some of them are as follows:

- The Semantic Web is defined as a web of data, ie. website that provides data storage, creating dictionaries and rules for data management [26];
- The purpose of the Semantic Web is to assign formal structure and semantics (metadata and knowledge) web content for more efficient management and access [16];
- Semantic Web to work together on web applications to both syntactic and semantic level [15].

The Semantic Web can be used as a suitable platform for implementing the system for electronic education because it provides all the necessary tools for e-learning: the development of ontologies, semantic annotation (tagging) of learning materials, the use of semantic technologies in the context of electronic courses and delivery of learning materials in accordance with predefined semantic rules. Application of Semantic Web in education is based on three essential possibilities [2]: opportunities for efficient storage and retrieval of information, the possibilities of autonomous agents to improve the learning process and finding adequate information, and opportunities for web support, expansion and increase communication skills of people in a variety of formats without limitations in terms of space and time. For now there is still a problem that a small number of semantic applications, systems and web services, and that their development is time consuming and expensive.
Ontologies can be used in different domains, among them being the domain of education [25], KDDM - knowledge discovery and data mining [18], finding content and information [19], [8], knowledge management [27], [17], in [5], [14], [24] and other doamins of reseraching. The ontology using in the field of electronic education was first mentioned in the work of the author [20], and eventually the idea received more popularity and importance. Ontologies are used to support semantic search, allowing you to search multiple repositories and reveal the correlation between learning objects that are not directly understandable. They provide new opportunities for e-learning systems because they provide intelligent access and manage Web and semantically rich information modeling applications and their users. This enables support for more adequate and more accurate representation of students, their learning goals, learning materials and the context of their use, and more efficient access and navigation through learning resources. Using ontology as a knowledge model allows different types of users to share their knowledge through semantics. The semantic modeling, an ontology is a representation of the standard languages, such as RDF, RDFS and OWL [1]. In the the research authors [9] shows the ontological taxonomy technologies used in electronic education. Different technologies and languages are used to create ontologies and semantic web applications [25].

Model implementation

This section presents model implementation and creating semantic modules for the Moodle LMS system named *MAL (Moodle Adaptive Learning)* Fig. 1. Learning objects displayed for e-commerce course are shown in Fig. 2.

Figure 1. MAL system

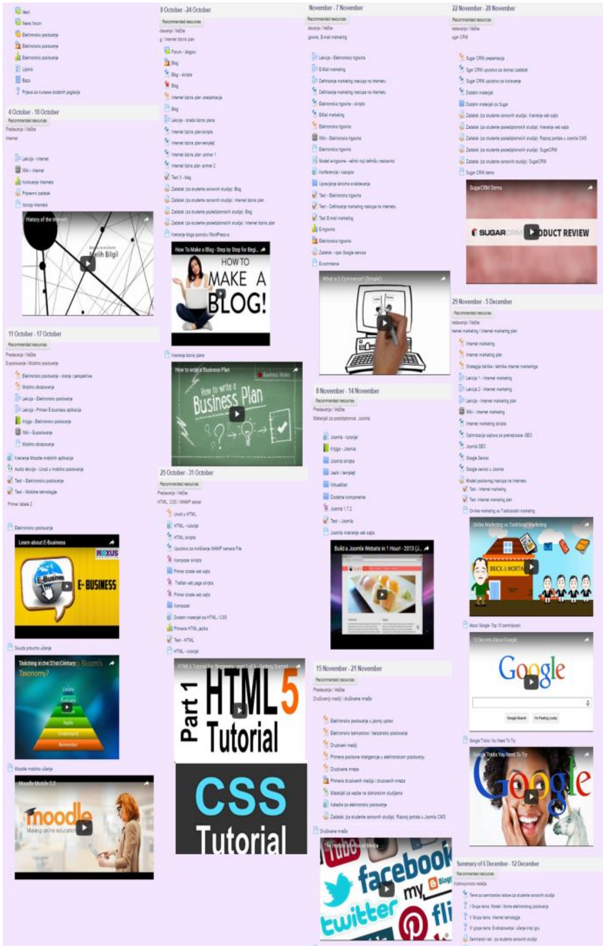

Figure 2. E-commerce electronic course

Learning objects - LO are part of the teaching materials that are characterized by a significant amount of information about their content and use. This additional information is defined as a set of metadata, according definisinaoj IEEE LOM specification. Also, the above specification is used to describe the relationship between existing learning objects. Learning objects whose relations are explicit graph nodes are considered resources. Types of connections and metadata represent the semantics of resource graph. Learning objects can still be called educational facilities, information facilities, intelligent buildings, facilities, skills, knowledge unit reusable components for training and learning units [3]. The purpose of the learning object that contains information that can increase the level of knowledge. It follows that represent the basic unit as means of creation and dissemination of educational content. They have been developed to meet the need for high-quality and multi-usable educational fragments are the organized in an accessible way for each student. Facilities learning help to solve the problem of expensive reproduction of teaching materials for e-learning courses [7].

Specifications of learning objects include the following features [22]: sustainability interoperability, accessibility, reusability [6], granularity, adaptability and pedagogical aspects [13]. Learning objects can have different form (text documents, images, tests, quizzes, graphics, video and audio recordings) and can be used in different contexts (increase of the student's knowledge, the explanation of other concepts or develop practical skills students).

There are three important phases during the student interaction with MAL platform Fig. 3. The first one is related to detection of student learning style. Felder-Silverman questionnaire is used for determining initial learning style and it is the only sub phase where student is required to spend time answering the questions. Information from the semantic report is used for determining current learning style of the student and this sub phase is being executed in the background of the learning process. Another phase, which is also being executed in the background of the learning process, is related to defining relationships between learning objects and learning styles for both learning resources and files. The third phase is related to the visualization and semantic enrichment of learning objects.

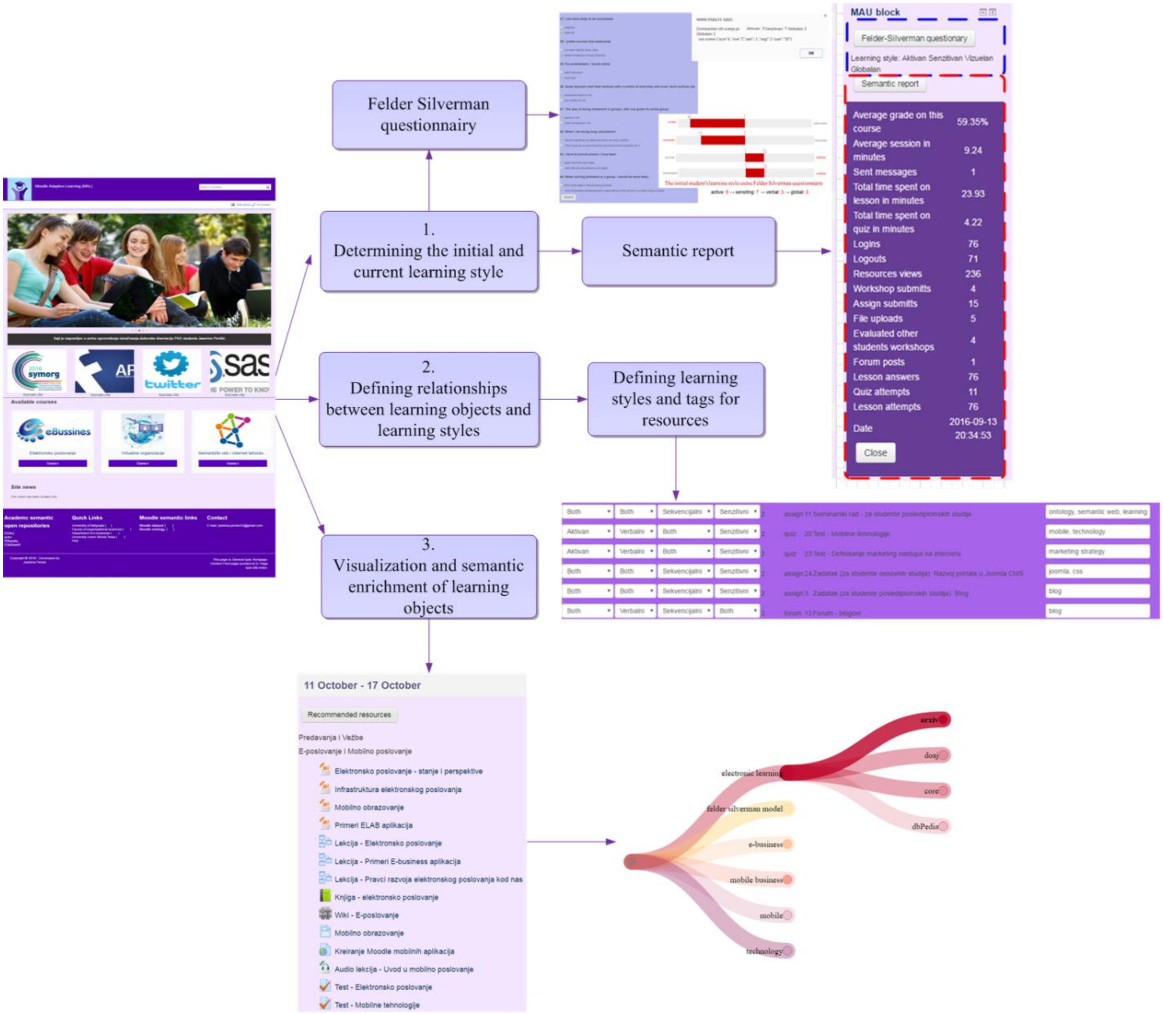

Figure 3. Phases during interaction with MAL platform

The first time student log into the MAL system, he/she will fill in the registration form and complete Felder-Silverman questionnaire i.e. Index of Learning Styles (ILS). After registration, the student visits certain learning objects and does some actions. During the learning process, his/her learning style can be changed, so it will be necessary to update the student profile. Dynamic updating of student's learning style is based on the concept of monitoring what students are doing during learning process, i.e. the analysis of student's interactions with the educational system. Created semantic modules are responsible for collecting these data which is essential for the process of adapting the educational system.

Various indicators can be used for real-time monitoring of students' activities. Three types of indicators have been used in this study. The first indicator is the student's overall grade at the course level. The calculation of time spent on learning objects was implemented as the second indicator. The number of each learning objects visited by the student, and the total number of learning objects visited were counted for the calculations of the third indicator. These three types of indicators provide all necessary data for determination of the patterns of students' behavior.

Modeling *MAU* ontology

In this paper we created a ontology that defines the concepts related to learning objects, the model student and learning styles. Ontology is named MAL - Moodle Adaptive Learning. Protégé tool and

Stanford methodology is used for ontology modeling [21]. MAU ontology is exclusively designed for the Moodle LMS. Domain MAU ontology is e-learning. According to hers characteristics, MAU ontology is one of the larger ontology, is quite complex and robust. On the other hand, the advantages are: generality, comprehensiveness, flexibility and applicability. In the following text, the process of modeling MAU ontology will be explained and graphically presented (*OntoGraf* representation). Classes contained in MAU ontology are of crucial importance for the adaptation process
of the system based on learning styles. The main classes of MAU ontology are *Course*, *LearningObject*, *LearningObjectStyle*, *FelderSilvermanQustionary*, *User*, *UserActivity*, *Grades*, *Answers* and *AuxillaryClasses*, as shown in Fig. 4.

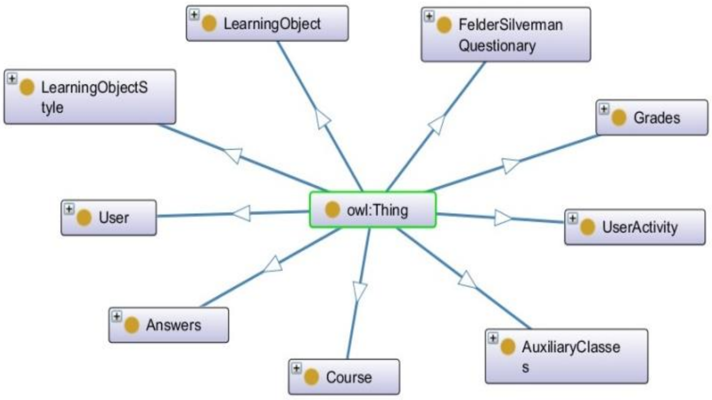

Figure 4. The main classes of MAU ontology

The first step in ontology modeling was to formally define the topics covered in Moodle courses. This step is typically realized using independent domain ontology, but as we have explained before, all concepts and relations required for the implementation of proposed model are defined within MAU ontology. *Course*, *LearningObject* and *LearningObjectStyle* classes are intended for defining the structure of learning material. Each course in MAL system contains several lessons with different resources (learning objects) assigned to them. The class *Course* defines the basic structure of course. This class is connected with classes *User*, *Logs*, *CourseCategory* and *AuxillaryClasses*. The class *LearningObjectStyle* represents a class specified for modeling the relationship between the learning objects and student learning style. This class defines which learning object belongs to which learning style. The class *LearningObjectStyle* has the following subclasses: *ActiveLO*, *GlobalLO*, *IntuitiveLO*, *ReflexiveLO*, *SensitiveLO*, *SequentialLO*, *VerbalLO*, *VisualLO*, as shown in Fig. 5.

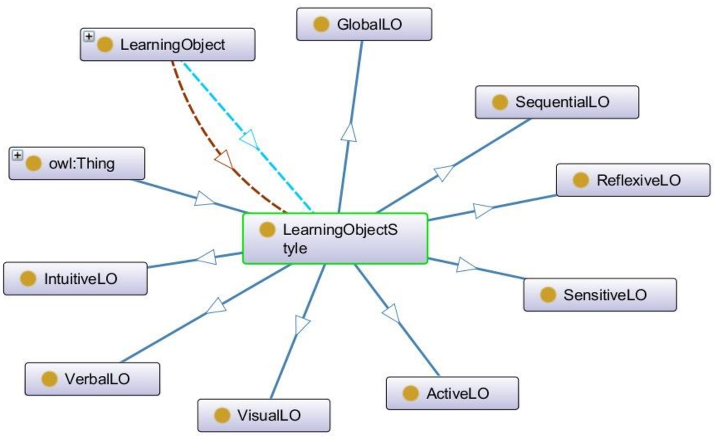

Figure 5. Modeling LearningObjectStyle

Relationships between classes are different colors. For example, the blue line indicates the relationship subclass, purple line indicates the individual, yellow line indicates the relationship of other classes to the user, a dark blue line indicates the link to the user class, etc. Line type affect which class is associated with another class and what is the type of connection between them. This is important for the ontology development and interpretation because OntoGraph diagram can be easily understandable, and thus changed or optimized.

RESULTS AND DISCUSSION

Protégé has built-in reasoning mechanisms that check consistency and regularity in the ontology. Pellet reasoning mechanism (OWL-DL) was used in the process of creating and testing of *MAU* ontology. Individual classes that participate in the process of semantic reasoning should be clearly defined at the beginning of creating semantic rules. SWRL language (Semantic Web Rule Language) was used to create semantic rules. It is written in SWRL tab in Protégé. In the following text is shown SWRL code where student of active learning style, remains in the active learning style according to the set indicators and their limit values.

FelderSilvermanQuestionary(?fsq) ^ FelderSilvermanQuestionary(?res) ^ LessonTime(?ltt) ^ BorderValues(?bvq) ^ BorderValues(?bvl) ^ User(?u) ^ actRef(?fsq, "ac") ^ TotalGrades(?tg) ^ gradeValue(?tg, ?gradeVal) ^ hasGradesType(?res, "rezonTemp") ^ ViewedUA(?quizV) ^ ViewedUA(?forumV) ^ ViewedUA(?lessonV) ^ PostedUA(?pua) ^ viewsResource(?quizV, "quiz") ^ viewsResource(?forumV, "forum") ^ viewsResource(?lessonV, "lesson") ^ numberOfViews(?lessonV, ?brojPregledaL) ^ numberOfViews(?quizV, ?brojPregledaQ) ^ numberOfViews(?forumV, ?brojPregledaF) ^ numberOfPosts(?pua, ?noPua) ^ timeSpentL(?ltt, ?vreme) ^ upperBound(?ltt, ?upperLtt) ^ upperBound(?bvq, ?upperBvq) ^ upperBound(?bvl, ?upperBvl) ^ relatedToRes(?bvq, "Quiz") ^ relatedToRes(?bvl, "Lesson") ^ relatedToUser(?forumV, ?u) ^ relatedToUser(?quizV, ?u) ^ relatedToUser(?lessonV, ?u) ^ relatedToUser(?pua, ?u) ^ relatedToUser(?fsq, ?u) ^ relatedToUser(?tg, ?u) ^ swrlb:greaterThan(?gradeVal, 0.5) ^ swrlb:greaterThan(?brojPregledaF, 14) ^ swrlb:greaterThan(?noPua, 4) ^ swrlb:greaterThan(?brojPregledaQ, ?upperBvq) ^ swrlb:greaterThan(?brojPregledaL, ?upperBvl) ^ swrlb:greaterThan(?vreme, ?upperLtt) -> actRef(?res, "ac") ^ relatedToUser(?res, ?u)

The result of execution of semantic rules is student's learning style according to the Felder-Silverman model of learning style. After creating and testing semantic rules, they should be inplemented into the semantic environment. In our work we used Jena as semantic environment and Pellet as inference engine.

Working in Jena semantic environment includes the following: creating a semantic model that consists of model obtained from D2RQ server instances and ontology model; creation of methods necessary for the system adaptation using APIs; the execution of semantic rules; performing semantic queries; applying semantic reasoning mechanisms and getting results of semantic reasoning; transfering semantic results to Moodle; creating of reports in Moodle based on obtained semantic results; updating Moodle MySQL database in real-time.

An important contribution of this paper is the development of electronic education model based on semantic adaptation of learning objects. Implemented model is based on the Moodle platform and is suitable for use in higher education institutions in Serbia has great practical value and represents a significant scientific results. This work has resulted in a series of expert contributions, each of which can be singled out: analysis of application ontology in an electronic education, review and analysis software infrastructure necessary for their implementation, the implementation environment and infrastructure for the implementation of the ontology in an electronic education and the adaptation module by using the proposed model. The research results can be applied individually within the parts of educational institutions and at the level of the educational institution as a whole. Descriptions of lifecycle development of semantic models for personlizovanu adaptation system for e-learning, semantic data mapping, the creation of ontologies, the implementation of the 3 models in the semantic development environment as well as the integration of semantic and educational development environment can serve as an example of good practice.

CONCLUSIONS

Developed a semantic model for dynamic adaptation of the educational system can be successfully applied in higher education institutions for the realization of personalized teaching activities. The results and the solutions proposed in this paper open the possibility of further research in the field of application of ontologies and semantic development of demanding concepts that provide different functionality. Improvements model described primarily be considered in the direction of linking semantic model with
social networks. In this option would be exercised semantic enrichment of student models in real time and referred to his model as a whole and not just one criterion of adaptation.
As multiple monitors for adaptation, to get the exact results of the return preferences of the students. In accordance with the modern development of information systems and technology and an innovative semantic direction of application development and the Web, a growing number of universities and institutes provides open access to their semantic bases. The reason is simple, optimized, faster access to distributed, differently structured and the data described. It is this concept seeks to solve the problem of interoperability, using the unified standard for the semantic description of the unique concepts of the Semantic Web.

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SUPPORT MECHANISMS IN THE FUNCTION FOR THE ADVANCEMENT OF WOMENS ENTREPRENEURSHIP

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Abstract: In education, women are identified as a specific target skills and competencies precondition for any business enterprise, it is necessary arrangement of education of women, both in formal and informal education system. Non-formal and continuing education directed yen population of adult women. Aggravating factors affecting the low motivation of women to participate in adult learning and education are inadequate emancipated, unfavorable educational structure, demanding family roles of wife-mother, the difficult situation caused by belonging to rural areas and underdeveloped regions. Reduce the high unemployment rate of young women in the world and in Serbia can be achieve only creating favorable conditions for the development of entrepreneurship. This will be achieved primarily improving the microeconomic business environment and ensuring the start-up capital. Primarily, it should create the conditions that would allow a safe and long-term development of their own business.
Key Words: women's education, entrepreneurship, unemployment, the initial capital.

INTRODUCTION

Affirmation of women entrepreneurship as a relevant objective of development of modern society, is supported by a number of international document [5], [6], [11]. The Beijing Declaration adopted in 1995 is the key document in which the integrated objectives and principles set out in the UN Charter, the Universal Declaration of Human Rights, in particular the Convention on the Elimination of All Forms of Discrimination against Women and, inter alia, the Declaration on the Right to Development. Women's entrepreneurship is recognized as an important mechanism for achieving equality, democratization and development of society, the preservation of peace and poverty reduction.
The phenomenon of female entrepreneurship includes all aspects, above all, that women want and need to reconcile family and professional obligations, and that his engagement in entrepreneurship highly personalized, transparent in him bringing his personality and values. Although more women in the population, they are most present workforce at one of the lowest-paid sectors - services, very few women in leadership and management positions, and the average earnings achieved by women in relation to men were lower in almost all activities [3], [9], [13]. From these studies, in short, to learn, and that women who have entered the private business well educated, that their professional composition varies, most are married, with children, to areas where they founded the private affairs, mainly belong to traditional female occupations that rarely have their own start-up capital, and to form micro or small enterprises. The reasons for starting a new business are the most common means of ensuring the existence of family and children and the desire to prove their own abilities. The biggest obstacle they faced was called. Work on three fronts: the household, the children family and work and gender discrimination [10].
In practice, women are often excluded from decision-making. Decides in small, informal, and as a rule, men's groups, which excludes women from institutional policy or diminishes their political power even when they are represented. Exclusion of women from institutional politics can slow down the democratic process and in the countries of ex-Yugoslavia. A particular problem to be solved is participation in public and political life of the multiple discrimination of women. The woman has more than men in the world, or in the economy, according to official information and indicators, minorities all over the world.

MATERIAL AND METHODS

Women's entrepreneurship as a phenomenon of our time until recently they bought very little attention [16]. The first important scientific papers on this subject appeared in 1976. In the journal 'Journal of Contemporary Business' published work is' Entrepreneurship: A New Frontier Woman' 'which drew attention to the upward trend of this kind of entrepreneurship. For example, according to statistics from 1972, about 4.6% of all US businesses are led by women. After investigations of the UN in 1995 two changes that have occurred in the last ten years have led to the establishment of a positive climate for the development of women's entrepreneurship are:

- Establishing legal and legislative equality for women;
- Ensuring equal access to vocational education and training for women.

Male resistance to women is stronger in Europe than in America. Polls in Italy and the UK have shown that nearly half of men and reject the idea that women can perform task managers. Statistical analysis of the population of managers in the US and Western Europe has shown that women make up only 3% of CEOs of major companies and occupy about 12% of middle and lower management positions, even though they were in the labor force for more than 45%. In the literature, this phenomenon is explained by the existence of strong or impenetrable barrier, which is the result of a combination of all stereotypes. In the world there are three countries where women make up more than half of the employees. This is Sweden (60% of employees are women), Canada and the US (52% of employees are women). The other extreme are countries of the Middle East in which the proportion of women in the labor force between 35% (Israel) and 4% (Iraq, Saudi Arabia). Unfortunately, one of the still strong reasons meager representation of women in the management of their personal acceptance of "female roles" and from it emerged not interested in leading or managerial career [2].

In most cultures there is a strong division between male and female roles [10]. According to such cultural stereotypes that dominate, especially Arab countries, Latin America and the less developed regions of the world, managers can be only men. Women are expected to be subservient and dependent, not to stand out and to serve men. Even in developed democratic societies, where women enjoy formal equality, these cultural stereotypes are not completely eradicated. Different legal constraints that women are placed in a second-class status only recently removed from the legislation of most developed countries, and in underdeveloped are still very much present (for example, Switzerland's did not have the right to vote until 1971, France no regulation to protect women from harassment at work, and in the US women for the same job often receive lower wages than men).

But already in the 21st century things started to change. Between one quarter and one third of all businesses in the world today run by women with a growth rate up to two times, compared to the national average in the USA. Women are owners of approximately 30% of all businesses in the world which has been shown in Table 1. Entrepreneurs in developing countries now represent a vital driving force in all sectors of the economy, whether measured by the number of new jobs, the number of employees or the volume of realizing profits as shown in the following Table 1 [15].

Table 1: Women-owned businesses in the world (in %)

Country	Year	Women-owned (%) enterprises
Netherlands	1992	8
Mexico	1990	9
Japan	1991	13
Germany	1993	15
Canada	1995	17
Australia	1994	18
US	1996	20

Female entrepreneurship in Serbia

On the labor market, statistics do not anticipate an unfavorable position of women in relation to men from around 900,000 unemployed, 56 percent are women, but it is similar to their percentage share in the 1.9 million employees. Author [17] gives in his work a review qualitative study of the perceived enabling factors for the female entrepreneurship in Serbia.
On the other hand, in Serbia, women are owners or co-owners of 16 thousand companies. This is the fifth of the total number of domestic companies. When these figures are compared with other countries, it is possible to conclude that Serbia already has a European average because even in Sweden, for example, no more than 22 percent of women entrepreneurs.
Unfortunately, a large number of companies in Serbia are only registered in the woman's name. More precise information is obtained when seen in how the company is the wife of the owner and the manager, because then the more likely that the companies are not only present name. By this criterion, according to data from the Agency for Business Registers, the women manage to 6,700 small and medium-sized and 16 large companies in Serbia.
"Women's entrepreneurship in Serbia was mentioned ten years ago, when international aid programs were directed at women-refugees, as the most vulnerable category".
Research suggests that as many as two-thirds of women who have a job, consider the woman in Serbia difficult to start a business because of the "Balkan syndrome". In one group of courageous women who have begun to engage in business, this percentage was reduced to a quarter. The principle is proverbial - who wants to do something - finds a way, who does not want - he finds an excuse.
So whether women themselves may give rise to men's frivolous understand the business? Often, they themselves are the victims of prejudice that could be "subject to" discrimination by males as best seen in Figure 1. In addition, women often do not have enough confidence to say, there is no authority to impose their views, and they fear that the reason for the loss of the value in the eyes of men.
The fact is that in Serbia there are still traces of patriarchy, but it is not only a male. Do women begin to act more decisively, men will certainly not reject a good business proposition, just because he sent a woman. And that is the future of women's entrepreneurship, the future we must create and carve women. Any other approach would mean further loss of half of the intellectual capital, as a company and a country.
However the Statistical Office of the Republic of Serbia in its annual report of 2012 stated that the total number of employees (1.73 million), 1.34 million were employed in the companies, of which 626,000 were women. When it comes to farming, women have been registered 28% of all farms. However, they make up only 23% of all individual farmers and 71% of unpaid family members in agriculture. In 2012, he was an almost equal number of those who would and who would not have started their own businesses, while men showed a greater willingness than women. It also has been shown that women with higher education show the greatest interest in the opening of a private business, where the youngest 47% of women do so if they have some features which confirms that entrepreneurial orientation with the younger generation to grow.
Based on information available from multiple sources, it is clear that the economic potential of women in Serbia is not used enough, either as a business owner or as a workforce. Comparative studies show that in 2007, among women aged 18-64 years, there were only 7.9% entrepreneurs. Recent studies from 2009 indicate that there were 14.9% of self-employed among women aged 15-64 years who are registered as employees.

Profile of women entrepreneurs

Profile of women entrepreneurs from the existing private sector is analyzed in the framework of the project "Improvement of economic and social rights of women in Serbia and Montenegro", conducted by the United Nations Entity for Gender Equality and the Empowerment of Women [12].
Entrepreneurs are found in all regions of Serbia and in this regard, there are no major differences between the regions of Belgrade, Vojvodina, Sumadija and Western Serbia. Entrepreneurs are a little less present in the region of Eastern and Southern Serbia, where a lot of slow economic activity, only one in five entrepreneurs from the region.

It is noticeable that young entrepreneurs (19-30) in business concentrated mainly in four sectors: industry, trade, knowledge economy and information and classic services. Entrepreneurs middle age (31-49) is strongly concentrated in the trade sector, followed by other sectors lag far behind, while the elderly (50+) are somewhere between the two previous groups.
According to the National Employment Service for 2011 of the total registered unemployed at the end of 2010. At 52.69% are women. Of the total number of unemployed persons registered with the National Employment Service, mostly women in the age group 25-29 years 14.5%. Data on employment rates in Serbia by gender and age is shown in Table 2 (Publication Labour cost survey for 2010 - Source Statistical Office of the Republic of Serbia).

Table 2. Serbia's employment rate by age and sex

The employment rate		**Age 15-19**	**Age 20-24**	**Age 25-30**	**Age 30-65**
Gender	**Male**	52,1	61,6	75,4	88,0
	Female	35,4	51,6	70,8	84,7

Mechanisms to support female entrepreneurship

The developed countries of the world use different mechanisms to support women's entrepreneurship through the informal and formal sectors. The informal sector is organized through non-governmental organizations in urban and rural areas carried out various projects to bring together entrepreneurs, establishment of associations and connections with institutions in order to achieve the targets that contribute to fostering women entrepreneurship. Another important activity of the informal sector networking at local, regional and international levels. Cooperation achieved and implemented activities opens the possibility of joint implementation of projects approved by the dedicated funds that encourage entrepreneurship, regional cooperation and/or gender equality. The activities of women's organizations in urban areas are aimed at achieving gender equality, economic independence, support women's entrepreneurship, socialization excluded groups, health care and assistance to the elderly. Realizing their own or joint projects with other organizations realizes the activity or program, a media promotion are trying to emerge from anonymity and become recognizable in the community where they operate.
In rural areas there is evidence of slow emancipation of rural women since it is now a lot of talk and expects the revitalization of domestic industries, and on that basis the draw of rural women and their families out of poverty. For example, research on rural women's organizations in Vojvodina , show that throughout history initiatives and support for the emancipation of women, as a rule, come from other women. Rural women's organizations function as women and it was so socially acceptable as a special, while the male company or organization perceived as a general, which gives rise to differences in funding, to the detriment of women.

RESULTS AND DISCUSSION

Female entrepreneurship is a reality and one of the main factors contributing to economic development in many countries. Political and economic changes in the past have created the possibility for women to set up companies and manage them. One possibility that is increasingly used today in countries with developed market economy, women control more than 25% of the total number of companies. Women's entrepreneurship is rapidly expanding around the world. Women represent more than one third of the total involved in entrepreneurial activity, while their participation in the informal sector of the economy is much larger. Generations of women in the world diverse heritage and education contribute to their environment and express very encouraging signs of entrepreneurial spirit.
In our environment, it is known that the main motive of entrepreneurial business of a financial nature. There are still factors of motivation of female entrepreneurship [1], [4]:

- Dissatisfaction in large companies it occurs due to various conflicts in the family, then layoffs, job responsibilities..

- The balance family and work for this reason more women are opting for smaller companies, because children cannot look after themselves can yourself.
- The desire for challenge 44% of women entrepreneurs shows that it began work, he realized that all they can do for the employer can do for yourself.
- Motivational differences.

Many analysts believe that women do not do big companies in order to satisfy your ego. They support each other. Researching has shown that men and women see success differently. While men see their success as achieving the objectives of women experienced success as a work that fills them, as well as control over their lives.

CONCLUSION

In all developed and traditional, patriarchal environments it is evident that women are at a disadvantage, especially when it comes to property ownership. It is common practice that when the inheritance of immovable property (land, houses, buildings) than women expected their share of an inheritance gifts brother or a male family member. When entering into marriage, as a rule, the right of ownership is transferred to the man, even in cases of joint construction or purchase of a house or apartment. Time of women remains deprived of the right to dispose of his own property, or the right to run their own business, if there is a need for it, since there is not enough material resources, and is not able to raise mortgage loans as a favorable alternative provision of financial resources. If a woman is financially dependent on each other or have their own sources of income, there is likely to be on the margins of social events and without the possibility of active socialization.

The potential of women's entrepreneurship is manifested through a greater diversification between different economic sectors, younger entrepreneurs, at the aggregate level, which means a greater number of business activities focused on the knowledge economy and production, a lower concentration in the store. When entering the most important potential of women entrepreneurship are: determined not to give up easily, after the first attempt; The main disadvantages are a frequent entry into entrepreneurship because of the mere pressure of economic necessity and without sufficiently developed business ideas, while the obstacles are unfavorable resources to start, especially the lack of financial capital.

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DETERMINATION OF THE INFLUNCE FROM ELECTROMAGNETIC RADIATION OF THE LATHES ON OCCUPATIONAL SAFETY AND HEALTH OF THE OPERATORS

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Abstract: This paper presents the effects of electromagnetic radiation on occupational safety and health of the turners. It was discussed the size of electromagnetic radiation on turners parts of the body while lathes Potisje Ada PA C 22 and Potisje Ada PA B 30 are in operating and idling mode.
There are determined influential factors on electromagnetic radiation and so that in lathes electromagnetic radiation increases with the cuting speed, cuting depth, and cuting feed.
Key words: electromagnetic radiation, lathes, health and safety.

INTRODUCTION

Aim of the study is to experimentally determine the size of the electromagnetic radiation on turners parts of the body, while lathes Potisje Ada PA C 22 and Potisje Ada PA B 30 are operating and idling.
In human body that is staying in variable EM field it is induced a current, whereby E field induce currents significantly greater intensity than the magnetic. Under the influence of this field, there were generated oscillations of free ions and rotation of dipole molecules in the frequency field. A strong EM fields can perform rotation, deformation, destruction and merging cells and to disrupt the cell membrane potential.
In the paper was examined the impact of EM fields on the incidence of malignant diseases in exposed population. It was discovered increased mortality from all forms of leukemia and acute leukemia in adults chronically exposed to EM field of over 0.3 μT. The higher occurrence of cancer (lung tumors predominate, pharynx, digestive tract, respiratory and sinus, thyroid, nervous system tumors, lymphomas and melanoma of the skin and eyes) was established among workers whose profession is related to work with electricity.The International Committee of ionizing radiation has recommended 10 Kv/m and 0.5 μT for workspaces and 5 kV/m or 0.1 μT for public spaces [4].

MATERIAL AND METHODS

Electromagnetic radiation

Electromagnetic radiation represents electromagnetic wave motions that may arise and to transmit at the speed of light, both in the material middle and in vacuum (air free). Electromagnetic radiation is energy that electromagnetic waves or particle matters transmit through space.
An electromagnetic wave (electromagnetic radiation) is a combination of oscillating electric and magnetic fields that travel together through space in the form of mutual orthographically waves. Alternately, magnetic field causes a turbulent time variable electric field, and turbulent electric field causes the variable magnetic field. The fields are characterized by the vectors of the strength on electric and magnetic fields, which are mutually orthographical, and plain formed by these two vectors is normally appointed to the direction of propagation - transverse waves. Fig.1 shows the electromagnetic spectrum with wavelengths (m), names of the radiation, corresponding frequencies and single photon energy (eV) [5].

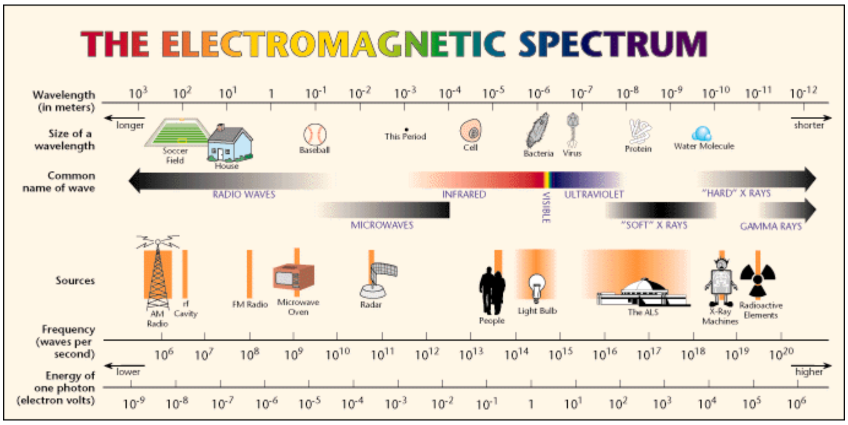

Figure 1. Electromagnetic spectrum

Directive of the European Parliament and of the Council 2004/40/EC defines the limit and action values for exposure to EM fields to 300 kHz in the working environment [6].

Table 1. Limits and action values for exposure to EM fields up to 300 kHz in the working environment

Frequency range	Current density for head and trunk J (mA/m2) (rms)	Whole body average SAR (W/kg)	Localised SAR (head and trunk) (W/kg)	Localised SAR (limbs) (W/kg)	Power density S (W/m2)
Up to 1 Hz	40	–	–	–	–
1 — 4 Hz	40/f	–	–	–	–
4 — 1 000 Hz	10	–	–	–	–
1 000 Hz — 100 kHz	f/100	–	–	–	–
100 kHz — 10 MHz	f/100	0,4	10	20	–
10 MHz — 10 GHz	–	0,4	10	20	–
10 — 300 GHz	–	–	–	–	50

SAR – Specific energy absorption rate

Lathes

Machines in the processing of scraping – lathes are divided into categories for individual, serial and mass production, depending on the volume of production. Lathes Potisje Ada PA C 22 and Potisje Ada PA B 30 (Fig. 2) are universal lathes belonging to individual production, which can easily costumize the transition from one configuration of the workpiece to another, and from one dimension to another.

Figure 2. Lathe Potisje Ada PA B 30

Technical characteristics of the lathes Potisje Ada PA C 22 and Potisje Ada PA 30 B are shown in Table 2.

Table 2. Technical characteristics of latheas Potisje Ada PA C 22 and Ada Potisje PA 30 B

Machines in the processing of scraping		Universal lathe PA B 30	Universal lathe PA C 22
Characteristic			
Max. turning diameter D_{max} (mm)		800	650
Height spikes channel H (mm)		300	220
Distance spikes channel L (mm)		1500	1000
Electromotor	Typ	-	-
	P_M (kW)	7,5	7,5
	Speed n_M (o/min)	2400	2400
Cuttinig speed	n_{min} (o/min)	20	20
	n_{max} (o/min)	2400	2400
	φ_n	1,25	1,25
Cutting feed	s_{min} (mm/o)	0,040 (0,321)	0,040 (0,321)
	s_{max} (mm/o)	1,142 (9,136)	1,142 (9,136)
	φ_s	1,12	1,12

Experimental conditions

Machine tool: Lathe Potisje Ada PA C 22, Lathe Potisje Ada PA B 30.
Material and dimensions: Steel 17MnCr5 (SRPS EN 10027) ϕ35 mm.
Measuring equipment: Magnetosmog TYP WKDA 02.705.

RESULTS AND DISCUSSION

In figure 3 is presented the electromagnetic induction in nT at the distance of 0.5 m from the lathe Potisje Ada PA C 22 with the following working conditions: cuting speed- n (rpm), cuting feed- s (mm/o) and cuting depth- t (mm).

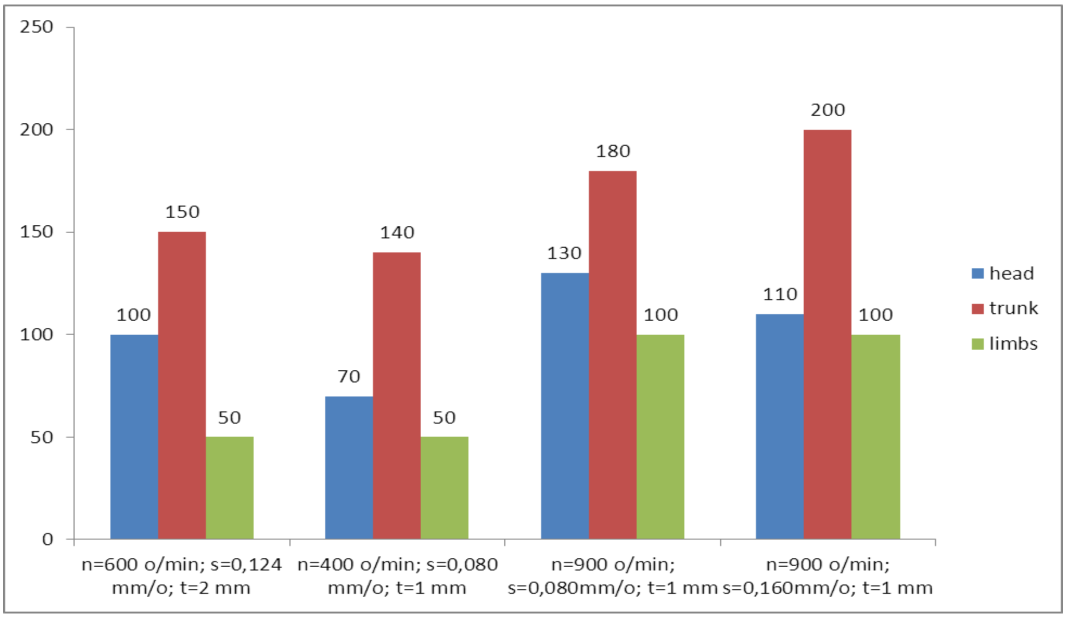

Figure 3. Electromagnetic induction in nT of the lathe Potisje Ada PA C 22

In figure 4 is presented the electromagnetic induction in nT at the distance of 0.5 m from the lathe Potisje Ada PA B 30 with the following working conditions: cuting speed- n (rpm), cuting feed- s (mm/o) and cuting depth- t (mm).

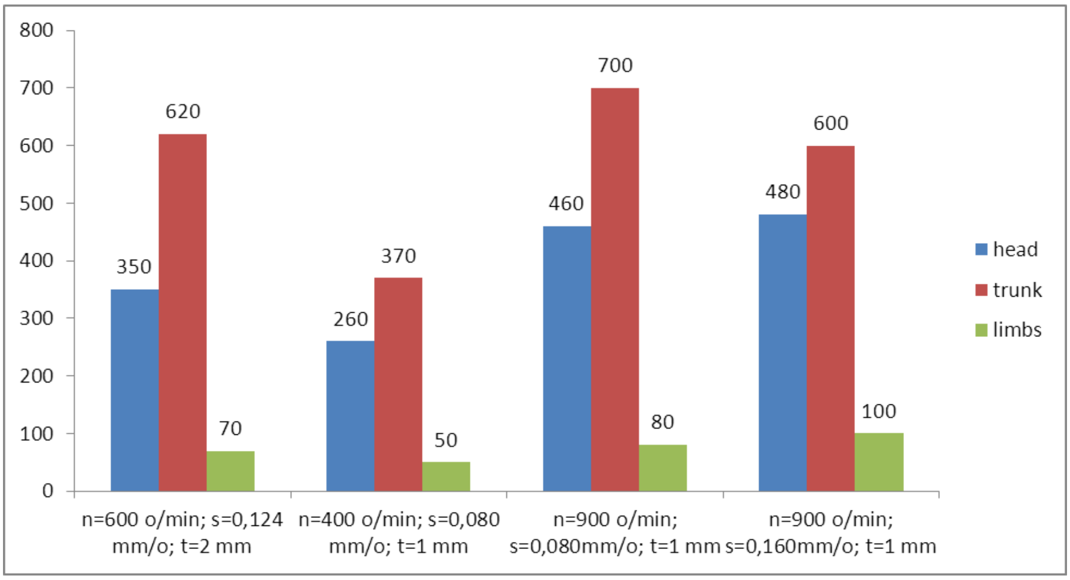

Figure 4. Electromagnetic induction in nT of the lathe Potisje Ada PA B 30

CONCLUSION

Based on the above presented it can be concluded that electromagnetic radiation that occurs in the process of scraping can cause adverse effect on the turner safety and health.

It can be concluded for the electromagnetic radiation that it exceeds the limit of normal levels (about 0.5 μT) in the area of the body for the lathe Potisje Ada PA B 30, while in other parts of the body the electromagnetic radiation is within the acceptable limits.

In the case of the lathe Potisje Ada PA C 22 the electromagnetic radiation is well below the permissible limits in all modes og cutting and all parts of the body.

In the end, it can be concluded that the electromagnetic radiation of the lathes increases with the increases of the cuting speed, cuting depth, and cuting feed.

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APPLICATION OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN DISASTER MANAGEMENT

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Abstract: The economic consequences of disasters are increasingly affecting the normal functioning of societies. Disasters are more and more destructive. The information that leads to the prediction of these phenomena and the assessment of their consequences is very valuable. Information and communication technologies in the management of disasters have a greater significance. This paper illustrates how these technologies are applied in the disaster management life cycle.
Key words: information and communication technology (ICT), network, disaster management, resilience

INTRODUCTION

Due to the increasing frequency, scope and economic effects of emergencies, risk management in emergencies is gaining importance. Emergency management requires timely and good decisions. They should be based on appropriate indicators, the values of which will indicate how to prevent or respond to different threats. Today, many research institutions are working on the development of indicators. This has led to the use of advanced methods, techniques and tools in decision-making in emergency management.

The emergency situation is defined as the state when the risks and threats or the consequences of disasters, extraordinary events and other dangers per population, the environment and material assets are of such scale and intensity that their existence or consequences cannot be prevented or eliminated by regular operation of competent authorities or services, and therefore their mitigation and elimination requires the use of special measures, strengths and resources with enhanced working regime [1]. Many countries promote integrated protection and rescue system. The basic directions for ensuring national security are defined in the national security strategy [2]. This is the most important strategic document that sets out the basics of the security policy in the protection of the national interests, challenges, risks and threats to national security, sets out the basic tasks, priorities and directions of the functioning of the security system.

Good decision-making requires proper data. These data are numerous, diverse, spatially and temporally diversified. Information and communication technologies are therefore very important in disaster management. They are used to enable efficient resource management [3], applying the principles of sustainability [4], preparedness and safety management [5], and evaluation of consequences of adverse events - for example, contamination of the river flows that can cause industrial accidents [6].

MATERIAL AND METHODS

In order to efficiently manage emergency situations and adverse events, it is necessary to activate additional forces, organize protection and rescue people from the affected areas, and then proceed to remedy the situation and return the society to its original condition right before the occurrence of an adverse event. All this requires the realization of a social consensus, extremely precise coordination of activities, as well as the exchange of information between all participants in the processes that take place simultaneously. During the emergencies, the wrong decision in most situations is due to the lack of accurate and complete information, that is, the absence of a complete picture of causes and consequences of occurrence of adverse events. Such decisions can lead to additional human casualties and material losses, an additional feeling of hopelessness and unprotectedness of persons living in the affected area, especially considering that an emergency situation is usually connected to a very

destructive event affecting a narrower area, which alone is not capable of responding to its consequences, as it has no human or material capacity to do so.
A life cycle is a term that is mentioned in analyzes of different systems, objects, or events, to describe a particular set of events that occur during their entire life, from initiation to the end of existence or life. The life cycle is a series of interconnected steps that describe all stages during the life or existence of a system, object, or event. In order to describe the activities related to unwanted events and emergencies, the notion of the life cycle of disaster management has been introduced.
The life cycle of disaster management consists of interconnected phases that occur one after the other, they are interconnected, so the exchange of information is necessary, the coordination of the participants' activities in the processes, as well as the execution of certain preventive and corrective actions in order to overcome the consequences of occurrence of adverse events and reduce damage to the smallest possible level.
Numerous authors have attempted to describe the disaster management and the activities that take place during this management. They identified certain basic phases in the life cycle. Some representative models for disaster management are shown in Table 1.

Table 1. Representative disaster-management models and their classsification according to orientation

Orientation	Model
Activities (processes)	CRM [7], SHFM [9], DOM [9], DRRS [10], CM-DM [11]
Phases	CFEP [12], DMM [13], DMMC [14]
Actors	iERF [15], ICDM [16], DNMM [17]

Models of activities or processes describe the main activities and processes in the disaster management system. These activities relate to the details that are necessary to perform in order to enable adequate disaster management. These models are often defined for specific types of catastrophes, as they require specific activities in the process of preparing and responding to the occurrence of an adverse event.
The actor models define key actors in the process of emergency management. These actors are numerous and involve all members of the community, from individuals, through emergency services, special operations in emergency situations, to military and police forces. Each of them has certain obligations and rules of conduct in emergency situations, prescribed by legal procedures.
Phase models define the general phases, time observed in the period before, during and after the occurrence of an unwanted event. These phases involve a number of operational activities that are performed by different actors before, during and after the occurrence of an adverse event. They are described generally, presented most often by flow diagrams or block diagrams, and provide a general definition of emergency protection and rescue systems. This type of model is generally accepted when defining the general framework of the emergency management system, while the models from the previous groups are usually applied when it is necessary to specify a particular model, for a particular type of emergency situation, and a limited domain of action. Therefore, in the following text, when considering the application of information and communication technologies in the context of disaster management, this type of model is used.

ICT TECHNOLOGIES IN DISASTER MANAGEMENT

Information and communication technologies have found their application in all the spheres of modern society, from education to production. Due to the large amount of necessary information, the need to coordinate different actors and the need for rapid response, information and communication technologies have found application in the management of emergencies. Their application is growing, and from the basic, faster processing of data, it is becoming more and more advisory. Different information and communication technologies and their application depend primarily on the way communication is obtained between different actors during the response to the disaster. Types of communications and ICTs are shown in Table 2.

Before an unwanted event occurs, the types of communication are adapted to preventive actions and to familiarize people with possible consequences of unwanted events. Various web contents, static and dynamic, can be used, as well as electronic instructions, electronically available courses, e-mails. In addition, regular communication channels can be used to communicate with the company. Information from sensor networks, wired or wireless, as well as risk maps, may also be available to the public, and must be available to persons participating actively in the protection and rescue activities.

Table 2. Different types of communication before, during and after the occurrence of an adverse event

Time frame	Communication types	ICTs
Before	Advisory and preventive communication, training, public calls for preventive collection of resources in the form of reserves, monitoring systems	Wikis, blogs, websites, electronic manuals, e-learning courses, regular communication channels (phone, voice-over-ip) with stakeholders, TV messages, short message communication, e-mails, wireless and wired sensor networks for monitoring and prediction, GIS for risk mapping, crowdfunding, knowledge bases
During	One-to-one and one-to-many communication with affected area people, alarm activation	Regular communication channels in emergencies (phone, radio communication), short message communication, e-mails, social media (social networks), crowdsourcing, tagging, sound alarms activation software (by phone, by sirens), wireless and wired networks for monitoring
After	One-to-many communication with people suffered loss, direct communication, alarm deactivation	Blogs, websites, wireless and wired sensor networks for monitoring consequences, GIS for consequences mapping, crowdfunding, crowdsourcing, tagging

Communication changes significantly before and during the occurrence of a disaster. Then the occurrence of events is signaled. This can be done individually (by phone, electronic or short message), or group (sirens and sound announcements). Protection and rescue services are activated by standard communication channels (radio connections, phones) as long as these channels are available. Also, monitoring of the condition with the monitoring system is continued without interruption.
After the occurrence of an unwanted event, the consequences and possible ways of helping the victims are informed in all available ways. Web 2.0 technologies can be used (blogs, tagging locations with casualties or high material losses, location with resources to help the injured, etc.). GIS technology is used to map out the consequences and risks, and tag all of problematic locations. Further notification can be done by using social networks.

CONCLUSION

This paper presents the application of ICTs in disaster management. Although initially ICTs were used only for resource management, data processing and elementary inventory support, as well as an analysis of the consequences, the tendency is to apply them for predicting disasters and their possible consequences. This can be achieved by using machine learning and intelligent prediction methods. Good results have been achieved in the process of forecasting major weather problems and tsunamis, which significantly reduces the number of human casualties as the consequences of these natural disasters.

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BIOLOGICAL FILTRATION LOAD WITH FILTER FILL CALCULATION

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Rezime: The components, function and performance characteristics of the biological filter have been studied and described iIn this paper. The selection of project parameters values depends on the size of the object, the desired purification effect, and the type of filter fill. The calculation for the high-loaded biological filter is described through the example with the adopted values given in the table. Biological filter simulations were performed using the CATIA software package.
Key words: biological filter, filter fill, purification, load, dimensioning, calculation

INTRODUCTION

One of today's great problem is the man's wrong attitude about water as an inexhaustible natural resource. It is believed that for many tens of years mankind will face the problems of great water shortages in general, or water that can qualitatively satisfy human needs. The number of inhabitants on our planet is increasing rapidly, the need for water even faster, and its quantity does not change. Research shows that water consumption has doubled since 1950. By 2025, 2/3 of the population will experience a serious lack of water. For now, according to expert data, 2.5 billion people have lack the basic hygiene conditions due to water scarcity, and even more than 5 million people die annually due to water pollution. The most endangered parts of the world are the areas of Asia and Africa, in areas where the evaporation is higher than the amount of annual precipitation.
Polluted waters are a special form of water with changed original shape and composition. Their special sight is wastewater. Waste waters are the waters of the worst quality, they are very polluted and, in order to be used for certain purposes, they must be refined beforehand. The problem of wastewater treatment is very complex and it is one of the limiting factors for the further development of humanity. Wastewater treatment is carried out using various physical, chemical and biological processes [1]

BIOLOGICAL FILTER LOAD AND DIMENSIONING

BIOLOGICAL FILTER

There is no unique wastewater treatment system because each of them has special characteristics, especially for industrial wastewater.
The dropping filters imply natural treatment of wastewater that occurs when the waste water enters the receiving stream and flows over solid rocks or rocky river surfaces. In a natural purification process, bacteria in the walls and stones remove dissolved organic pollutants and purify water. For biological filter calculation, the dimensions presented in Table 1 [2] are taken into account:

Table 1. Basic sizes for biofilter dimensioning [2]

Term	Index	Unit
Volumetric load biofilter filled with organic matter	B_V	g $BPK_5/m^3\cdot$dan
Surface loading of organic matter per unit area filled with biofilter	B_A	g $BPK_5/m^2\cdot$dan
Surface hydraulic load per unit of horizontal surface of the building	$q_{A\ (1+R)}$	$m^3/m^2\cdot h$

The amount of recirculation compared to QSV18 (eighteen-hour mean flow during dry weather)	R	-
Specific biofilter's surface fill	A_V	m^2/m^3

The choice of project parameters values depends on the size of the object, the desired purification effect, and the type of filter fill. The usual project parameters for the dimensioning of single-sided biological filters of different sizes and types of filling, according to ATV (Germany), are given in Table 2. According to this instruction, the minimum diameter of the biological filter is 30 m and the maximum is 40 m.

Table 2. Single - stage biological filters dimensioning according to ATV [2]

<table>
<tr><th colspan="3">Purification</th><th>Without nitrification</th><th>With nitrification</th></tr>
<tr><td colspan="5">Filling with the gravel</td></tr>
<tr><td rowspan="4">Volume's organic purification B_V (kg BPK_5/m^3d)</td><td rowspan="2">Facility for > 500 residents</td><td></td><td>0,4</td><td>0,2</td></tr>
<tr><td>With a uniform flow in 24 h</td><td>≤ 0,6</td><td></td></tr>
<tr><td colspan="2">50 – 500 residents</td><td>≤ 0,2</td><td>-</td></tr>
<tr><td colspan="2">50 residents</td><td>≤ 0,15</td><td>-</td></tr>
<tr><td colspan="3">Hydraulic surface load $q_{A\ (1+R)}$ m/h</td><td>0,5 – 1,0</td><td>0,4 – 0,8</td></tr>
<tr><td colspan="3">Recirculation versus $Q_{SV\ 18}$</td><td>R ≤ 1</td><td>R ≤ 1</td></tr>
<tr><td colspan="5">FILLING WITH PLASTIC ELEMENTS
(does not apply if BOD5 is in water after primary deposition < 200 mg/l</td></tr>
<tr><td>Volume's organic purification B_V</td><td>Specific surface A_R (m^2/m^3)</td><td>~ 100
~ 150
~ 200</td><td>0,4
0,6
0,8</td><td>0,2
0,3
0,4</td></tr>
<tr><td>Hydraulic surface load</td><td>Specific surface A_R (m^2/m^3)</td><td>~ 100
~ 150
~ 200</td><td>0,8 – 1,0
1,0 – 1,5
1,2 – 1,8</td><td>0,6 – 1,0
0,8 – 1,2
1,0 – 1,5</td></tr>
<tr><td colspan="3">Surface organic load</td><td>4</td><td>2</td></tr>
</table>

Tipical values for biofilters dimensioning are given in Table 3., according to USA literature.

Table 3. Typical values for biofilters dimensioning [2]

Biofilter's load				
	Low	**Middle**	**High**	**Very high**
Hydraulic load (m^3/m^2d)	1 – 4	4 – 10	10 – 40	40 – 200
Organic load (kg BPK_5/m^3d)	0,08 – 0,32	0,24 – 0,48	0,32 – 1,0	0,80 – 6,0
Depth (m)	1,5 – 3,0	1,25 – 2,5	1,0 – 2,0	4,5 – 12
Recirculation	0	0 – 1	1 – 3 ; 2 – 1	1 – 4

Material	Slag Gravel	Slag Gravel	Slag Gravel Plastic	Plastic
Needed load (kW/10^3 m^3)	2 – 4	2 – 8	6 – 10	10 – 20
Water flow	Intermittent	Intermittent	Continuous	Continuous
Dosage Intervals	Lass than 5 min	15 – 60 s	Less than 15 s	Continuous
Efluent	Nitrificated	Partially nitrificated	Partially nitrificated	Partially nitrificated

Blowing biofilters consist of a deep layer of carrier, filter fill, high permeability, and on the surface of the carrier a thin layer of immobilized cells of microorganisms is formed - biofilm. The wastewater is sprayed over the top of the filling and from there it is seated, drops (from here name) through the filling, is collected at the bottom of the filter and taken to the secondary precipitate, where suspended particles originate from the waste water and particles of the biofilm washed from the carrier in the filter. Aeration is provided by a natural change.
Dropwise biofilters are divided into two basic categories (1) low-effective, and (2) high-effective, and their basic characteristics are given in Table 4 [2].

Table 4. Dropwise filters basic characteristics [2]

Characteristics	**Low-effective**	**High-effective**	
		Stone fill	**Plastic fill**
Depth (m)	1,8 – 3	1 – 2,5	4 – 10
Specific Surface A_V (m^2/m^3)	40 – 65	40 – 65	80 - 100
Porosity	0,45 – 0,55	0,45 – 0,55	0,90 – 0,97
Size of fill element (mm)	25 – 75	25 – 75	Depend of the material
Hydraulic load surface q_V (m^3/m^2d)	1 – 3	9 – 28	20 – 75
Volume organic load B_V (kg BPK_5/m^3d)	0,1 – 0,4	0,4 – 1,8	do 15
Re-circulation ratio (R)	0	1 – 4	1 – 4
Washing the microflora	Periodically	Continuous	Continuous
Nitrification	Yes	On lower load	Not under economical work
BPK_5 in en-fluent (mg/l)	< 25	>30	>30
Suspended particles in effluent (mg/l)	< 25	>30	>30

Dropwise biofilters are often an alternative to the active sludge process, for less wastewater flows, due to lower operating costs and simpler work, but they also have less pollution removal efficiency. They are constructively executed as a deep-bed tower, filled with biofilters, high permeability, and a thin layer of immobilized microorganisms, biofilm, is formed on their surface. By spraying water over the top of the filling, and by placing it over the biofilm through filling, the wastewater is purified, thus

achieving the desired degree of purification. At the bottom of the filling tower there is a collection tank, from which the water is drawn to the secondary precipitator.
Dosage of waste water on the top of the filling is most often done by spraying from a set of nozzles or, more often, through rotating single or multiple distributors, with nozzles at the bottom, from which the water spills over the surface of the fill over the entire cross-section of the tower. Glyphosphere fillers are typically (due to the weight of the fill) more shoal and with larger diameters, while the biofilters with a plastic filling are a deeper but with smaller diameter [3].

BIOFILTER CALCULATION

The calculation of the high-pressure biological filter is described by example for 20,000 inhabitants with the following values adopted [4]:

- Organic load per residual 0,077 kg BPK_5/d;
- Primary treatment of water removes 25% of raw waste $BPK_{5;}$
- Adopted diameter of biological filter is 25 m;
- Adopted filter's high is 2,5 m;
- Porosity of broken stone is ε=0,36
- Specific water consumtion is q_v= 210 l/inh. per day;
- Hydraulic load is HO= 1,4 $m^3/d/m^2$.

Volume (V), is calculated according to (expression 1):

$$V = B \cdot H = \frac{d^2 \cdot \pi}{4} \cdot H = 1227{,}18\ m^3 \tag{1}$$

Broken stone volumen (V_K) is calculated according to expression 2:

$$V = \frac{V_K}{1 - \varepsilon} \tag{2}$$

$$V_K = V \cdot (1 - \varepsilon) = 1227{,}18 \cdot (1 - 0{,}36) = 785{,}39\ m^3,$$

So, the hight of fill is:

$$H_i = \frac{V_k}{A} = \frac{785{,}39}{490{,}87} = 1{,}6\ m$$

Wastewater flow (Q) calculation using hydraulic load HO is (expession 3):

$$HO = \frac{Q}{A} \tag{3}$$

$$Q = HO \cdot A = HO \cdot \frac{d^2 \cdot \pi}{4} = 1{,}4 \cdot \frac{25^2 \cdot \pi}{4} = 687{,}22\ \frac{m^3}{d}$$

Daily wastewater mass calculation, which comes to the biofilter BPK_5 is given in expression 4. Firstly the calculation BPK5 for urban wastewater load (BOD5-g has to be done:
Prvo treba izračunati BPK_5 opterećenja gradske otpadne vode ($BPK_{5\text{-}g}$):

$$BPK_{5-g} = 20.000 \cdot 0{,}077 = 1.540\ kg/d \tag{4}$$

BPK_5 load of the water load at the biofilter input (BPK5-b) is 75% of the urban waste water load (expression 5):

$$BPK_{5-b} = \frac{1.540 \cdot 75}{100} = 1.155 \text{ kg/d} \tag{5}$$

Biofilter's organic load can be calculated based on (expression 6):

$$OO = \frac{BPK_5}{V} = 0{,}94 \ \frac{kg}{d}/m^3 \tag{6}$$

3D BIOFILTER MODEL

According to the obtained values, in the CATIAV5 software package, a biological filter model was performed.

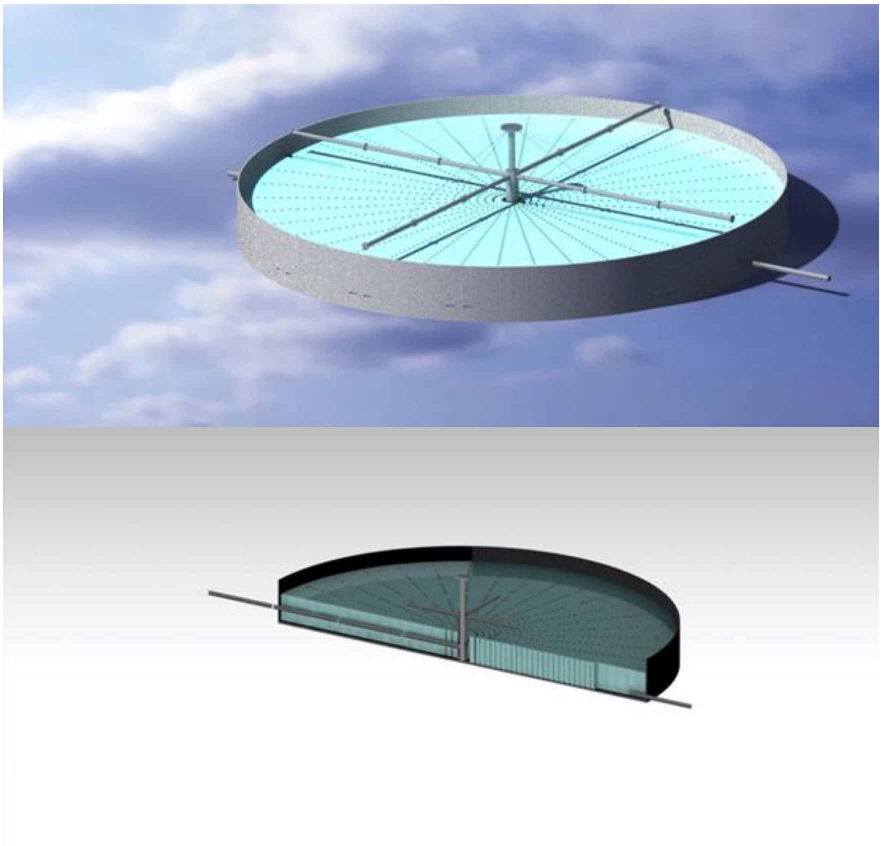

Figure 1. 3D Biofilter Model with filter's fill

Figure 1 shows a vertical cross section through a classic biological filter (dropWISE filter) modeled in the CATIAV5 software package. The water on the upper surface is filled with water sprayed from splinker (Segner wheel) that rotates due to the reactive water jet force. The required pressure of water in splinker is about 0.15 bar. For a two-speed sprayer, the speed should be up to one rotation in 10 minutes, which may vary depending on the hydraulic load. The height of the filter fill is about 3 m. Below the filling there is a double bottom, where purified water is collected.

CONCLUSION

The task of biological purification is to remove as much as possible biodegradable organic matter. Decomposition of organic matter is performed by various types of microorganisms. Biological purification of colloidal and dissolved organic matter is translated into a form of more or less stabilized sludge, which should be removed by precipitation prior to the discharge of wastewater into the natural environment of the sea. Biological processes are also used to remove nitrogen (as a

biogenic element) from wastewater, using processes of nitrification and denitrification. The organic fraction of sludges, generated during the primary treatment of wastewater (primary sludge), can also be removed from the biological route, and the excess of microflora biomass from the process of wastewater biological treatment (secondary sludge), which is called (biological) stabilization of sludges or digestions, can be degraded.
It is of essential importance not to left wastewater treatment plants to themselves, as it is difficult to provide all the necessary logistics for the operation of these systems. Therefore, it is necessary to establish an organization for managing these systems, controlling the system and maintaining them. Without qualification, these systems can not be sustained continuously, as demonstrated by the experiences of developed countries [5]. Wastewater treatment today is attracting more and more attention, imposed demands are rapidly growing up, and legal penalties for non-compliance are growing every day.

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OIL PRODUCTS AND PUMPING STATIONS

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Abstract: From several wells on the oilfield field, crude oil is transported by pipelines to collecting stations, the number of which depends on the layout and the yield of the wells. Boreholes can be fountain gutters and pumps. Purification of crude oil is carried out in collection stations. Gas is a regular companion of crude oil, and therefore each collecting station has gas discharge devices. Purified crude oil is transported through several pipelines to pipeline to the dispatch station, and from here by the main pipeline to the refinery or to the loading station, if the transportation to the refinery is carried out by means of mobile means (wagon tanks, car tanks, tankers). From the gas obtained, butane and propane, as well as carbon dioxide and sulfur are separated in the collection stations, if present in the gas.
Key words: collection pipelines, oil pipelines, collection stations

INTRODUCTION

Crude oil is a multiphase-multicomponent mixture of various hydrocarbons, water, gas and Solid particles. The properties of crude oil depend on the massive participation of certain phases and components inMixture. The diameter of the main pipelines is usually over 500 mm, the length is over 50 km, and the pressure of the transported raw material at the beginning of the pipeline is 50-65 bar and more. The collection pipelines in the oilfield fields have a much smaller diameter and its size depends on the volume of the well. They are usually 100-150 mm, but they can be even larger. In order to ensure the continuous receipt of crude oil from the collection stations from oilfield fields and the optimum regime of the main oil pipeline, the dispatching pump station, often referred to as the main pump station, has a large reservoir space. At the main pumping station, the first introduction of the transported raw material into the pipeline is performed, as well as the control of physical properties, if this has not been done previously. Figure 1 shows the technological scheme of the main pipeline.

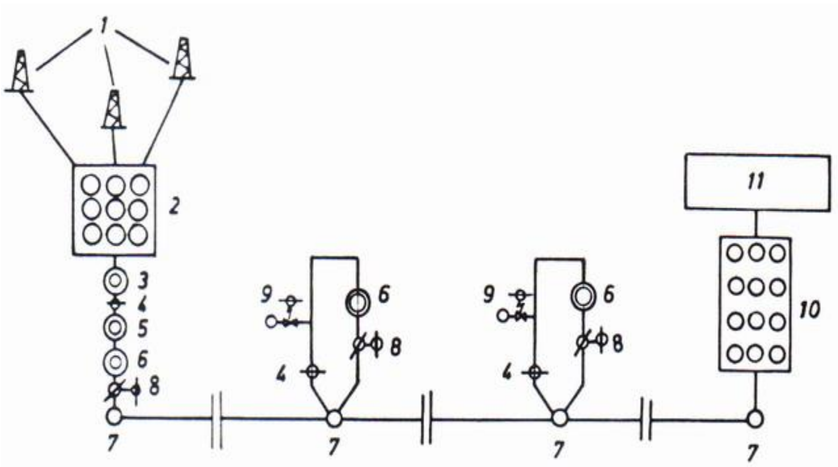

Figure 1. Technological scheme of the main pipeline

From several wells (1) from oil fields, crude oil is transported by pipelines to collecting stations (2). In collecting stations, purification of crude oil is carried out. The purified crude oil is transported from a number of collecting stations by a main pipeline to a delivery station consisting of: main pumping stations (3), filters (4), measuring devices (5) and auxiliary pumping station (6). Crude oil is further transported by a main pipeline along which there are devices for introducing and extracting a pipeline cleaner (7), as well as auxiliary stations in which the pressure increase and heating of the oil are made, consisting of: an auxiliary pump station (6), a filter (4), a pressure regulator (8) and a hydraulic shock absorber (9). Crude oil comes to receiving stations with tanks (10), and then pipelines are transported to the refinery (11).

OILFIELDS

Boreholes can be:
-fontanske,
-gas-lifts,
-pumpne.

Fontane boreholes are those in which the oil pressure in the well is sufficient to expel oil to the surface of the earth and carry the oil transport to the reservoirs within the collection stations.
Gas-lift wells are those in which the oil pressure in the well is not sufficient to expel oil into the surface of the earth. Due to this, at a certain depth, a gas under pressure, which flows, is injected It vertically pushes up crude oil upward so that oil goes up to the surface of the earth.
Pump holes (Fig. 2) are those in which, in addition to insufficient pressure of the well, the oil is discharged
.On the surface of the earth, the borehole also has a slight abundance. Then use the piston-piston pumps with Weights. The fountain wells become gas-lifts and pumps over time, as time pressure decreases Wellness of the well.

Figure 2. The appearance of the pump well

COLLECTING PIPES AND SABIRNE STATIONS

The collection pipelines have the task of transporting crude oil from the wells to the collection station. The collection pipes are made of steel. The diameter of the collecting pipeline depends on the wellness of the well and it ranges from 100 to 150 mm, although it can be even larger. In the collecting stations (Figure 3), crude oil is purified. Gases are allocated, Water and solid particles.

Figure 3. The appearance of the oil collecting station

The process of extracting crude oil from gas can also begin in the collection pipelines itself Specific pressure and temperature of the mixture. In the collection stations, the units are separated Gas is extracted from crude oil. Then the butane and propane, carbon dioxide are separated from the gas obtainedAnd sulfur. After the extraction of the gas from crude oil in the tanks, water and solid particles are removed. Water and Solid particles are heavier than crude oil and after a few hours of resting water and solid particles fall to the bottom of the reservoir in the form of sludge. This sludge selection process can be intensified Heating crude oil and adding calcium chloride. Purified oil is pumped into pure Reservoirs, and then the water and solid particles are transported to the place where it is carried out by the drainage channels Water treatment. Sulfur is extracted prior to transport to the crude oil dispatch station.

OUTPUT PUMP STATIONS

The purpose of the delivery pump station is multiple. In the dispatch pump station (Figure 4) are:
- the reservoir space accepts crude oil from collecting stations;
- pressurizes crude oil;
- refining crude oil;
- regulates the pressure of crude oil in the main pipeline and,
- performs measurement of physical properties of crude crude oil.

Figure 4. Pump station

Due to the fall of the pressure during transport, they are installed along the pipeline of the auxiliary pump station in which the increase in the pressure of crude oil compensates for lost energy in the previous one shares and heats up if necessary. At that time, the auxiliary pumping stations were supplied larger tank space and crude oil heating devices. Auxiliary pumping stations are usually built along the main pipeline route near the inhabited Places, electricity connections, water supply and sewerage. Distance between the main pump the stations and the first auxiliary pumping stations are 100 to 150 km, and the distance between the auxiliary ones pumping stations from 50 to 80 km. If the pipeline has to be laid far from the inhabited and if this would make it difficult to maintain pumping stations and generally exploitation. Then these distances are increased to 200 km between the main and the first auxiliary pump Stations, or up to 100 km between the following pumping stations.

MAGISTRAL OILS

Main pipelines are the pipelines through which they are transported (Figure 5): -Refined oil from shipping stations in oil fields to refineries or loading boats Stations for loading mobile means of transport; refined oil from unloading stations in river and seaports to refineries when Crude oil is supplied to tankers and refer oil crude oil from refineries to large consumers or to loading stations when their transport is predicted by mobile means of transportation. The diameter of the main pipeline is above 500 mm, the length is over 50 km, and the pressure is transported Oil at the beginning of the pipeline from 50 to 65 bar and more.


Figure 5. Appearance of the above-ground oil pipeline

As part of the refinery, when crude oil is transported through the pipeline, or in the circle of consumers Centers, if the products of crude oil are transported through an oil pipeline, there are reception stations with Sufficient tank space (Figure 6). When one pipeline predicts Supplying more refineries, or supplying more consumers with crude oil products, then Such an oil pipeline is equipped with drainage pipelines, devices for measuring delivered quantities and Remote control devices. The same is true when a pipeline is being moved to a place Oil for the loading station for filling a wagon tank, tank or tanker.

Figure 6. It looks like a tank space

Magistral oil pipelines are usually buried in the ground at a depth of 0.8 to 1.1 m measured from Surface of the earth to the upper edge of the pipeline. Depth of digging depends on the category of oil pipeline and the width of the protective belts of the populated areas, the facilities near the pipeline, etc.

The depth of burial is Increases to 1 to 1.35 m when various obstacles have to be overcome when laying pipelines: Waterways, roads, railways, etc. The depth is then measured from the bottom of the water flow, respectively from the upper edge of the road, rail, etc. Sometimes the main pipelines are laid above the ground on concrete Columns of height from 0.5 to 0.75 m. There are other ways of laying off the main pipelines: Beneath the sea and lakes at various depths, above wetlands, etc. Valves are installed every 10 to 15 km along the pipeline route in order to prevent major losses Oil if, for any reason, pipeline breakdowns occur. Damaged place is blocked by valves between which it is located. At the distance along the 15 to 20 km route, the house of the watchman is being built Oil pipeline, which includes a handy workshop with the most important tool for removing smaller ones Breakdowns on the pipeline. A pipeline cleaner (Fifure 7) is used to clean the pipeline. The pipeline cleaner is through the cleaners Station enters the pipeline. Moving through the pipeline, he removes the deposits from the pipe wall.

Figure 7. The appearance of the pipeline cleaner

Crude oils that are very viscous (heavy crude oil) must warm up before being introduced into Pipeline. This is done in the main and auxiliary pump stations that are then equipped Boiler rooms. Boilers are usually fueled by the transported oil itself, and as a heating fluid Hot water or overheated steam is used. Oil pipelines as well as other pipelines through which energy fluids must be transported must be equipped with fire extinguishers. Propulsion motors must be protected against explosion and they are located in separate departments, especially when it comes to petrol and diesel engines, or bath tubs for use, engines that consume gas are used as propellants.

CONCLUSION

Due to the fall of the pressure during transport, auxiliary pumping stations are installed along the pipeline in which, by increasing the pressure of crude oil, the lost energy in the previous section is compensated and it is doing the heating of crude oil if necessary. At that time, the auxiliary pumping stations are equipped with a larger tank space and heating devices for crude oil. Auxiliary pumping stations are usually built along the main pipeline route near settlements, electricity connections, water supply and sewerage. The distance between the main pump station and the first auxiliary pump station is 100-150 km, and the distance between the auxiliary pumping stations is 50-80 km. Crude oil that is very viscous (heavy crude oil) must warm up before being introduced into the pipeline. This is done in the main and auxiliary pumping stations that are then equipped with boiler rooms.

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DETERMINING CRACK LENGTH AND CRITICAL LOAD USING VICKERS INTERSURFACE INDENTATION METHOD ON THE INTERFACE OF THE SUBSTRATE / COATING

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Abstract: The properties of plasma spray coatings are directly related to the type and characteristics of the powder, deposition parameters, type of material and the morphology of the substrate. Key properties of the coating are toughness, strength, shear, hardness, inter surface toughness and adhesion of the coating. Adhesive strength determines the quality of the coating, while the cohesive strength of layers determines the lifetime of the coating in service. These properties are very important for biomedical inert and reactive ceramics which are deposited on implants. Plasma spray coatings show inter surface complexity with the substrate due to the influence of residual stress, porosity and micro cracks at the inter surface. Therefore, for each coating, adhesion strength must be examined. There are several methods of measuring joint adhesion strength of thermal spray coatings of which most commonly used is the method of tensile testing. Presented in this paper is the Vickers method of inter surface diamond pyramid indentation testing at the interface substrate/coating, which is used to determine coating adhesion strength.
Keywords: plasma spray coatings, indentation test, adhesion, cohesion.

INTRODUCTION

For evaluation of adhesion strength of plasma spray coatings or surface/coating bond strength, many methods have been developed, of which the most commonly used are the tensile test method specified by standard (ASTMC633) and the scratch test according to standard (ISO/WD27307), [1]. The Standard that refers to the tensile test cannot be applied in the evaluation of the coating with adhesive strength greater than the strength of the glue which is used to prepare samples for the tensile test, [2]. A universal method for measuring the adhesion of coatings does not exist due to various combinations of substrate/coating systems. The best method of determining adhesion strength is the one that simulates the practical state of stress in the coating layers, [3]. The residual stresses in the coating layers, a result of mismatched thermal and mechanical properties of the substrate and the coating, are of great importance for adhesion strength. Adhesion strength is not a constant in real circumstances, but a complicated feature that depends on the load conditions applied to the designed coating thickness, [4]. Therefore, it is important to determine the adhesion strength because, based on the test values, the quality of the coating is assessed, understanding the degradation of the substrate/coating bond at the interface in operating conditions is determined as well as the evaluation of life span of the coatings on the coated working equipment. The obtained estimate results also allow, through testing of a batch of samples, to homologate optimal powder deposition parameters which will enable coating reproducibility of high and uniform quality. In addition to standard procedures of tensile testing of adhesion strength, among the most common methods applied is the indentation test, which is schematically shown in Fig.1. [5]. This method can easily evaluate the adhesion strength of the coating by a plurality of diamond pyramid indentations on the substrate/coating interface using the Vickers method, which has long been accepted and is commonly used in industry. When using thicker coatings, the fracture toughness (K_{ca}) at the boundary surface of the substrate/coating is determined using the Vickers method of measuring the total lengths of cracks (Cc) caused by ploughing with a diamond pyramid along the interface. Several measurements are conducted for the testing. Shorter cracks along the interface indicate that the coatings have higher adhesion strength and interface toughness. Also, a higher critical indentation force (Fc) which causes cracking at the intersurface confirms higher adhesion strength of coatings.

This article describes the Vickers method which is applied for testing adhesive strength of coatings. The paper shows measurement values of critical loads (*Fc*) and total lengths of cracks (*Cc*) at the interface of the substrate and the NiCrAlY coating, and their values and causes of fracture are discussed.

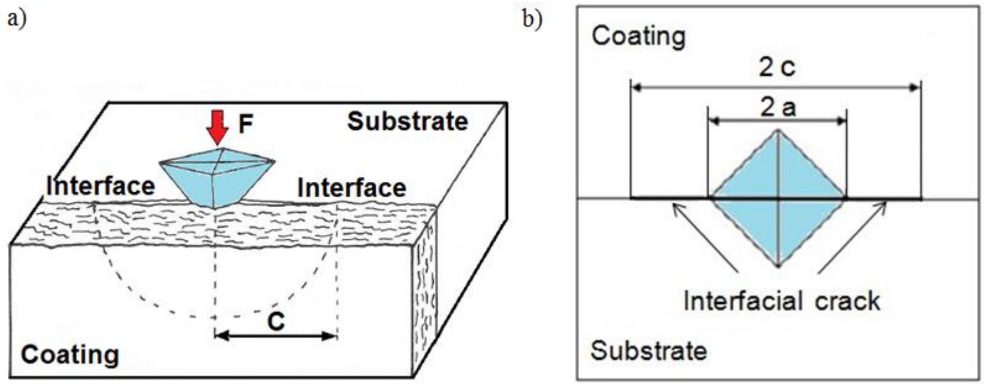

Figure 1. a) A schematic view of an indentation test; b) the geometry of the indentation

MATERIALS AND EXPERIMENTAL DETAILS

For the production of the coating the powder marked AMDRY 9624 (Ni22Cr10Al1Y) was used with a range of powder particles granulation of 11 to 37 µm, [6]. Before the process of depositing the substrate surface is roughened by Al_2O_3 corundum particles with a size of 0.7 to 1.5 mm. The coating was deposited with a thickness of 0.4 mm on a sample of stainless steel X15Cr13 (EN 1.4024). The material was used in soft annealed condition, 40x10x5 mm in size. The sample for the adhesion testing was prepared in the same way as for the hardness test, and the measuring was conducted on the cross section of the sample which prior to measuring was polished to a mirror shine. Measuring points were in the edge zone (A and C) with the highest content of residual stretching stresses and in the middle of the sample, zone (B) with the smallest proportion of the residual compression stresses. Indentation testing is based on the direct measuring of the length of radial cracks initiated by the Vickers indenter at the interface substrate/coating, as shown in Figure 2. The geometry of the imprint was of irregular shape with a crack initiated by the critical load at the substrate/coating boundary surface. The irregular shape of the imprint is due to the soft annealed condition of the substrate, which had hardness lower than the NiCrAlY coating.

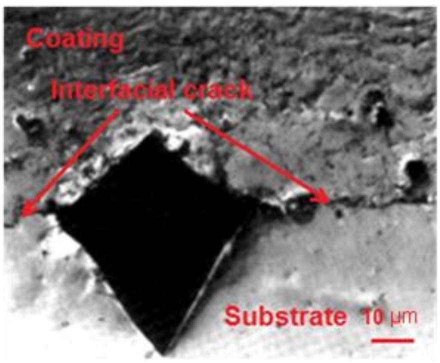

Figure 2. (BM) the geometry of the indentation with the crack at the interface initiated by the critical load

For obtaining reliable values six indentations in each zone of measurement were made, in order to reliably determine the mean length of a crack (C_C) and the mean value of the critical force (Fc). With the increase of the applied load (F) the depth of indentation and the length of the indentation half diagonal (a) increases. By gradually increasing the load, the diagonal of the indentation (a) at one point reaches a critical value initiating an intersurface crack. The crack is initiated from the corner of the indentation and extends along the interface, as shown in Fig.2. The ratio between the crack length

(c) and the applied load (F) is a straight line which represents the crack curve for a particular substrate and coating thickness, [7]. The measured crack length at the interface is used to calculate adhesion and interface toughness. The critical load of indentation (F_c) and the corresponding crack length (C_c) define adhesion and interface fracture toughness of the interface (K_{ca}) which is expressed by Equation 1, [7], [8].

$$K_{ca} = 0.015\left(\frac{E}{H}\right)_I^{1/2} \frac{F_c}{C_c^{3/2}} \qquad \text{(Eq 1)}$$

where $(E/H)_I^{1/2}$is the square root of the ratio of the modulus of elasticity and hardness at the interface. This ratio is expressed by Equation 2, [7].

$$\left(E/H\right)_I^{1/2} = \frac{\left(E_S/H_S\right)^{1/2}}{1+\left(H_S/H_C\right)^{1/2}} + \frac{\left(E_C/H_C\right)^{1/2}}{1+\left(H_C/H_S\right)^{1/2}} \qquad \text{(Eq 2)}$$

In the equation (E_I) is the Young's modulus, (H_I) is hardness and the indices (s) and (c) represent the substrate and the coating. The method of interfacial indentation of the diamond pyramid is reliable for assessing the adhesion strength of the coatings as it is independent of the thickness of the coating.

RESULTS AND DISCUSSION

In Table 1 shown are crack lengths (C_c) in the measuring zones, which hwere made at the interface by indenting with the diamond pyramid using different critical loads (Fc) with respect to the measuring location. Fracture cracks of a certain length that separate the coating from the substrate, extend horizontally along the interface. Figure 2 shows an example of a crack at the substrate/NiCrAlY coating interface in zone (B). The measured crack lengths were directly related to the stress state of the deposited layers in the measuring zones. The largest lengths of the cracks were measured in the edge zones (A) and (C) caused by the smallest load (Fc) as expected, since the edge zones are the sites with the highest content of residual stresses at the interface.

Table 1. The measured crack lengths (Cc) and the mean value of the critical load (Fc) and (Cc)

Measuring zone	**The length of the crack *Cc* [µm]**						***Fc* [N]**	***Cc* [µm]**
A	1460	1550	1390	1410	1290	1370	21	1411
B	1350	1410	1200	1280	1220	1310	49	1295
C	1530	1480	1520	1380	1510	1310	19	1455

According to the results shown in Table 1 we can see that the length of the crack (the binding of coating to substrate) varies significantly with the location of indentation along the cross-section of the sample. This variation of crack lengths is explained by the fact that the droplets of melted powder progressively and unevenly transfer heat to the substrate during plasma spray deposition; due to axial movement of the plasma gun from zone (A) to zone (C). Because of the edge effect in the process of deposition the molten particles input more heat into the edge zone of the coating. As a result of mismatch of thermal and mechanical properties of the substrate and the coating, in the buffer zone of the substrate/NiCrAlY coating there are residual stresses unevenly distributed along the interface. Shorter crack lengths formed with indenting with a higher indentation force (Fc) indicate that the coating in the center of the sample (zone B) has greater adhesive strength and interface toughness compared to the edge zones (A and C).

CONCLUSION

In this paper conducted was measuring of crack lengths and the critical load on the substrate/NiCrAlY coating interface using the Vickers method in order to evaluate adhesion and fracture toughness of the interface. On the basis of the measurements it can be determined that the Vickers method is very simple and reliable for assessing the quality of the bond between the substrate and the plasma spray coating. Due to an uneven distribution of stress caused by the different amounts of heat input during the deposition of powder and the difference in the coefficient of elasticity of the substrate and the coating, the highest strain and the lowest fracture toughness with the longest cracks has the interface in the edge zones of the sample. The obtained values of the study show good adhesion of the coating because at the interface substrate/coating in deposited state there are no observed defects, such as discontinuity of the deposited layers, voids, micro pores and contamination from the corundum.

ACKNOWLEDGEMENTS

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DEVELOPMENT OF TECHNOLOGY FOR PRODUCTION OF FLUX CORED WIRE IN SERBIA

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Abstract: Flux cored wire intensively is used in MIG, MAG, and TIG welding processes in the last decades. Flux cored wire in a design concept is the opposite of coated electrode. The designing of technology for production of flux-cored wires or similar selected types of fillers requires a high level of knowledge and applied technological solutions in industrial practice that would be optimal for the production capacity.
The industrial equipment, production of modern devices and constructions, also servicing, requires large consumption of different quality welding fillers, in Serbia. Serbia is a significant importer of welding fillers for the needs of most industrial branches, especially in the field of energy (thermal and hydroelectric power stations), mining (coal, non-ferrous metals, marble etc.), extractive and processing metallurgy (steel mills, extraction and processing of copper and precious metals), shipbuilding (nine shipyards), machine building, automotive and/or military industry.
At the Research and Development Centre, IHIS Techno-experts Ltd. Belgrade, designed was a production technology for welding fillers, equipped was a semi-industrial laboratory, designed and constructed were new semi-industrial technological lines and also purchased was part of the equipment for semi-industrial production with the support of the Ministry of Science of Serbia. Using this production equipment mastered were test products on the basis of a significant proportion of domestic raw materials of satisfying quality. Investigations provided at Research and Development Center – IHIS are related to the implementation and improvement of the technology of new metallurgical qualities of fillers and auxiliary materials.
Key words: flux-cored wire, arc welding, technology, flux cored wire

INTRODUCTION

Development of flux cored wire usually started with the examination of weldability, in this case it resulted in forming of a testing laboratory for further development of fillers. The term weldability, covers all requirements in terms of quality of welded joints, as well as the conditions under which it is possible to realize the designed quality of welded joints and the whole structure. Weldability is dependent almost equally on the base metal and filler material, but also on technological parameters applied during welding.
Exanimating weldability is always complex, so is studying the use of flux cored wire. During weldability assessment all processes which take place in the formation of welded joints (the melting and crystallization of the molten weld metal followed by phase transformations in the weld metal and heat affected zone), should be incorporated in obtaining good welded joints [1-5].
The development of welding fillers in the Research and Development Center IHIS was initiated during weldability tests on steels from the production program of Iron Works Smederevo, including the structural and micro-alloyed steels of a new generation. In order to substitute import and meet the basic needs of the domestic market for welding fillers, for a long time research activities have been directed towards the development of technology and mastering of experimental production of a large number of different quality welding fillers based on a significant share of domestic raw materials. The end result would be a new production facility in Serbia whose capacity should primarily meet domestic needs.

The first research activities designed to develop fillers were focused on the development of flux-cored wires for MIG/MAG and SAW welding processes, due to possession of domestic narrow steel strips as a basic raw material. Research in the field of developing fillers was continued through projects supported by the Ministry of Science of the Republic of Serbia [1-7].
As a result of work on research and development in the Research and Development Center, IHIS Techno-Experts Ltd. Belgrade, established and equipped was an Experimental laboratory that enables the development and production of new quality fillers and auxiliary materials for welding in the form of flux-cored wire and coated electrodes. The laboratory is also equipped, apart from welding equipment, with special technological equipment that enables activities in research and development of fillers and auxiliary materials for welding and their production as well.
The Experimental laboratory is equipped to a level that allows the realization of all the technological operations for producing flux-cored wire, coated electrodes and auxiliary materials for welding. Due to low capacity of the manufacturing equipment the laboratory can grow into a semi-industrial plant for production of alloyed high yield electrodes. Also, in the design of a high capacity plant for production of fillers the existing experimental equipment takes up the role of constant development of new quality of fillers.

DEVELOPMENT OF PRODUCTION TECHNOLOGY FOR FILLERS FOR ARC WELDING

The main objective is the development of technological stages of processing and related production equipment that will enable the successful production of a new quality of fillers such as flux-cored electrode wires and coated electrodes.
Fillers in the form of flux-cored wire are produced in a very large range of different metallurgic quality and according to the appearance of the cross section can be divided into classic and new generation, and according to use for the corresponding welding processes MIG/MAG and submerged arc welding process.
The designed technological process for the production of flux-cored wires of a new generation has changed and improved compared to the manufacture of classic flux-cored wire. The main difference is in the application of a steel strip twice as thick as that for classic flux-cored wire which requires changing the calibration system of the narrow strip to the formation of the flux-cored wire as well as the degree of deformation in the process of drawing to the final diameter [5]. The designed technological processes for production of flux-cored wire from a narrow steel strip are shown in the diagram, Figure 1.

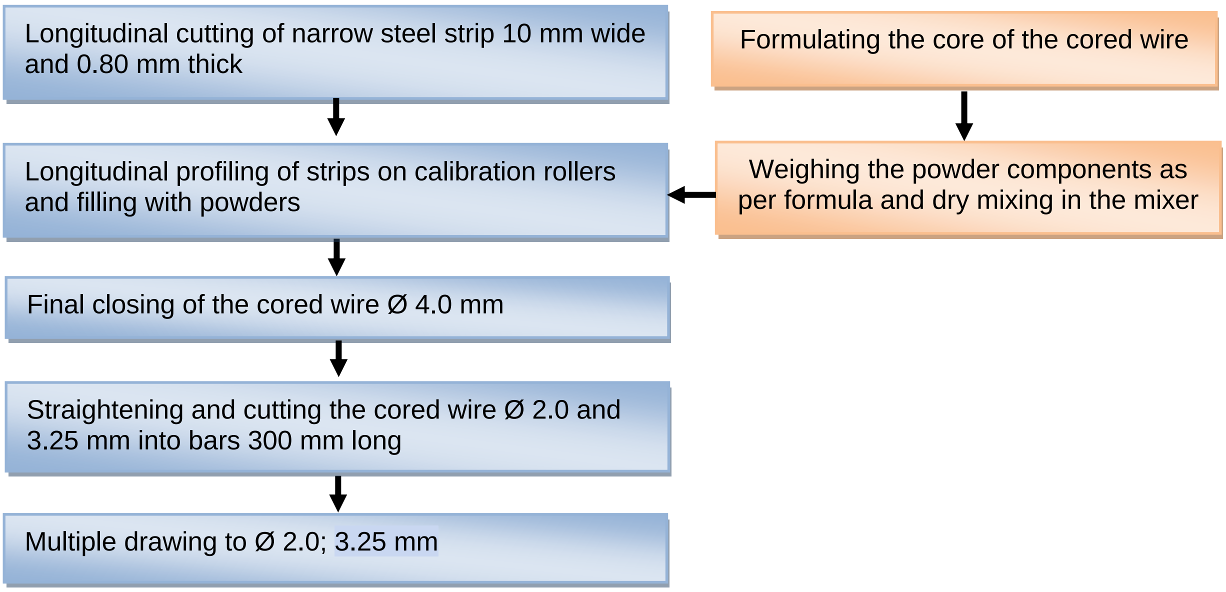

Figure 1. The technological schedule for production of flux-cored wires from narrow steel strip

During the development of the technology designed and made was a new continuous experimental line for calibration of narrow steel strip, filling with powder mixture and forming flux-cored wires.

The assembled production line is composed of three connected operational units of which the first consists of a system of calibrated rollers, which continuously extrude a longitudinally calibrated narrow steel strip 0.8-1.0 mm thick and 10 mm wide. The longitudinally calibrated strip has a grooved shape which in the second technological step, with a dozer, is uniformly charged with a powder mixture and continuously enters the final system of calibrated rollers for closing the strip ends and forming a flux-cored wire with an outside diameter of 3.8-4.0 mm. The formed flux-cored wire with a diameter of 3.8-4.0 mm is by plastic drawing processing reduced to the desired diameter, a minimum of 1.0 mm [1-4].

For successful implementation of the designed technological process it is necessary in addition to the production line for flux-cored wire to have the technological equipment for the preparation of powders (mill, vibrating sieve, dryer), equipment for weighing and mixing the components of the powders (scales, blender, grinder, W-mixer) and equipment for drying the components.

Flux-cored wires are manufactured in various diameters and are intended for welding and surfacing for the next applications:

• flux-cored wires of final diameter of 3.2; 3.0; 2.8; 2.6 mm are intended for submerged arc welding and surfacing (in a wide layer of 60 to 120 mm)

• flux-cored wires with a diameter of 1.2 to 1.6 mm are used for the MIG/MAG welding process.

Developed domestic technology and appropriate technological equipment are the result of a large number of technical and patent research solutions by the staff that provide simple and cost-effective solutions that are comparable to similar solutions that have emerged in developed industrial countries.

The experimental line, Figure 2a), for production of flux-cored wires allows from a narrow steel strip to produce flux-cored wire with a diameter of 3.8 mm and from which, with plastic processing get flux-cored wire with a minimum diameter of 1.2 mm [6-7].

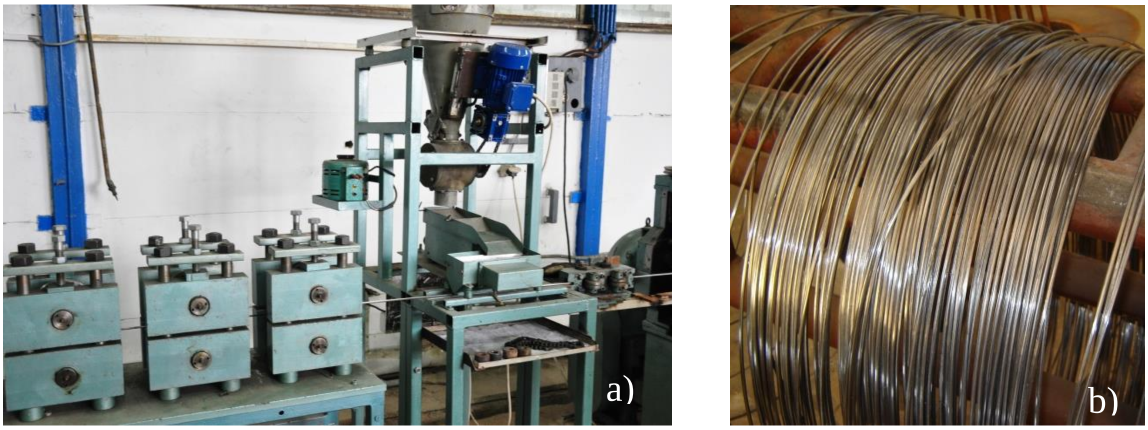

Figure 2. Device for calibration of steel strip and production of flux-cored wire a) and coil with drawn flux-cored wire b), (IHIS Techno-Experts Ltd. Belgrade)

RESULTS AND DISCUSSION

The technology was developed and production mastered for several metallurgical qualities of new flux-cored wires intended for SAW surfacing and MIG/MAG welding process.

For mastering technology and production of one of the qualities of flux-cored wire a steel strip thickness of 0.8 mm was obtained from the manufacturer U.S. STEEL, Serbia, and cutting to the required width of 10 mm was carried out in "Metalpromet", Gornji Milanovac. Marking and chemical composition of the steel strip are given in Table 1.

Table 1. Marking and chemical composition of the steel strip

Type of steel		***As per data***	***Chemical composition, %***				
JUS	DIN		C	Mn	P	S	Al
Č.0147	Q_{ST} 13	***Manufacturer catalogue***	0.10	0.45	0.03	0.03	0.02
		Tested	0.199	0.397	0.032	0.025	0.036

Analysis of the chemical composition of weld metal of the surfaced sample is given in Table 2.

Table 2. Chemical composition of weld metal made with produced flux-cored wire

Marking	*Chemical composition of weld metal, %*							
PPŽ-Ni1Mo	*C*	*Mn*	*Si*	*Ni*	*S*	*P*	*Mo*	*Cr*
	0.0908	*1.214*	*0.381*	*0.9231*	*0.0091*	*0.010*	*0.402*	*0.1265*

The obtained chemical composition results correspond, according to standard AWS A5.29. to the quality of flux-cored wire marked: E81T1-Ni1, E71T5-G designed for welding of steel for low temperatures, Table 3.

Table 3. Overview of flux-cored wires for MAG welding process according to AWS A5.29 standard

Marking AWC A5.29	*Chemical composition of weld metal, %*						*Field of use*
	C	**Mn**	**Si**	**Ni**	**S** (max.)	**P** (max.)	
E81T1-Ni1 Ar/CO_2	0.03-0.07	1.20-1.60	0.40-0.70	0.70-1.00	0.025	0.025	*All positions Steel for low temperatures*
E71T5-G Ar/CO_2,80/20 gas	0.05-0.09	1.00-1.40	0.30-0.60	0.70-1.00	0.015	0.020	

CONCLUSION

The laboratory for development of fillers and welding in the Research and Development Center is by the structure of the experimental equipment and the field of work unique in Serbia and represents an important basis for the development and introduction of new fillers and auxiliary welding materials into production.
The existing experimental laboratory, with the support of scientific and technical staff represents the technical and scientific core capable of performing technical and practical training of students and engineering staff in the field of plastic processing, technological manufacturing processes, fillers and conventional welding procedures [6-7].
The experimental equipment by capacity can be determined only for production of high yield, special high-alloyed fillers for welding and surfacing.
Also, in the case of designing a plant for industrial production of fillers, with the capacity design based on the needs of the Serbian market, the scientific and professional team is ready to transfer their technical knowledge and experience and offer know-how.

ACKNOWLEDGEMENTS

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BASELINES IN TECHNOLOGY OF OBTAINING THE NANOCRYSTALLINE TITANIUM-TIN-OXIDE CERAMICS

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Abstract: This work shows the initial results on the technology of obtaining the nanocrystalline titanium-tin-oxide (TTO) based ceramics for the use in the nonohmic devices, like nonlinear resistors whose electrical properties vary depending on the voltage, light, temperature, etc. The baselines of the solid-state synthesis of pure and 1 mol.% Nb_2O_5 doped $Ti_{0.8}Sn_{0.2}O_2$ solid-solution ceramics were presented, as well as the obtained ceramics structure and morphology characterization by the X-ray diffraction, scanning electron and electron dispersive spectroscopy techniques.
Key words: oxide ceramics, semiconductors, solid-state processing

INTRODUCTION

The polycrystalline metal-oxide ceramics as a protection against the high voltage in the electrical systems have been the subject of the scientific research for many years [1]. Zinc-oxide (ZnO) based ceramics are the most used and commercialized materials for this application, and their composition is usually very much complex: 98% is ZnO, and the rest are the additives such as Bi_2O_3, Sb_2O_3, Co_2O_3, MnO_2, Cr_2O_3, NiO and sometimes rare oxides like Pr_6O_{11} or Nd_2O_3. There are two types of shortcomings in these types of variable resistors (varistors): working mode breakdown and mechanical breakage. An unfavorable breakdown regime arises because of the local currents that can cause the heating, dissolution in the certain areas and an appearance of the holes in the varistor material. These drawbacks are probably caused by the nonhomogeneity of the obtained materials microstructure, which depends on its production technology, so it is of a crucial importance to optimize the synthesis method to obtain the material with the best possible properties. The induced stress and overheating processes lead to the cracking, mechanical breakage and in the end to the termination of the varistor function. Except for this basic system, a lot of attention has been paid to the investigation of other material systems as well, for example, ceramics based on tin-oxide (SnO_2), that have shown already the advantages and could successfully be applied instead of the ZnO based varistors if the existing problem of the poor SnO_2 sinterability could be solved. The solution to this lies in the appropriate mixing of SnO_2 with a number of different additives that would increase the SnO_2 sinterability. Investigation of the semiconductor ceramics based on the mixed tin-oxide and titanium-oxide SnO_2/TiO_2 system, i.e. $(Sn_xTi_{1-x})O_2$ solid-solution, is always an interesting and current topic of this type of the scientific research. The previous studies have shown that this material is applicable in both varistor [2] and sensor systems [3]. This system has promising properties that arise from the greater possibilities of forming different microstructures with appropriate grain sizes and grain boundaries, and with more chances for obtaining the highly dense and harder ceramic material [2]. The application of the mixed oxide matrix solves the problem of the poor SnO_2 densification and it is well-known that the sintered TiO_2 based ceramics reach the density of as much as 97% of the theoretical density. There are reports on the synthesis of Nb_2O_5 doped SnO_2/TiO_2 ceramics with the characteristics of a low-voltage varistor and a nonlinear coefficient of the current-voltage characteristics of about 9 [2]. Although the thermodynamic and kinetic properties of the SnO_2/TiO_2 solid solutions are generally known, some of the basics in their synthesis process, e.g. cooling and heating cycles, pressure effects, etc. are still not fully investigated. This mostly refers to the unknowns in the mass transfer mechanisms, the charge carrier, and the sintering mechanisms [2]. If it appears that the coefficient of the nonlinearity of this type of metal-oxide varistor is equivalent to the ZnO based varistors, and if its properties are the same or even better but achieved with the lower concentrations and number of additives, and at the lower sintering temperature, this would mean a significant progress in this field. The greater homogeneity of the obtained microstructure would bring a renewed and greater interest in such a varistor system and its industrial applications. In this paper, we synthesized the titanium-tin-oxide ceramics for varistor applications by a new solid-state method procedure, which is designed with the intention of achieving the better cost-effectiveness, primarily by lowering the temperature of sintering and by using a small number of the basic components. The preliminary electrical characterization of the obtained TTI ceramics showed promising features.

MATERIAL AND METHODS

TTO ceramic samples were prepared via a traditional solid-state method starting from the commercial powders of rutile SnO_2 (Sigma-Aldrich; ~325 mesh powder; purity 99.9% trace metals basis) and anatase TiO_2 (Sigma-Aldrich; purity 99.7% trace metals basis). The Nb_2O_5 (Alfa Aesar; purity 99.9% metal basis) was the source of the dopant ions. The stoichiometrical amount of the starting precursors were mixed to achieve $Ti_{0.8}Sn_{0.2}O_2$ composition and milled with zirconia media (Retsch GmbH PM100) in ethanol for 6h, and then calcinated at 800 °C for 2h with a heating rate of 10 °C/min in an alumina crucible. The treated powder mixture was then uniaxially pressed in 10 mm pallets under 500 MPa and sintered at 1280 °C for 2h with the same heating rate as employed during the pre-calcination step. The samples were marked as $Ti_{0.8}Sn_{0.2}O_2$ and $Ti_{0.8}Sn_{0.2}O_2{:}Nb^{5+}$, for the pure and Nb-doped TTO ceramics, respectively. The X-ray diffraction (XRD) was carried out using the Philips PW 1050 instrument, with Cu $K_{\alpha 1,2}$ radiation, and a step scan mode of 0.02°/s in angular range 2θ = 10–90°, which enabled good profile fitting using the PDXL software. The scanning electron microscope, SEM (JEOL JSM-6460LV) equipped with an energy-dispersive spectrometer (EDS) was used to investigate the morphology, microstructure and elemental concentration of the obtained ceramic samples.

RESULTS AND DISCUSSION

Phase composition

Fig. 1 shows the XRD patterns of the obtained ceramic samples. Rietveld refinement of the XRD patterns indicated that the main diffraction peaks could be indexed as tetragonal titanium-tin-oxide (ICSD#01-070-4404) solid-solution phase, $Ti_{0.8}Sn_{0.2}O_2$. The occurrence of the two peaks that belong to the rutile TiO_2 phase (marked with an asterisk in Fig. 1a) is probably an indication of the beginning of the spinodal decomposition (phase separation) process in the $Ti_{0.8}Sn_{0.2}O_2$ sample. The spinodal decomposition occurs upon cooling a perfect SnO_2-TiO_2 solid-solution from high temperatures and results in the formation of a modulated spinodal SnO_2-TiO_2 structure that consists of finely divided lamellas (alternatively rich in Sn and Ti) within each of the polycrystalline grains [4]. It seems that this phenomenon does not affect the $Ti_{0.8}Sn_{0.2}O_2{:}Nb^{5+}$ sample (Fig. 1b), most likely as a result of the impact that Nb-cation excess have on the $Ti_{0.8}Sn_{0.2}O_2$ matrix. The XRD profile analysis using the Halder-Wagner (H-W) and Williamson-Hall (W-H) methods [5] gave the crystallite size and lattice microstrain. The obtained values are shown in Table 1 and confirmed the TTO ceramics nano-crystallinity. The crystallite size and lattice microstrain values are higher for the Nb-doped sample compared to the matrix sample. Small additions of Nb_2O_5 to SnO_2/TiO_2 lattice should lead to the substitution of the matrix cations by Nb^{5+}, which promotes the sinterability through defect increase and should enhance the electron mobility [2]. In this process, probably more Nb^{5+} replaces the Ti^{4+} because Nb^{5+} ion exhibits the larger solid-solubility in TiO_2 and has a bigger mismatch with Sn^{4+} [6].

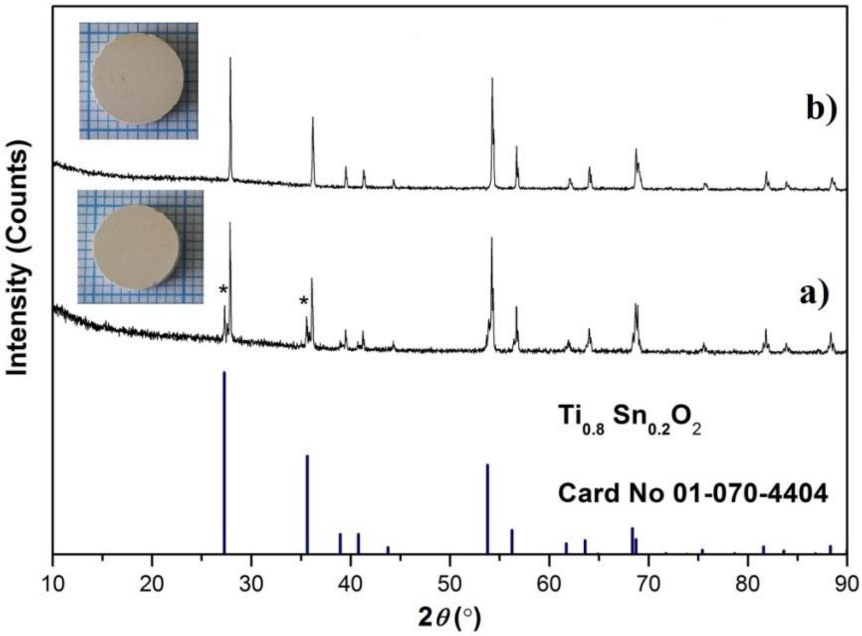

Figure 1. The XRD patterns of a) $Ti_{0.8}Sn_{0.2}O_2$ and b) $Ti_{0.8}Sn_{0.2}O_2$:Nb^{5+} ceramic samples. The insets (upper-left corners) represent the obtained ceramic pallets photos.

Table 1. Structure parameters obtained by H-W and W-H methods from XRD data.

Composition	**H-W method**		**W-H method**	
	Crystallite size (nm)	**Strain (%)**	**Crystallite size (nm)**	**Strain (%)**
$Ti_{0.8}Sn_{0.2}O_2$	99.1	0.08	169.5	0.09
$Ti_{0.8}Sn_{0.2}O_2$:Nb^{5+}	113.6	0.80	206.7	0.08

Microstructure and elemental composition

The SEM micrographs of the obtained ceramic samples and their elemental composition from the EDS analysis are shown in Fig. 2 and Table 2, respectively.

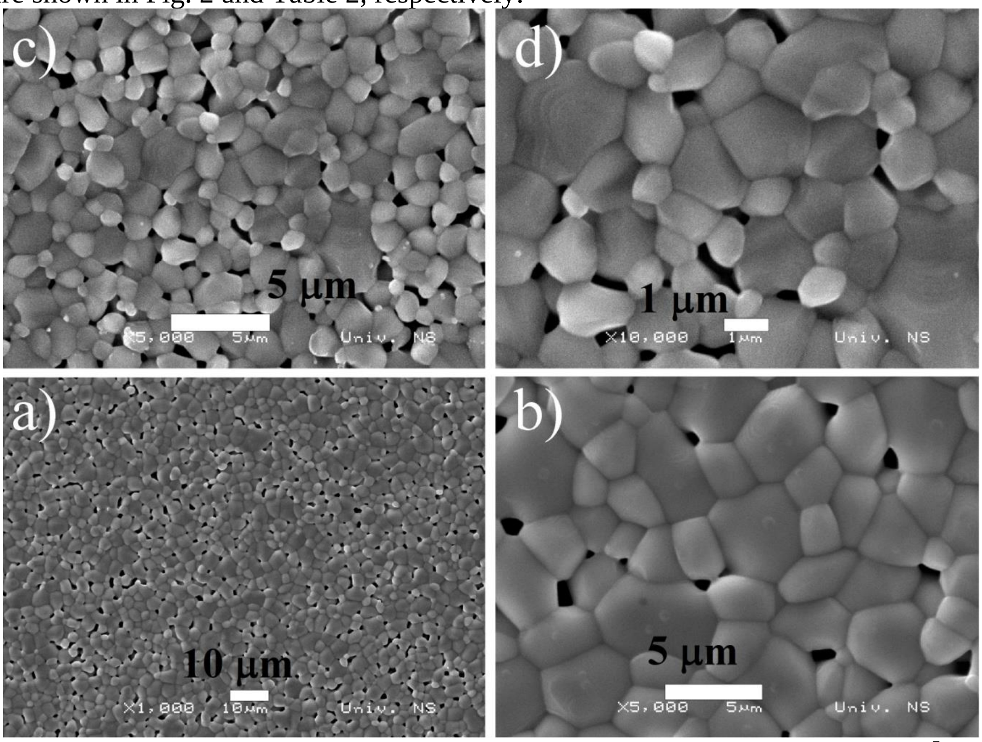

Figure 2. The SEM images of the obtained a)-b) $Ti_{0.8}Sn_{0.2}O_2$, and c)-d) $Ti_{0.8}Sn_{0.2}O_2$:Nb^{5+} ceramics.

The microstructure of the Nb-doped sample (Fig. 2c and Fig. 2d) characterizes in the smaller matrix grains. Table 2 shows the weight percentage of the elements present in the TTO ceramics. The EDS measurements confirm the incorporation of Nb ions into the $Ti_{0.8}Sn_{0.2}O_2$ lattice since the characteristic peaks corresponding to Nb are identified (Fig. 3) in the $Ti_{0.8}Sn_{0.2}O_2:Nb^{5+}$ sample.

Table 2. EDS elemental composition (weight %) for TTO ceramic samples.

Composition	O	Ti	Sn	Nb
$Ti_{0.8}Sn_{0.2}O_2$	35.67	34.38	29.96	00.00
$Ti_{0.8}Sn_{0.2}O_2:Nb^{5+}$	45.75	28.25	24.38	1.62

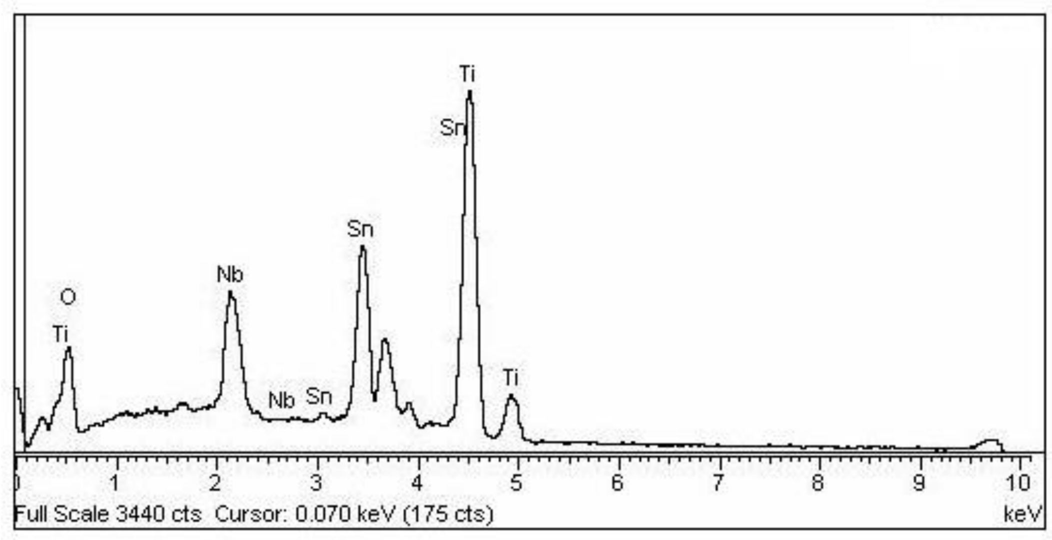

Figure 3. The EDS spectrum of the $Ti_{0.8}Sn_{0.2}O_2:Nb^{5+}$ ceramic sample.

CONCLUSION

The metal-oxide varistors are produced today in the various shapes and sizes for the use of in different electrical appliances. Today, the production efficiency is also important, so it is necessary to take into account the cost-effectiveness of the whole synthesis technology by selecting a small number of the basic components of the varistor system, achieving good properties of the material at the lower temperatures of the synthesis, and similar. This paper reports the baselines in the technology of obtaining the nanocrystalline single-phase rutile $Ti_{0.8}Sn_{0.2}O_2$ solid-solution ceramics by a new solid-state procedure with a success of lowering the temperature of sintering from the common 1450 °C to1280 °C.

ACKNOWLEDGMENT

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POSSIBILITIES OF GUIDING THE MECHANICAL CHARACTERISTICS ACCORDING TO THE TECHNOLOGICAL PARAMETERS IN SEMISOLID MATERIALS PROCESSING

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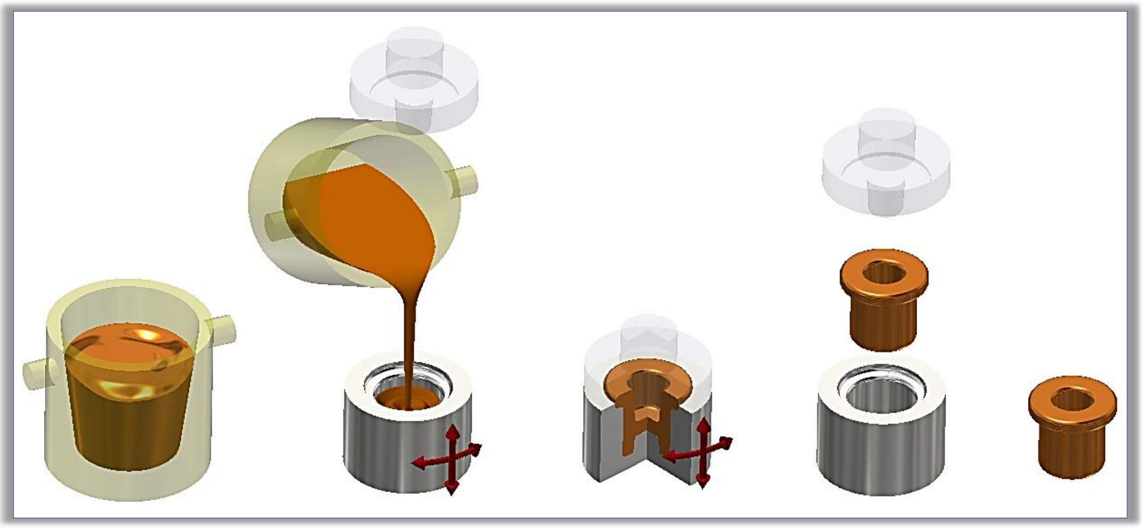
Abstract: A relative new method within the forming technologies that fulfill these aims is the processing of the semisolid materials. The basic principle of processing in semisolid state is to produce parts within the solidification range of the alloy. Within this range, a part of the material is already liquid, while other parts are totally solid. The paper shows some particularities of the processing in semisolid state of the metallic materials, points out the advantages of using this process for producing the parts and suggests a methodology for settling the technological parameters of the process for which the mechanical characteristics of the produced parts have the desired values. By using this methodology, control diagrams can be achieved in order to have a completely control on the process. Based on the experiments, the mechanical characteristics of the die forging parts are to be determined depending on the technological parameters that influence the process.
Key words: semisolid processing, qualitative characteristics, control

INTRODUCTION

The aim of the metallurgic and metallic materials processing industry consists in developing and reaching of some new materials, with improved properties and performances, low costs and finding of some new processing methods, mixed or non–conventional, to allowed producing of some parts having high mechanical characteristics at a low price.
A relative new method within the forming technologies that fulfill these aims is the processing of the semisolid materials. The basic principle of processing in semisolid state is to produce parts within the solidification range of the alloy. Within this range, a part of the material is already liquid, while other parts are totally solid. In order to have a thixotropic behavior, the solid phase has to be made of spherical (globular) particles covered in liquid phase. This special microstructure can be reached by a certain stirring (mechanic or electromagnetic) during casting of the raw material bars [1].
The semisolid state processing as know, generally, two–development route: Thixo–forming route and Rheo–casting route [3, 4].
Thixo–forming is the general used term for described of the obtained process of the final parts from the semisolid state materials, with a help of the metallic dies/forms and the top die. If the part is obtained in a metallic closed form, the method is called thixo–casting, and if the part is obtained in an open die, is called thixo–forging. The Rheo–casting is other route for development of the semisolid processing in the semisolid state. It is used, still from beginning of the researches like as the technology for obtaining of the material with non–dendrite microstructure for ulterior processing through thixo–forming. In 1996, is developed a new rheo–casting (NRC) process, which was patented by UBE Industries Ltd. In November 2000, the authors H. Kaufmann, M. Nakamura, H. Wabussey and P. J. Uggowitzer mention this new method in the Diecasting World magazine [2].
Another variant of the rheo–casting process (*NRC–new*) is presented in [3]. This variant (*NRC–new*) involves the following stages: elaboration of alloy, alimentation of the mould with alloy and the mechanical agitation through vibrations and the forming in presence of the vibrations. Figure 1 presents a scheme of this variant, where the processing stages are pointed out. With red arrows is symbolized the mechanical agitation of the material and the die.
The processing of the metals and metallic alloys in semisolid state offers many advantages as comparing to the conventional processing methods (casting in liquid state and forging, die–forging, stamping in solid state), advantages that come out of the behavior and characteristics of the materials in semisolid state. So, due to the heat content, lower than that of the liquid metal, high processing speeds can be applied, the wear of the deformation tools being lower.



a) b) c) d) e)

Figure 1. The scheme of the *NRC–new* method:
a) alloy elaboration, b) alimentation of the mould with alloy and the mechanical agitation through vibrations; c) forming in presence of the vibrations; d) extraction and e) finite part

The presence of the solid during the filling of the die and the controllable viscosity, that is higher than that of the liquid metals, makes possible to reach parts with low blister cavities, with low macro and micro–segregation and with a fine micro–granulation structure. The gas captation is also low, and the parts have an excellent surface quality. The materials in semisolid state have lower flow resistance than the material in solid state, which is why parts having complicated configuration and thin walls can be produced. The energetic consumption is lowered by approx. 35–40% as comparing to the conventional processing methods because of the heating at temperatures within the liquidus range and of the low deformation strains.

PROBLEM FORMULATION

Technologically, within the *NRC–new* process can be obtained parts having the desired mechanical characteristics, by proper choosing the technological parameters that influence the process.
In order to achieve that, it is the aim to set a methodology for determines the values of the technological parameters of the *NRC–new* process, for which the mechanical characteristics of the material used in order to produce the die–forged parts have desired values.
Beginning from the experimental results, within a first stage, the mathematical models regarding the dependence of the parameters that have to be optimized (mechanical characteristics of the material) on the influence technological parameters of the process are to be determined, under the form of some equations (1):

$$\begin{aligned} Rm &= f(p,\ Td,\ f,\ ....) \\ HBS &= f(p,\ Td,\ f,\ ....) \\ A &= f(p,\ Td,\ f,\ ....) \end{aligned} \tag{1}$$

The second stage within the optimizing activity is to reach the optimal coordinates within the multifactorial space. This means to determine the extreme values (maximal and minimal) of the parameter that has to be optimized and of the factors, for which the parameter that has to be optimized gets these values; because of this, the respective stage is called optimization.
Based on the experiments, the mechanical characteristics of the die forging parts are to be determined depending on the technological parameters that influence the process.
As parameters that have to be optimized, the following can be chosen:

≡ tensile strength, R_m [N/mm^2];
≡ Brinell hardness, HBS;
≡ elongation, A [%].

Taking into consideration the technological parameters that influence the *NRC–new* process in semisolid state [3], the factors that are taken into consideration can be the following:

≡ deforming pressure, p [bar];
≡ the temperature of the alloy under which the deforming pressure is applied, Td [°C] or the solid fraction, fs [–];
≡ vibration frequency (the frequency of the perturbatory strain), f [s^{-1}];
≡ die temperature, T_M [°C];
≡ period of time that the part is still kept inside the die after solidification, t_m [min].

In order to reduce the number of experiments and to simplify the optimizing calculation, we will chose the most significant parameters out of those above mentioned, i.e.: deforming pressure (p), the temperature of the alloy under which the deforming pressure is applied (Td) and the vibration frequency (f).
In papers [3], [4] and [5] are described the installation and the method of experimentation. Table 1 presents the variation levels of the technological parameters.

Table 1. The variation levels of the technological parameters

Parameter	**Level of variation**
Deforming pressure (p)	50
	100
	150
The temperature of the alloy under which the deforming pressure is applied (Td)	574
	577
	588
Vibration frequency (f)	500
	1500
	2500

THE ALGORITHM FOR DETERMINATION THE MATHEMATICAL MODEL

We consider the mathematical model as being a non–linear dependence that can be describe by the regression equation (2), where the variables x, y, z represent the technological parameters of influence (independent variables), function u is the parameter that has to be optimized (dependent variable) and $C_1,\ldots, C_{10}$ are the regression coefficients.

$$\begin{aligned} u\,(x, y, z) = C_1 \cdot x^2 + C_2 \cdot y^2 + C_3 \cdot z^2 + C_4 \cdot x \cdot y + C_5 \cdot y \cdot z + \\ + C_6 \cdot x \cdot z + C_7 \cdot x + C_8 \cdot y + C_9 \cdot z + C_{10} \end{aligned} \tag{2}$$

We also set the variation limits of the variables (x, y, z) and also the variation limits of the parameter that is to be optimized. The limits of the graphical representation ($limx_{inf}$, $limx_{sup}$, $limy_{inf}$, $limy_{sup}$, $limz_{inf}$, $limz_{sup}$) and the average values of the variables and those of the analyzed characteristic (x_{aver}, y_{aver}, z_{aver}, u_{aver}) are to be also settled.
The determination of the regression coefficients $C_1,\ldots,C_{10}$ is made by using a calculation program, written in MathCAD [6]. By using this program, the values of the correlation coefficient (rf) and those of the deviation from the regression surface (sf) can also be settled.
The optimal values of the independent variables (x_{opt}, y_{opt}, z_{opt}) for which the dependent variable *u* corresponds to an optimal value are to be determined.
The equation (2) represents the equation of a hyper surface and cannot be represented within the 4D space. That is why successively each independent variable (x, y or z) was replaced by its average value (x_{aver}, y_{aver} or z_{aver}), thus resulting some equations that can be graphical represented and that can be also interpreted by the technologists.

Thus, the regression surfaces described by the settled equations are graphically represented, and also the level lines of the same dependences. They can be used as diagrams in order to control the processing technology in semisolid state.

THE MATHEMATICAL MODEL FOR CONTROL OF THE Rm PARAMETER

The variation limits of the independent variables (p, Td, f) and those of the dependent value Rm, according to the table 2 and the following limits for graphical representation are taken into consideration:

- ≡ lim pi = 66,66
- ≡ lim ps = 133,33
- ≡ lim Tdi = 574,87
- ≡ lim Tds = 586,12
- ≡ lim fi = 700
- ≡ lim fs = 2300.

The average values and the deviations of the independent variables are shown in table 3.

Table 2. The variation limits of the variables

	min.	**max.**
p [bar]	50	150
Td [^{0}C]	573	588
f [s^{-1}]	500	2500
Rm [N/mm^2]	230.9	276.3

Table 3. The average values and the deviations of the independent values

	Average value	**Deviation**
p [bar]	100	40.825
Td [^{0}C]	579.33	6.3421
f [s^{-1}]	1500	816.5
Rm [N/mm^2]	254.2	10.265

Under these conditions, the equation of the regression hyperspace is described by the equation (3):

$$Rm = -0.00014 \cdot p^2 - 0.19811 \cdot Td^2 + 1.3e{-}006 \cdot f^2 + 0.010011 \cdot p \cdot Td - 0.000502 \cdot Td \cdot f + 0.00015733 \cdot f \cdot p - 6.0427 \cdot p + 230.3066 \cdot Td + 0.27256 \cdot f - 66643.0994 \quad (3)$$

The equation of the hyperspace was reached with a coefficient of correlation of rf = 0.79 and the deviation from the regression surface is sf = 6.30.

The optimal values of the independent values (p_{opt}, Td_{opt}, f_{opt}), for which the dependent variable corresponds to the maximal value Rm = 262.803 N/mm^2, are: p_{opt} = 100.0306 bar, Td_{opt} = 581.7869 °C and f_{opt} = 1566.39 s^{-1}.

For the average values of the independent variables (p_{aver}, Td_{aver}, f_{aver}) listed in table 4, the equations of the regression surfaces are:

$$Rm_{(pmed)} = -0.19811 \cdot Td^2 + 1.3e{-}006 \cdot f^2 - 0.00050 \cdot Td \cdot f + 231.3077 \cdot Td + 0.28829 \cdot f - 67248.77 \quad (4)$$

$$Rm_{(Tdmed)} = 1.3e{-}006 \cdot f^2 - 0.00014 \cdot p^2 + 0.0001573 \cdot f \cdot p - 0.018578 \cdot f - 0.243 \cdot p + 288.5769 \quad (5)$$

$$Rm_{(fmed)} = -0.00014 \cdot p^2 - 0.19811 \cdot Td^2 + 0.010011 \cdot p \cdot Td - 5.8067 \cdot p + 229.55 \cdot Td - 66231.34 \quad (6)$$

Figures 2, 3 and 4 show the graphical representations of the regression surfaces described by the equations (4), (5) and (6), and the representation of the level lines for the same dependences.

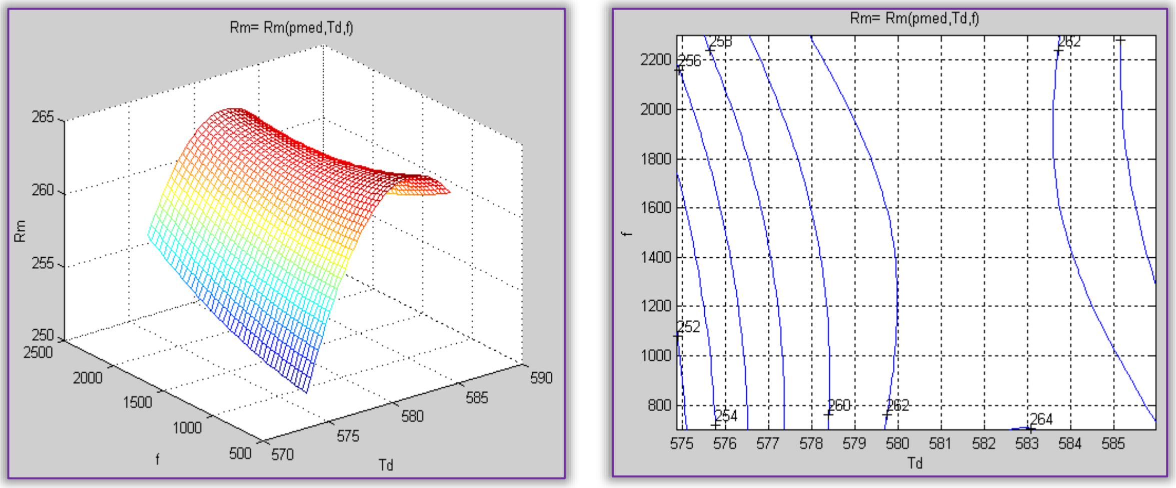


Figure 2. Representation of the regression surface Rm and the level lines of the Rm = Rm(Td,f) dependence for p = p_{med}

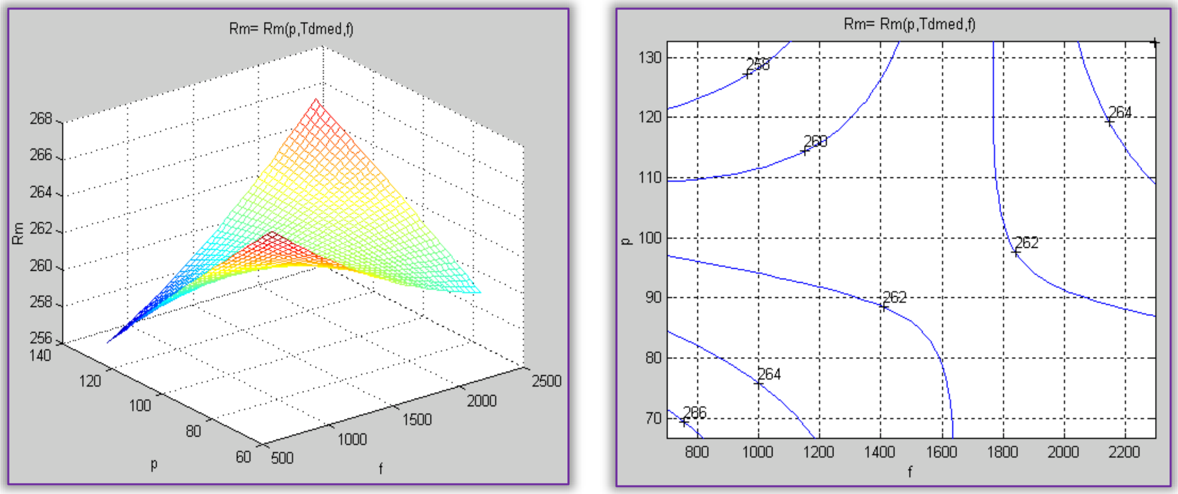


Figure 3. Representation of the regression surface Rm and the level lines of the Rm = Rm(p, f) dependence for Td = Td_{med}

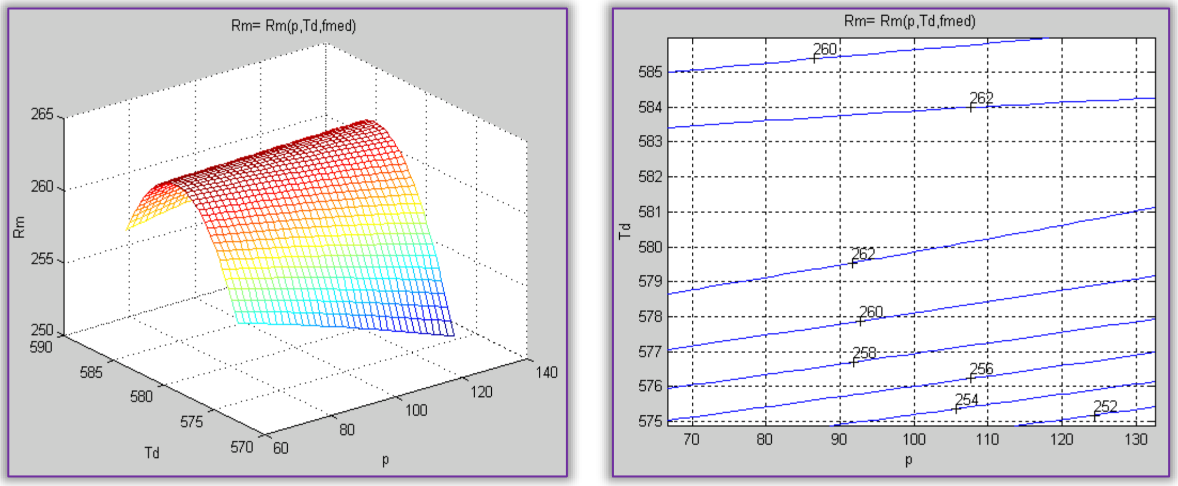


Figure 4. Representation of the regression surface Rm and the level lines of the Rm = Rm(p, Td) dependence for f = f_{med}

CONCLUSIONS

The diagrams represented in Figures 5, 6 and 7 can be used of set the technological parameters of the process for which the mechanical characteristics of the parts produced by *NRC–new* process have the desired values.

These diagrams were designed for average values of the parameters (for example, the diagram in Figure 5 shows the dependence Rm = Rm(Td,f) for the average value of the deforming pressure p = p_{med} = 100 bar), but by representing the diagrams for values of the parameters within the variation limits (i.e. deforming pressure p has values within the variation range: 50–150 bar), control diagrams can be obtained to have a completely control on the process.

For example, in order to produce a part out of an aluminum alloy (AlSi7Mg0.38) by using the installation described in [4], having the tensile strength of Rm = 260 N/mm^2, we have to proceed as follows: we choose the corresponding diagram, in this case we have chosen the diagram that presents the dependence Rm = Rm(Td,f) for p = p_{med} =100 bar. Then, we have two possibilities: we set the value of the variation frequency f within the variation range and then we set the by using the diagram, the corresponding value of the temperature Td, or we choose a value for the Td temperature and we set, by using the diagram, the vibration frequency f.

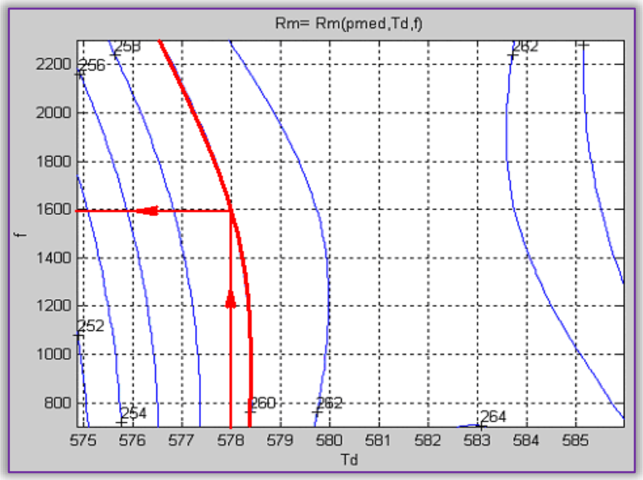


Figure 5. Example for choosing the technological parameters in order to achieve some given resistance characteristics

In the situation given in Figure 8, we have set the temperature value at Td = 578 °C, and the frequency resulted out of the diagram, corresponding to the line 260, is f = 1600 s^{-1}.

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DFMEA ANALYSIS OF HYDRAULIC MANUAL PUMP BODY STRUCTURE

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Abstract: The aim of this paper is to demonstrate the impact of the FMEA method application to the product quality improvement, in this case in the construction of a hydraulic hand pump. An inadequate product design process results in an inadequate process of designing the technological process, which leads to errors in the manufacturing process, increased number of changes, production and assembly delays, delays in delivery of products, and increase in the cost of production. DFMEA analysis was used as one of commonly the most used method for determining the occurrence of errors, the impact of these defects on the product and the corrective measures taken to eliminate them.
Key words: DFMEA analysis, product quality, hydraulic hand pump, construction

INTRODUCTION

In the conditions of a large supply of products and services on the market, there are increasing demands from customers to manufacturers and service providers. The goal of every company that wants to survive on the market, to be competitive and successful, is the fulfillment of the requirements of customers or users of products. The measure of customer's satisfaction is maintaining and improving the quality and reliability of the product.
By increasing the demands of the users, the requirements for increasing the quality of the product are also increasing. The questions raised here are: what potential mistakes can occur, what is the cause of these errors, and what are their consequences. When defects are defined, it is necessary to determine the corrective measures needed to bring the quality of the product to an acceptable level, because if errors are not eliminated, the unsatisfactory quality and discontent among users is going to appear.
In order to achieve a certain level of product quality, it is necessary to manage these quality. The challenge is to create quality and reliability in the early stages of product development. There are various methods and tools that can be used to achieve better results. One of the methods for quality management is the FMEA method - Analysis of potential errors and their effects on the product.
Errors can occur during product lifetime at any stage of product creation and use. Research has shown that most of the quality problems on products occur due to mistakes made in the phase of product and process development, and that only a small part of the problem occurs due to failures in the process of production, the process of controlling and exploitation. Therefore, product and process designers have the task to discover errors made at this stage of time and to remove or mitigate them using corrective measures.

MATERIAL AND METHODS

FMEA analysis

Analysis of possible errors and their consequences is one of the preventive quality management methods. It is well-known under the generally accepted abbreviated version FMEA, of the English name Failure Mode and Effect Analysis.
It is a method based on a systematic approach to analyzing the parameters of a single process and identifying weak spots - the risk of error occurrences is revealed. The potential error, the consequence of the error and the cause of the error, as well as the probability of errors and their impact are analyzed, even in the early stages of the development of the production process, which enables the earlier improvement of the quality level.
FMEA analysis was developed in the US military industry after World War II with aim to analyze the system during the early stages of its development. During the 1960s, the FMEA method began to be

used by the aeronautical and space industry, with emphasis on safety features. At the end of the 1970s, its application in the automotive industry (Ford Motor Company) began. In the 1980s, FMEA analysis became the tool for TQM (Total Quality Management), and the 90s Six Sigma (Six Sigma) tool. In February 1993, the AIAG -Automotive Industry Action Group and the American Society for Quality Control (ASQC) protected copyright for FMEA standards that were widely distributed in industry [3].
FMEA analysis includes the following activities [1]: identifying all potential product defects that may arise as a result of an error in the product or process design; determining possible causes of any potential error; the analysis of each pair a *possible error - a possible cause*, in order to determine the probability of a potential error occurrence, the possible consequences of the error on the product, the probability that the error can be detected in the production or control process; evaluation of the project risk factors; the impact factors RPN failure calculation and verifying the effects of corrective measures.
Three components are used for project risk factors calculation: error factor occurrence - O (*Occurrence*) - this estimation is proportional to the error occurrence probability, severity factor - S (*Severity*) - this estimation is proportional to the severity of the error, the factor probability of error detection - D (*Detection*) - this estimation is inversely proportional to the probability of error detection.
Risk factors are valued on a scale from1 to 10.
These three components multiplied give the RPN (Risk Priority Number) effect factor:

$$RPN = O \cdot S \cdot D \quad [1] \tag{1}$$

The calculated failure impact factor is compared with the predefined values of the failure critical impact factor. If the impact factor is less than the predetermined RPN value, the design solution of the product or process is considered satisfactory, and if the calculated failure factor is greater than the predetermined failure factor, then with the appropriate preventive or corrective measures in the product design solutions must be provided to put the cancellation impact factor into the prescribed values.
Corrective measures can be implemented in the area of product design, project design or a solution in the control and testing process. They must be clearly defined, as deadlines for implementation also. After the implementation of the corrective measures, an assessment of their effect is carried out.
According to the subject of the analysis, FMEA is divided into: FMEA project - DFMEA and FMEA process - PFMEA.
DFMEA is product-oriented. Its goal is to identify potential weak points in the product design (construction) through the analytical product design review (which could be the cause of product non-compliance, which will be manifested by users).
DFMEA analyzes the product design before its realization in production, always starts in the early stages of design and its focus is on the product function and must be completed before the end of the production process.
When a FMEA analysis team is formed, a further flow of analysis activities can be divided into the following phases [4]: preparation for analysis, project analysis, the current situation assessment, corrective measures, the effects of corrective measures assessment and documentation of the analysis.

Hydraulic hand pump series 40-506.900

Analyzed system - hydraulic hand pump series 40- 506.900 is pump for tilting the cab of the vehicle from production program of PPT Hydraulics AD. Hydraulic pump for tilting the cab on vehicles series 40-506.900 is a hand pump a piston type, with high pressure and small dimensions. It guarantees functional lifting and lowering the cabin. It is designed to work in the hydraulic system with one-way or two-way cylinder. Clips in the pump are completely protected from the effects of dirt and weather conditions. They have a built-in filter to protect sensitive throttle opening and valve from dirt. This ensures high reliability in operation. Pump parts are made of high quality materials with appropriate heat treatment and galvanic protection. They are manufactured in serial production with the examination of all pumps after assembling. They are installed on trucks KAMAZ - Russia's largest manufacturer of commercial vehicles [5].
The principle of operation of this pump is as follows [7]: a) Rotating the distribution shaft by the lever, is achieved communication for suppression the working fluid in line A or line B, b) Alternating axial

movement is achieved using the movement of the lever of the piston, and provides the suction or the suppression of the working fluid, c) Lifting the lever in the above part provides the piston raising, thereby creating an empty space below the piston, due to which the pellet raises the intake valve and the working fluid from the chamber of the tank via the suction sieve filled chamber below the piston and d) Moving the lever to the down and the piston moves downward and pushes the working fluid through the discharge valve into the chamber A. During this time the working fluid out of the chamber B, through the distribution shaft and a damper non-return valve, is returned to the tank.

Figure 1. Hydraulic hand pump series 40-506.900

Hand pump for lifting and lowering the cabin should be installed in the vehicle at the access site. It needs to handle and lever is easily accessible and to facilitate their installation in positions that allow the raising and lowering of the vehicle cab. The mode of operation of the hand pump is shown in the following figure.

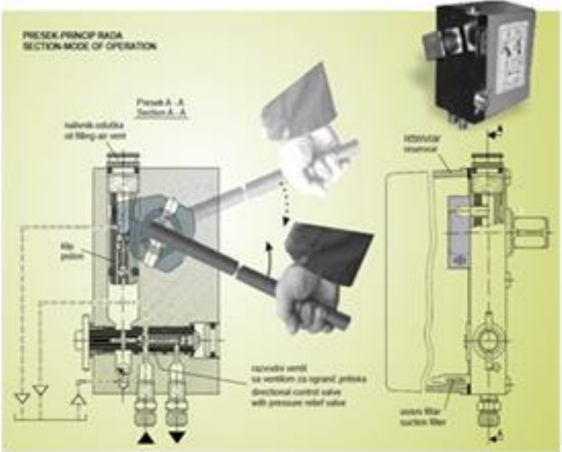

Figure 2. Section-mode of operation of the hand pump [6]

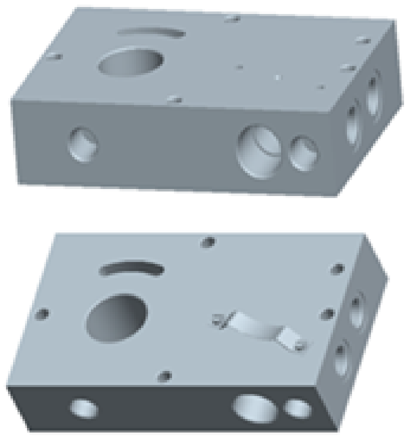

Figure 3. Hand pump body and sub-assembly

Constructional structure of the hand pumps 40-506.900-K1 consists of five sub-assemblies: plate 40-506.902, body 40-506.905, meter 40-506.920, piston 40-506.924 and vent 40-510.530.The functions of these subassemblies in the device are as follows [8]:

- plate 40-506.902– guarantees transmission of torque from the crank to the working piston,
- body 40-506.905 – accepts seal between the body and the reservoir within the function without leaks
- meter 40-506.920 – to check the oil level in the tank for proper operation of the device
- piston 40-506.924 – to convert mechanical force into hydraulic and
- vent 40-510.530 – allows air flow into and out of the tank.

In the subassembly, the body 40-506.905 enters the following positions and their function within the device is as follows: *the body of the pump 40-506.913* - allows the function of the device, *spring plate 40-504.441* - allows the stable operation of the non-return valve and the M3x4 screw SRPS M.B1.103 6.8 FeZn5c.

RESULTS AND DISCUSSION

DFMEA analysis, for all angles on the body of the pump, was carried out on the 40-506.900 hydraulic manual pump and this analysis was done on the documentation forms of company PPT Hydraulics for DFMEA, according to the rules and instructions for the development of the DFMEA analysis**.**
Since that each component of a product exists and functions within a sub-assembly, the assembly or the device itself, potential errors on each component can lead to a failure of complete product function or to performance degradation and, consequently, to customer dissatisfaction**.**
The body of hydraulic hand pump, series from 40-506.900, as the most complex element of the manual hydraulic pump for tilting the cab on motor vehicles, has the most extensive DFMEA analysis. This analysis covers all angles: those that do not have any influence on the pump function, those whose change affects the operation of the pump so it maintains its function, but with a reduced level of performance and those whose change influences in such a way that the pump loses its function.
The calculation of the impact factor of the failure, RPN, helps to determine the most critical angles. Those are the angles in which RPN > 50 and in which case corrective measures are prescribed and implemented, and then the evaluation of those corrective measures is made and all that is documented in the analysis.
The complete DFMEA analysis takes 21 sides, and in this paper only a few characteristic examples of angles with different effects on the pump function, are presented.
Angles that do not have any influence on the pump function are, for example, the letters A and B that are imprinted on the body of the pump. Even greater deviations in the position of these angles would not jeopardize the function.
The most important angles, that affect the operation of the pump, are:

- ø20H8 on the length of 31^{-1} - on that part a cuff on a piston is moving on, which makes the oil is sucked;
- ø16H8 at a length of $62.5^{+0.1}$ - on that part, a displacement axle is moving, which movement achieves communication for the suppression of the oil that creates and raises the vehicle's cab;
- ø25F7- position where a lever is placed, whose launch causes the piston movement is achieved, and its movement allows the suction of the oil;
- ø1 - through this aperture the oil returns to the reservoir;
- ø2.5 (2x) at an intermittent distance of $20^{\pm 0.1}$ and a distance from the pump edge $27.5^{\pm 0.1}$, through these openings communication is achieved for oil suppression and it is important to match them on the pump body and the distribution shaft;
- $33^{-0.1}$ - the length of the gutter through which the movement of the piston is achieved, the movement of which allows the suction of the oil;
- $5.4^{\pm 0.05}$ and $16.8^{\pm 0.05}$ - the distances at which the guide is used as a limiter when the lever is rotated, which movement leads distribution axle to the required position for achieving communication for the suppression of the oil, that creates the lift and lowering of the vehicle cabin.

Even small deviations of these angles from the given measures can lead to the loss of pump function or occurence of reduced performance, so the leakage of oil, insufficient lifting of the cab or no lifting of the vehicle cabin, can occur.
After the DFMEA analysis, we come to the conclusion that the following changes in the construction must be carried out, in order to improve the product:

- $5.4^{\pm 0.05}$ and $16.8^{\pm 0.05}$ - the coordinate distances on which the chute is used, which serves as a limiter when the handle is turned;
- $62.5^{+0.1}$ - the co-ordinated length at which the distribution axis is rotated, which movement provides communication need for the suppression of oil;
- N8 - improved surface quality on the largest sides of the pump body;
- $2^{+0.5}$/30 ° and 1.8/15 ° - adjustable bevel at the position of the lever and the distribution shaft;
- ø25F7, ø18 $^{+0.4}$, M12x1.5, 0.5/45 ° and 0.5 - harmonized dimensions of the holes on the body of the pump and levers, terminals and screws.

orva oetoletka PPT HIDRAULIKA AD u restrukturiranju

MOGUĆI NEDOSTACI I ANALIZA EFEKATA (DFMEA - KONSTRUKCIJA)

Oznaka dokumenta: FH.R.Z4.73.10

Kamaz — Sistem

R.pumpa K1 — Podsistem — Broj FMEA:

Telo pumpe — Komponenta: 40-506.913 — Konstruktor: — Pripemio

Godina konstr./programa — Datum: — Datum (Orig.)

Sastav tima: — Datum (Rev.)

Stavka/ Opis	Potencijalna greška	Posledice potencijlne greške	O ce na	Klasifikacija	Potencijalni razlog nastanka greške	Kontrola postojeće konstrukcije (preventivna)	O ce na	Kontrola postojeće konstrukcije (otkrivanje)	O ce na	R. P. N.	Preporučena aktivnost	Odgovoran Datum završetka	Rezultati preduzetih aktivnosti: Preduzeta aktivnost	O ce na	O ce na	O ce na	R. P. N.
Dimenzija otvora ⌀1mm	Dimenzija veća od ⌀1mm	Nema većeg uticaja	2		Nema većeg uticaja	Upoređivanje dimenzija tela pumpe i opružnog lima	2	Testiranje na ugradnju	2	8							
	Dimenzija manja od ⌀1mm	Otežani protok ulja	7		Mala protočna površina	Upoređivanje dimenzija tela pumpe i opružnog lima	3	Testiranje na ugradnju i proračun protoka	2	42							
Rastojanje otvora 16,8±0,05mm	Rastojanje veće od 16,8±0,05mm	Loša komunikacija za potiskivanje radne tečnosti	8		Neodgovarajući položaj ručice i razvodne osovine	Provera standarda i upoređivanje sa dimenzijama razvodne osovine	4	Smanjivanje dimenzije i provera na ugradnju	3	96	Analiza i usklađivanje dimenzija tela pumpe i razvod. osovine		Korigovana kota i testiranje na ugradnju	4	4	3	48
	Rastojanje manje od 16,8±0,05mm	Loša komunikacija za potiskivanje radne tečnosti	8		Neodgovarajući položaj ručice i razvodne osovine	Provera standarda i upoređivanje sa dimenzijama razvodne osovine	4	Povećanje dimenzije i provera na ugradnju	3	96	Analiza i usklađivanje dimenzija tela pumpe i razvod. osovine		Korigovana kota i testiranje na ugradnju	4	4	3	48
Dimenzija otvora ⌀5H8	Dimenzija veća od ⌀5H8	Čivija ispada iz tela pumpe	8		Nedovoljan preklop čivije i otvora za ugradnju u telu pumpe	Provera standarda i upoređivanje sa dimenzijom čivije	4	Smanjivanje dimenzije i provera na ugradnju	2	64	Analiza i usklađivanje dimenzija otvora na telu pumpe i čivije		Korigovana kota i testiranje na ugradnju	4	4	2	32
	Dimenzija manja od ⌀5H8	Otežana montaža	6		Neusklađenost dimenzija čivije i tela pumpe	Provera standarda i upoređivanje sa dimenzijom čivije	3	Povećanje dimenzije i provera na ugradnju	2	36							
Skošenje 2+0,5/30°	Ugao veći od 30°	Oštećenje zaptivke - curenje ulja	7		Oštra ivica oštećuje zaptivku	Provera standarda i upoređivanje sa dimenzijom zaptivke i poluge	3	Smanjivanje dimenzije i provera na ugradnju	2	42							
	Ugao manji od 30°	Nema većeg uticaja	2		Nema većeg uticaja	Provera standarda i upoređivanje sa dimenzijom zaptivke i poluge	2	Testiranje na ugradnju	2	8							

CONCLUSION

In all projects there is a risk of various errors occurrence, from the design process to the exploitation of the product. Therefore, FMEA analysis is used, as an engineering tool for detecting potential errors that can lead to failure, even at an early stage of design. However, the FMEA analysis is very demanding, requires a lot of work, time and people, so the question arises: How useful is this analysis and is it cost-effective?

The main goal of every company is to create profits. The FMEA analysis is focused on delivering a quality product to customers and the financial impact of various potential problems under this analysis is not directly addressed, but it is known that production and assembly malfunctions due to errors lead to increased production costs and delivery delays. If the mistake goes to the customer, the costs of servicing are also increasing, and all these increased costs reduce profits.

Since there are four different pumps in the 40-506.900 series, in the end, a comparison of the construction documentation of the hydraulic hand pump 40-506.900-K1 was made, which was processed in this paper and one of the pumps for which the DFMEA analysis was not performed.

It is concluded that all the corners corrected in the DFMEA analysis at the early design stage, but during the construction process, were only corrected in the production process in the previous case, which caused a great number of changes to the design documentation, production halt, a certain number of finishes, assembly delays, all of which led to an increase in production costs. All of these errors, the consequences of these errors and unforeseen costs are avoided in the case of the hydraulic hand pump 40-506.900-K1, for which FMEA analysis was performed. This confirmed the positive impact of this analysis on the reduction of errors in design and process, if applied in the initial phases of the project.

It concludes that the FMEA analysis influences the reduction of errors in design and process, and consequently on cost reduction in the process of production and increasing the level of product quality, which was the goal of this work.

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STUDY ABOUT ACTIVE STRUCTURE

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Abstract: We propose a new idea of structure to prevent the increase of deformations as a result of the increase of the cutting process, and we believe that we do not need larger and stiffer structures, which would automatically lead to increased weight, consumption and cost, but rather a flexible structure, with no vibrations, which is not impossible to deform, and which deforms within the limits of its flexibility according to a predictable deformation rule.
Key words: structure, deformation, lathes, adaptive controls.

INTRODUCTION

We intend to provide a solution for the latest-generation equipment, which is especially characterized by increases installed power, and propose a new structure with a lower half-circle slide and an upper flat closing slide. This structure is considered to be of superior quality due to its advantages, such as: it takes up little space, chips are easily removed, it is quite simple to make, its main advantage being the fact that it allows for an optimum usage of the structure. Last but not least, it is possible to determine structure deformation using classical calculation methods. Although this may not appear to be a significant advantage, since there are quite precise calculation methods which can be used in almost all cases, such as the finite element method, the possibility to determine the deformations of the new structure through relatively simple classical calculations is extremely important because it is the only option where, by means of electronic calculation, after the deformation formula is established, we may obtain, in real and useful time, the size of the deformation in the cutting equipment section, or, using the derivation of the signal of a force transducer, we may even anticipate the evolution of the deformation, this being a first step in what we will hereafter refer to as "active structure" [1,3].
In our attempt to prevent the increase of deformations as a result of the increase of the cutting process, we believe that we do not need larger and stiffer structures, which would automatically lead to increased weight, consumption and cost, but rather a flexible structure, with no vibrations, which is not impossible to deform, and which deforms within the limits of its flexibility according to a predictable deformation rule. Thus, we may anticipate deformation, using electronic computers, which is extremely important, since anticipated deformation of numerical control equipment is relatively simple to calculate and sending corrections to operating elements in time so that the part will be machined with maximum precision [4].
For our proposed structure, we established calculation methods in order to obtain deformation values fast, we studied the distribution of loads on the structure as well as the distribution of pressure. The calculations were done using classical methods, and personal methods as well as demonstrations, and verifications were done using the finite element method.

THE STRUCTURE

The basic idea in the design of the new structure was to define a supporting structure for lathes with adaptive controls, which have, in addition to numerical controls, a copying system as well.
It is very important to be able to anticipate deformations for the new structure, and therefore the structure must include relatively simple geometric elements, for which calculation formulae are known, so that an expression of the deformation rule may be established for the entire structure [6].
This expression processed by an electronic computer may provide corrections to the shifting of the operating elements so that processing precision may be increased (fig.1).

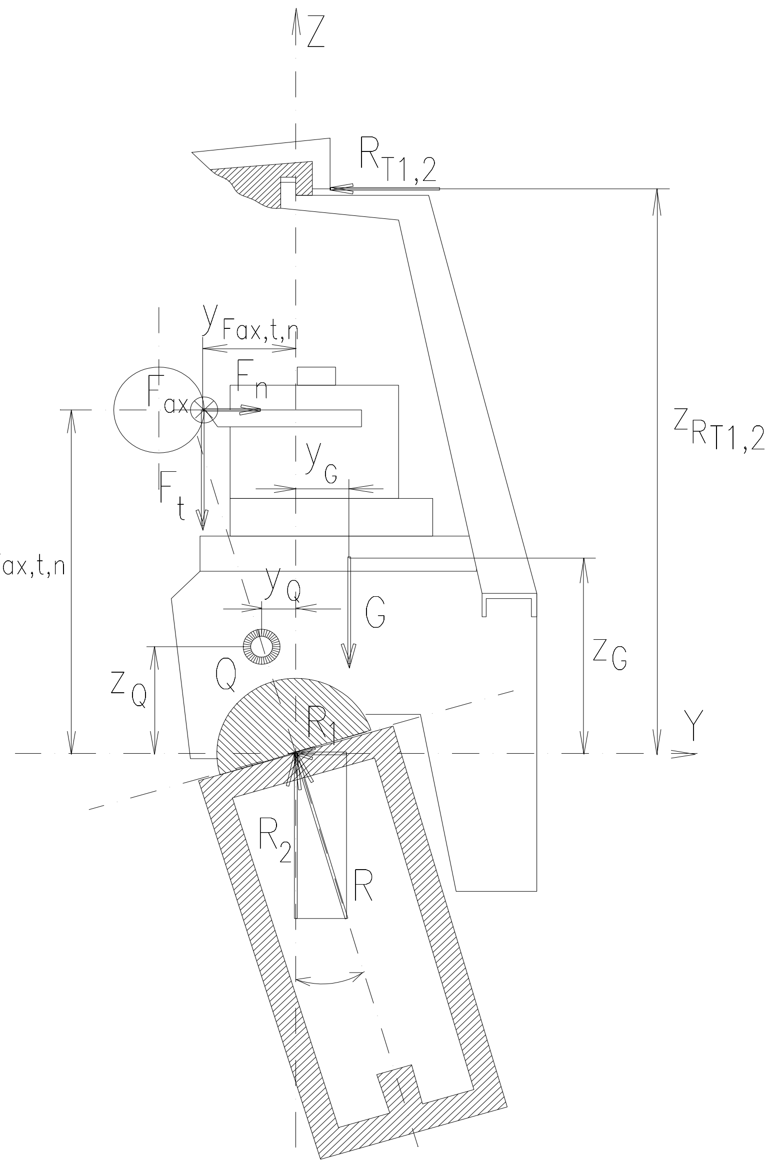

Figure 1. Corrections of active structure

The longitudinal slide rest is guided on a lower semicircular slide and an upper flat rolling slide, which ensures closing, meaning it prevents the feeder to rotate around its x axis. The two slides are connected by two arms joined to the longitudinal slide rest [2].
Major stress is supported by the lower structure, the upper closing bar being subject only to a simple bending.
The lower slide is supported by a longitudinal supporting structure joined to it, and which includes simple figures with characteristics that can be determined through formulae.

RESULTS AND DISCUSSION

The entire resistance structure practically consists of a rectangular pipe with uneven walls, reinforced by a vertical brace in its lower side and a half-circle in its upper side, on the surface of which the sliding is performed.
There are multiple advantages to such a structure, notably the simple shape, it is easy to make, it takes up little space, it is light, and therefore it is low-cost, the chips can be easily removed because of the half-circle shape, and the supporting capacity of the structure is used to the maximum.

The structure is positioned in an angle compared to the vertical axis, so that the composite force affecting the carriage passes through the rotation axis of the structure as often as possible, and therefore subject it mostly to simple bending.

CONCLUSION

Knowing the deformation evolution trend at all times, they can be compensated either by minute movements of the operating elements, or by an electro-mechanical system with dick springs and electromagnets which would generate minute movements in the upper flat rolling slide. The first option is preferable, due to the fact that it is simpler and stiffer.

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MULTIMEDIA LESSONS DESIGNED TO SUPPORT MATHEMATICS LEARNING

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Abstract: *Adobe Flash* development system can be a useful tool for teaching mathematics. This paper contains a partial description of multimedia lessons introduction in mathematics teaching created with *Adobe Flash* for learning the volume of a definite integral. We have used the advantage of animation as multimedia support to the abstract part of the curriculum, which we consider to be critical to understanding, as well as mathematical issues in which the movement helps reaching certain conclusions in an easier, visual way. The research included the first year students at the Faculty of Construction Management in Serbia, Belgrade city. The students were divided into two groups, one of which was taught through traditional teaching methods, and the other with the help of the aforementioned interactive multimedia animation. Positive results of the introduction of *Flash animation* in teaching mathematics, obtained in this study, emphasize the fact that they cause more successful learning, and derived goals present an impulse for teachers to use animations in everyday teaching.
Key words: interactive learning environments, media in education, multimedia/hypermedia systems.

INTRODUCTION

Multimedia programs that have been used in teaching process in recent years give us all sorts of new possibilities of teaching and learning: creating electronic student books with text, images, animations and films, etc. Multimedia also allows completely different organization of teaching and educational work, adaptable to abilities and interests of each student. Besides, learning with the help of multimedia is becoming increasingly important field of research dealing with teaching methodology. Numerous studies in mathematics have shown significant benefits of multimedia learning comparing to traditional one [1]. It turned out that the introduction of multimedia animations in the teaching of mathematics contributes to a higher level of understanding of the curriculum, motivation and students’ engagement [4], [10].
In literature, different software tools with different approaches to the issue of their use at different educational levels and with varying degrees of interactivity are emphasized among the multimedia applications used in mathematics teaching *Adobe Flash* [4], [18], [14], [15], *Scientific* [21], *Mathematica* [8], *GeoGebra* [23], *Geometers' Sketchpad* [20], *Autograph* [9], *Cabri* [6], *Aplusix* [7], etc. Among them is *Adobe Flash*, which is a very powerful graphics and animation tool developed in 1997. In addition to being used to create multimedia animation and applications for different purposes on the World Wide Web, it has proven itself to be very successful and illustrative in applications in mathematics teaching [5], [14], [15], [17], [18]. The advantage of this software, which we used to create multimedia lessons, is the possibility to choose their contents, as well as multimedia support to precisely those parts of curriculum which are crutial for understanding. *Adobe Flash-animations* stand out by the fact that every mathematical issue can be generated and explained “step by step”, with the emphasis on “the power of visualization”. On the other hand, visualization is critical for solving and understanding abstract mathematical issues [3].
All of this gives rise to the idea that an applicative software is created that presents a more up-to-date and interesting approach to teaching mathematics with the help of *Flash* in order to improve the quality of students' knowledge in the field of integrals. This research is only the continuation of the project (from the aforementioned mathematical area) that had already been conducted on fifty first year students of the Faculty of Architecture, whose results of learning with the help of Adobe *Flash* multimedia lessons were very good [18]. The aim of this paper is to further (compared to the previous

study) describe animations related to a certain integral, as well as to establish the significance of their impact in learning to acquire new knowledge of a hundred students in selected Faculty in the researched area, as well as the comparison of obtained results with the results from previous researches.

MATERIAL AND METHODS

Multimedia Presentation of Selected Examples and Problems of a Definite Integral

We opted for multimedia presentation of a definite integral, because of its important role and frequency in teaching mathematics in secondary schools and colleges. Also, we wanted the material that is most frequently, due to the lack of teaching time, based on abstract and theoretical methodological approaches, to be shown in a different way, through animation. In teaching practice, it has been also shown that students usually approach this material without the essential understanding of the notion of a definite integral, and its multiple applications in the real world and some other areas (for example in physics and geometry, on the examples of distance travelled, work done by a variable force, problems of areas and volumes, arc length of a curve, etc.). That is the reason we first wanted to introduce the concept of a definite integral and its definition in a different, visual way, and then to display the theorems and the application of a variety of definite integrals in multimedia lessons, etc.
The lessons on a definite integral are designed as a set of chapters which includes: introduction, chosen issues in physics and geometry, definition of a definite integral, integrability, basic characteristics of a definite integral, Newton-Leibniz formula, the application of a definite integral – calculating areas of certain shapes in a plane and the volume of some shapes in space.
In this work, we are going to show only some selected examples of multimedia units' illustrations of a definite integral.

Calculating the Volume of some Shapes in Space with Multimedia Presentation

If there is an axis Ox in a plane and a limited shape Φ, as in Fig.1. (illustration of the multimedia presentation shown to the students), that has the following characteristics:

(1) planes π_X are orthogonal to Ox axis and their intersections are plane shapes that have area while the shape Φ is positioned between planes π_a and π_b, $a < b$;

(2) the area of the intersection F_X of the shape Φ with the plane π_X equals $S(x)$, while $S(x)$ is a known continuous function of coordinate x.

Suppose, further, that we know the volume of a cylinder and we know that the cylinder, whose base has a surface area B and the height H, has the volume $V = B \cdot H$.
Let $\coprod = (x_0, x_1, ..., x_n)$, $a = x_0 < x_1 < ... < x_n = b$, be a devision of the slice $[a,b]$. Let us observe a "field" P_i of the shape Φ determined by planes $\pi_{x_{i-1}}$ and π_{x_i} and choose $\xi_i \in [x_{i-1}, x_i]$, $i = 1,2,...,n$ (part of the animation illustrated in Fig. 2/a). If there is the cylinder C_i whose bases are matching figure F_{ξ_i}, on which plane π_{ξ_i} intersects Φ, the bases belong to planes $\pi_{x_{i-1}}$ and π_{x_i}, and the generating lines to the bases are orthogonal to Ox axis (the intersection has been shown by the animation and illustrated in Fig. 2/b). The volume $V(C_i)$ of the cylinder equals to ($B = S(\xi_i), H = x_i - x_{i-1}$)

$V(C_i) = S(\xi_i)(x_i - x_{i-1})$, $i = 1,2,...,n$.

Let us get the sum $\sum_{i=1}^{n} S(\xi_i)(x_i - x_{i-1})$.

According to our intuitive notions of volume, we introduce the mark for the shape volume Φ, $V(\Phi)$. It is defined and equal to $V(\Phi)$ if for every $\xi > 0$ there is $\delta > 0$, that is such that for all divisions

Π for which $d(\Pi) < \delta$ and for every choice of points $\xi_i \in [x_{i-1}, x_i]$ there is $\left|\sum_{i=1}^{n} S(\xi_i)(x_i - x_{i-1}) - V(\Phi)\right| < \varepsilon.$

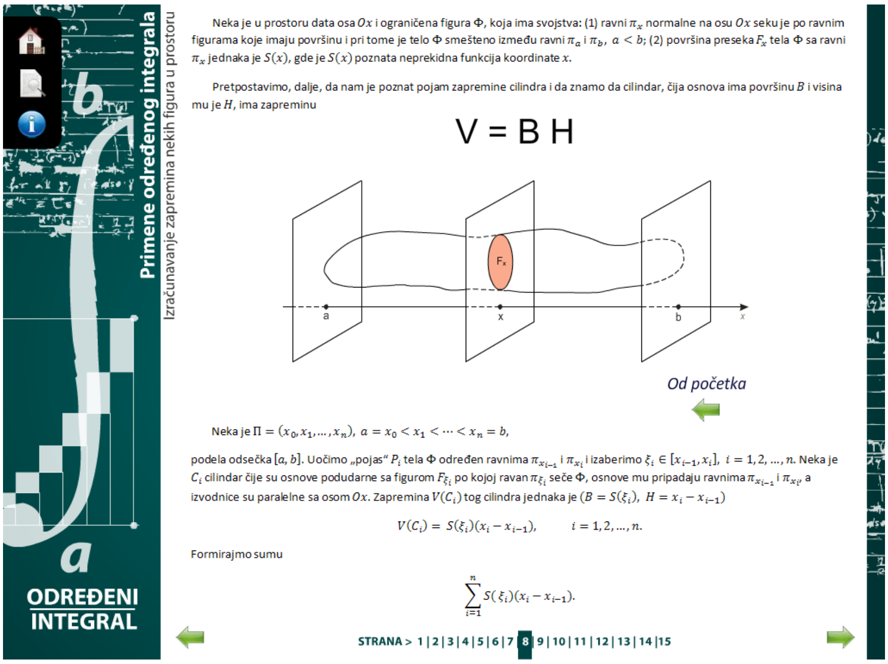


Figure 1. Part of the illustration of the multimedia presentation of the issue of calculating area through a defined integral

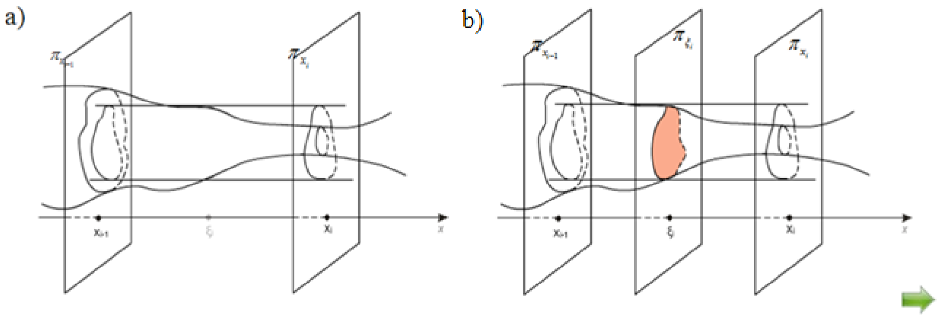
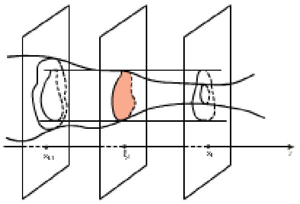


Figure 2. Multimedia illustration of the solution of calculating a rotating shape volume, step by step (1st part)

The observed sum is the integral sum for function $S(x)$ on the interval $[a,b]$ with the devision Π and the choice of points ξ. Due to the assumption that $S(x)$ is a continuous function on $[a,b]$, such a number $V(\Phi)$ exists and it is: $V(\Phi) = \int_a^b S(x)dx.$ From this formula, we can derive obviously known Cavalieri's principle. If two shapes can be put in such a position that the intersections of both shapes with any plane, parallel to a given plane present shapes of equal areas, then the two shapes have equal volumes.



$$V(C_i) = S(\xi i)(x_i - x_{i-1}), \quad i = 1, 2, \ldots, n.$$

$$\sum_{i=1}^{n} S(\xi i)(x_i - x_{i-1})$$

$$\left| \sum_{i=1}^{n} S(\xi i)(x_i - x_{i-1}) - V(\Phi) \right| < \varepsilon$$

Od početka

$$V(\Phi) = \int_a^b S(x)dx$$

Figure 3. Multimedia illustration of the solution of calculating a rotating shape volume, step by step (2nd part)

If now, in plane xOy there is a curvilinear trapezoid F, determined by the function graph $f(x), f(x) \geq 0, a \leq x \leq b$ (Fig. 4/a, initial part of the animation) and there is a shape Φ which is formed by rotation of trapezoid F around the axis Ox., we get a rotating shape for which the intersection area $S(x)$ with plane π_X is in fact the area of the circle of radius $f(x)$, (which is shown in Fig. 4/b and Fig. 4/v, through the illustration of the animation that clearly shows, through movement, the rotation of trapezoid around the axis, getting the rotating shape, as well as the intersection with the plane). Therefore, $S(x) = \pi(f(x))^2$, so that it is $V(\Phi) = \pi\int_a^b (f(x))^2 dx.$

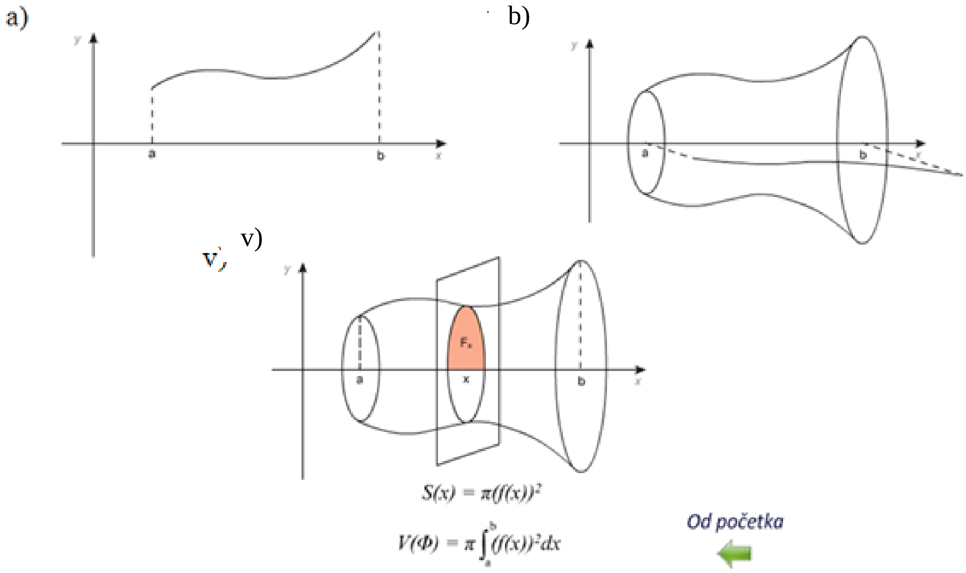


Figure 4. Multimedia illustration of the solution of calculating a rotating shape volume, step by step (3rd part)

Overview of the experiment

Under the influence of the aforementioned research and results, some of the issues of our research were as follows: Is there a difference in tests' results in the field of definite integrals between the first group of students that were taught by traditional teaching methods (control – *traditional group*) and the second one which was taught by multimedia units through *Flash* animations (experimental – *multimedia group*)? and If there is a difference, in which tasks is it more prominent?

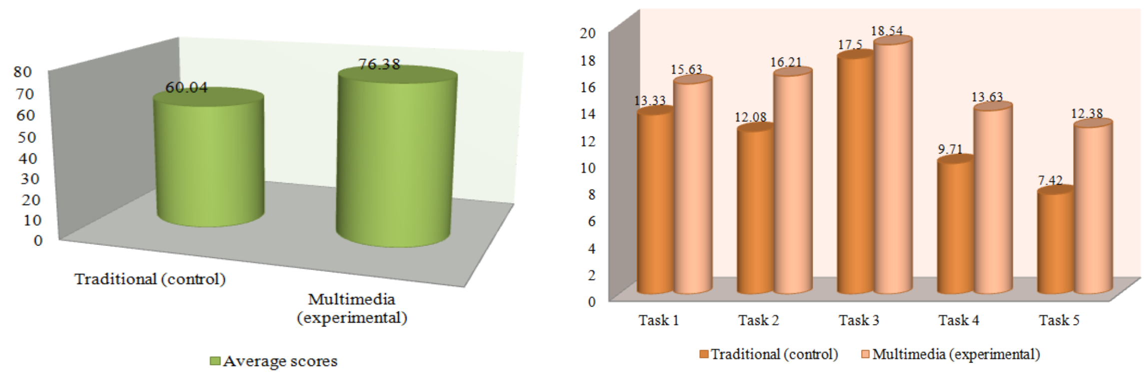
A total number of the first year participated in the study were fifty (50) at the Faculty of Construction Management, University Union "Nikola Tesla" in Belgrade, Serbia. Students were divided into two groups of twenty-five (25) which were named after the method of teaching applied in a group: Group I, control - traditional group (in which students were taught in the traditional way) and Group II, experimental - multimedia group (in which students were taught using multimedia, i.e. with the help of Adobe *Flash* animation). They were devided randomly, with approximately the same pre-knowledge acquired in the field of the definite integral, which had been determined by a pre-test. The pre-test contained exercises of already covered areas in regular classes on solving indefinite integrals, as well as exercises in the field of analytical geometry, the knowledge of which was necessary to calculate the area of shapes and volume of the body with definite integrals (for this test the exercises were mostly used from [13], [16].

Lectures from selected areas were identical in content material (whose only certain parts were described in the previous section), i.e. axioms, theorems, examples and excercises were totally identical in both the Group whose lectures were taught in a traditional manner and in the Group in which lectures were taught using multimedia. It is important to emphasize that the lecturer for both groups, traditional and multimedia, was the same as well as the number of given lectures. Selected material in multimedia Groups was shown with the help of a software package made in *Flash* (Adobe *Flash*, version 10.0).

After the lectures, students of both Groups took the same test of definite integral knowledge – calculating the volume.

Research results

The mean value of the points of a traditional Group of students was 60.04 with a standard deviation of 16.20, and for multimedia Group 76.38 with a standard deviation of 19.13 points. The results of t-test for two independent samples show that the multimedia Group of students has a significantly higher score on the test compared to the traditional one ($t = -3.193$, $p = 0.003$). The average scores of both Groups are presented in Fig. 5/a and individually by tasks in Fig. 5/b.



a) b)

Figure 5. a) Average scores for tests results b) Test results by tasks

DISCUSSION AND CONCLUSION

Based on results we can conclude that students in the multimedia Group of the Faculty of Construction Management solved the second, fourth and fifth excercises significantly better, while the average number of points at the first and third excercises was negligibly different in the two Groups. The conclusion of this analysis is that students were much more successful in solving problems in which visuality was essential for the understanding and calculation. These results confirm our assumption that by the use of computers in the definition of definite integrals and calculating the volume by their implementation, better results are achieved, because in addition to numerical approach to solving, visual approach (in our case through animations), offers much more, which is in line with the results of the research conducted by authors [8]. Our students said that animations helped them to understand and connect terms, previously considered to be abstract, in a better with specific volume calculations.

In the field of mathematics, *Adobe Flash* is often used in geometry due to its possibility of perceiving problems in space. For example, the use of animation and aforementioned teaching methodology proved to be very successful in the research, which encompassed 100 students from two faculties of Union Nikola Tesla University in Belgrade from Serbia to learn the field of Isometric transformations and Regular polyhedra [14], [17]. Furthermore, in Spain, at the University of Oviedo (Department of Structural Engineering) on a sample of 60 students, experimental teaching with the help of *Flash animation* for teaching descriptive geometry was performed [5]. Although most of the students who participated in the research (90% of them) considered that the traditional way of teaching as well as the role of a teacher in class were irreplaceable, most of them (81%) thought that animation should be included in the traditional classroom. That corresponds to our research. As advantages of the use of multimedia learning and *Flash -animation* they most often stated that they preferred the visual display of the issues, step by step, that it was interesting and that they kept their attention. Those were the most common responses from students in our research. These responses are, inter alia, in direct relation to the possibility of taking control of speed and choosing the moment of transition to the next step in solving the problem through animation. Most animation, as we have seen in our examples in the previous chapter, have "control buttons" that allow the user to stop, continue, go back to the beginning, go to the end, go one step forward and one step back. In this way, multimedia enables teacher to have control over the animation during lectures and adjust it to the students' needs, in terms of visualization, understanding, etc. During our multimedia lectures, there were the cases of students who complained that the display of animation was either too fast or too slow for them, which is in accordance with the principle of individual student ability [11], [12].

While some scientific studies examined the significance of the use of *Flash animation* in teaching exclusively, the aim of the others was to investigate the impact of using animation in general (of any kind), in teaching and learning natural sciences [2]. The results indicate that the use of animation causes better problem solving and understanding of scientific concepts. Results also show that students who were taught with the help of animation developed a greater motivation to learn natural science, in the sense of self-efficacy, interest and satisfaction, connection to everyday life, as compared to the control group students. We can conclude that animation provides a better understanding of learning materials in two ways. First, it allows you to create mental pictures of concepts, phenomena and processes. Second, it can be used as a substitute or help with some of the cognitive processes that some students are missing, such as abstraction, imagination, creativity, etc. Researchers, who analyze the importance of the use of animation among students, conclude that "more visualization" when learning leads to "better learning process." The research by author [19], by its conclusions, indicates that the best way to learn dynamic processes is by using computerized animation. Similar conclusions were reached by author [10], whose research results indicate that the use of animation and visualization contributes to more successful conceptual students' understanding. They cause more successful creation of the mental pictures of a given problem among students, i.e. its faster and more successful solving and objectives derived from these, and our research, serve as an impetus for teachers to use new technology in animation, which will be used in the classroom as much as possible.

Acknowledgments

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Session 2.

Environmental Protection Engineering and Occupational Safety

GLOBAL CLIMATE CHANGE – TRUTHS AND MYTHS

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Abstract: Carbon dioxide is believed to be the main cause of human-induced climate change because it has been emitted in vast quantities from the burning of fossil fuels and it is a very long-lived gas, which means it continues to affect the climate system during its long residence time in the atmosphere. However, fossil fuel combustion, industrial processes, agriculture, and forestry-related activities emit other chemical substances that also influence climate. Some gaseous emissions, such as nitrous oxide, are long-lived greenhouse gases like carbon dioxide, and so contribute to long-term climate change. Other substances have shorter atmospheric lifetimes because they are removed relatively quickly from the atmosphere.
The current information for global climate change points to global warming/climate change being influenced by the sum of many effects with no one effect (such as an anthropogenic effect) being only one part of a multi-component group.
Key words: climate, change, carbon dioxide, environment

INTRODUCTION

The most general definition of *climate change* is a change in the statistical properties of the climate system when considered over long periods of time, regardless of cause. In the current sense, especially in the context of environmental policy, the term *climate change* has unfortunately and incorrectly been predominantly associated with anthropogenic activities (human activities) as the causative factor without giving consideration to the other reasons that also contribute to climate change.
For example, slight variations in the orbit of the Earth orbit lead to changes in the seasonal distribution of sunlight reaching the Earth's surface and how it is distributed across the globe. There is very little change to the area-averaged annually averaged sunshine; but there can be strong changes in the geographical and seasonal distribution of sunshine. The three types of orbital variations are variations in eccentricity of the Earth, changes in the tilt angle of rotational axis of the Earth, and precession of axis. Combined together, these orbital variations produce cycles which have a large impact on climate and are notable for their correlation to glacial and interglacial periods. In fact, solar variability has had effects including in the period from 1645 to 1715AD, part of the Little Ice Age during the 15th and 17th Centuries (Figure 1) that was marked by relative cooling and greater glacier extent than the centuries before and afterward (Lamb, 1969; Eddy, 1976).
In addition, the possibility that the Earth suffered episodes of global glaciation as recently as the Neoproterozoic period (900 and 543 million years ago) has been discussed in terms of the variation of carbon dioxide in the atmosphere (Hoffman et al., 1998; Kennedy et al., 2001; Hoffman and Schrag, 2002; Pierrehumbert, 2004). Moreover, the cyclical nature of the energy output from the Sun is not yet fully understood but, with that in mind or in reality being ignored by the climate change doomsday aficionados, there are natural fluctuations in the cycle of warming and cooling that have little to do with anthropogenic sources (NIPCC, 2014a, 2014b).
The most significant climate processes since the Pliocene Epoch (3.6 to 5.5 million years ago) are the glacial and interglacial cycles. The present interglacial period (the Holocene) has lasted approximately 11,700 years. Global temperatures have been estimated to be 1 to 2^{o}C warmer than the present temperature, yet sea level was approximately 50 to 80 feet meters (165 to 265 feet) higher than current levels. It would seem that temperature is not a major determinant of the sea level and several variable factors are involved, of which carbon dioxide concentration in the atmosphere is not the major culprit (Tang and Gao, 1992; Tang, 1995; Tang and Gao, 1995; Stott et al., 2007) and which are not always considered by the global climate proponents.

INTERGLACIAL PERIODS

An interglacial period (alternatively an *inter-glacial period*) is a geological interval of warmer global average temperature lasting thousands of years that separates consecutive glacial periods (Figure 2). Each peak and valley of the sinusoid wave is subject to fluctuations in temperature that can cause variations in the behavior of the climate of the Earth. The beginning and termination of the glacial periods can cause major disruptions in the climate in which the termination of glaciation was responsible for the release of carbon dioxide into the atmosphere which leads to doubt on the accuracy of measurement of the concentration of carbon dioxide in ice cores (Kirschvink, 1992; Hoffman et al., 1998; Stephens and Keeling, 2000; Kennedy et al., 2001; Hoffman and Schrag, 2002;) within an Ice Age. In addition, snow and ice are viscoelastic materials (Jellinek and Brill, 1956; Shapiro et al., 1997; Camponovo and Schweizer, 2001; Kozin and Pogorelova, 2009; Bartelt et al., 2012) which means that they move and deform over time and are unstable. This throws doubt on the validity of the measurements of carbon dioxide in ice cores as an accurate method for determining the global warming effect.

The current Holocene interglacial period has persisted since the end of the Pleistocene, approximately 11,400 years ago. Furthermore, during the 2.5 million year span of the Pleistocene, numerous glaciation events, or significant advances of continental ice sheets in North America and Europe have occurred at intervals of approximately 40,000 to 100,000 years. These long glacial periods were separated by more temperate and shorter interglacial periods. Therefore, a reasonable question relates to the amount of carbon dioxide that is being emitted into the atmosphere, not by anthropogenic effects, but by Mother Earth herself as a result of deglaciation!

In the present interglacial period (the Holocene), the climatic optimum occurred during the Sub-boreal period (approximately 3000 BC to 500 BC) and Atlanticum period (approximately7000 BC to 3000 BC). The current climatic phase following this climatic optimum is still within the same interglacial (the Holocene). This warm period was followed by a gradual decline until about 2,000 years ago, with another warm period until the Little Ice Age(1250 to 1850 AD).The preceding interglacial optimum occurred during the Late Pleistocene Eemian Stage (130,000 to 115,000 years ago) during which time the sea level was approximately 25 to 30 feet higher than current levels and the water temperature of the North Seawas approximately 2°C (3.6^{o}F)higher than at present.

THE ROLE OF HUMAN ACTIVITY

The recent attention given to the greenhouse effect and global warming is based on the recorded increases in concentrations of some of the greenhouse gases due to human activity. Of particular interest are water vapor, carbon dioxide, methane, nitrous oxide, chlorofluorocarbons, and ozone. With the exception of chlorofluorocarbons, all of these gases occur naturally and are also produced by human activity.

Carbon dioxide (CO_2) is considered the most important human-influenced greenhouse gas. Scientific measurements reveal an unmistakable global increase in the amount of carbon dioxide, which arises primarily from the burning of fossil fuels (motorized vehicles, electric power plants, and homes heated with gas or oil) and the burning and clearing of forested land for agricultural purposes. But is carbon dioxide the real culprit for global climate change?

Taking carbon dioxide as the example, the common assumption in interpreting ice-core carbon dioxide records is that diffusion of carbon dioxide in the ice does not affect the concentration profile. However, this assumption has been tested recently and the solubility of carbon dioxide in the ice melt water leads to errors in the estimation of the carbon dioxide concentration in the ice core (Ahn et al., 2008). This finding throws considerable doubt not only on the origin of carbon dioxide in ice core sample but also (and especially) on the amount of carbon dioxide in various ice core samples. As a result, there must also be doubt about the subsequent interpretation of the analytical data relating ice core carbon dioxide as the sole culprit behind global climate change.

Detailed measurements on ice cores from Greenland and Antarctica show different mean concentrations of carbon dioxide for samples at the same gas age. Based on the present knowledge of the global carbon cycle, the high mean inter hemispheric difference of the carbon dioxide concentration between high northern and southern latitudes could be excluded. Diffusive mixing of the air negates short term variations of the atmospheric concentration of carbon dioxide (Anklin et al., 1995). It was concluded that the chemical production of carbon dioxide was the most probable cause of the elevated concentration of carbon dioxide in air bubbles. In addition, it was further suggested that the carbon dioxide concentration in the ice is affected by chemical reactions in the ice. This work throws doubt on the measurement of the carbon dioxide in the ice as it pertains to the carbon dioxide of the atmosphere and the global climate change (global warming) theory.

CONCLUSIONS

Climate change is inevitable. It is already happening as a result of the current interglacial period. Contributing to this change are (i) natural effects, which include the Earth in an interglacial period and (ii) anthropogenic effects, which include the release of non-indigenous gases into the atmospheres (Schneider and Mass, 1975).

Currently, in the context of climate change, there needs to be a lesser reliance on emotion and more reliance on hard accurate and reliably unbiased science (Nelson, 2014; Moore, 2015; Nelson, 2015; Porter, 2015; Ramsey, 2015; Taylor, 2015). On the other hand, publicly singling out specific researchers on any side of the discussion based on perspective they have expressed and implying a failure to appropriately disclose funding sources – and thereby questioning their scientific integrity – sends a very dangerous message to all researchers (Burnett, 2015a, 2015b). However, scientists can be their own worst enemies! To combat the emotion of the moment and future moments, it is necessary to gather opinions from independent, nongovernment organizations and scientists who are free of financial and political conflicts of interest – too often ideological or economic agendas limit the options (Porter, 2015; Smith, 2015). Climate change, whether man-made or not, is a global phenomenon but it must be recognized that anthropogenic causes are only one small part of a much wider climate hazard - the dangerous *natural* weather and climatic events that Mother Nature periodically invokes will always be present (NIPCC, 2014).

Climate change is more a natural hazard and arises as part of the evolution of the Earth and the idea that there can be a one-size-fits-all global solution to address future climate change fails to deal with the real and major issue of climate and climate-related issues. There should be planning (rather than responding to the panic-laden issue related to carbon dioxide) as to the means by which future generations will deal with the effects of an interglacial period on the Earth. There is a need to uphold the principles of fair-minded examination of the evidence and allow open debate (Thorner, 2014; NAS, 2015).

A point that seems to be forgotten (or ignored) in all of the climate-related debates and publications is that the earth is resilient to changes (Will, 2010) and also is currently in an inter-glacial period. As a result (surprise, surprise!) the temperature of the earth will increase. The actual extent of the temperature rise is unknown (who was around to measure the temperature increase during the last inter-glacial period?) but and will contribute to the overall temperature rise. Perhaps the scientists who ignore such a phenomenon are also guilty of misconduct.

Also, it is time to reduce heavy reliance on computer model predictions and go into the field to observe what is actually happening in the real world.

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CONTRIBUTION OF SERBIAN LOCAL SELF-GOVERNMENTS TOWARD ENVIRONMENTAL PROTECTION EFFECTIVENESS AND EFFICIENCY, BASED ON THE PROGRAMME BUDGETING

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Abstract: This work represents possible methodology for environmental protection contribution of Environmental protection contribution of Serbian local self-government effectiveness and efficiency based on the programme budgeting. Considering that the programme budgeting system of local sel-governments was obligatory for Serbian local self-governments as well as for the Ministries and national bodies, it provides sufficient data for the effectiveness and efficiency of programme activities and projects measurement, including the environment protection as separate programme. Although the reporting system has not been defined, yet, as the first programme budgets Serbian local self-governments prepared for the 2015. Year, it is still possible to measure effectiveness and efficiency of public money usage
Key words: programme budgeting, effectiveness and efficiency, the risk management

INTRODUCTION

Thy programme budgeting system bot at the local and national level in Serbia is in the phase of introducing. The system was obligatory to be implemented by public bodies starting for 2015. Year. Local self-governments and Ministries in Serbia ale obliged to plan their budget following the logic:

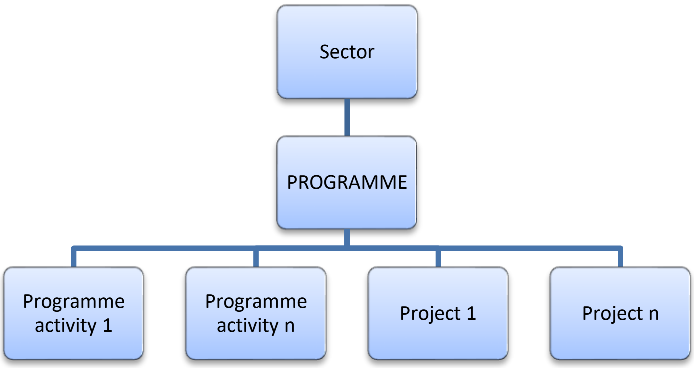

Figure 1. The programme budget system logic

In the program budgeting the focus is on the achievement of financed measures of Budget users, as well as relevant ministry in charge of financing, The Government (national and local) will use information of the goals' achievement in order to evaluate efficiency and effectiveness budget consumption and expenditure's' prioritization

At the moment, the following programmes (with number of programme activities) are defined[1]:

Programme 1: Housing, Urban and Spatial Planning (5)
Programme 2: Communal Service (8)
Programme 3: Local Economic Development (3)
Programme 4: Tourism Development (2)
Programme 5: Agriculture and Rural Development (2)

[1] The list of Programmes with recommended goals and indicators are available for local self-government at http://www.skgo.org/reports/details/1886

Programme 6: Environmental Protection (6)
Programme 7: Traffic Organization and Traffic Infrastructure (2)
Programme 8: Preschool Education (1)
Programme 9: Primary Education (1)
Programme 10: Secondary Education (1)
Programme 11: Social and Child Care (8)
Programme 12: Health Care (3)
Programme 13: Culture Development and Information (6)
Programme 14: Sport and Youth Development (4)
Programme 15: Local Self Government Public Service (12)
Programme 16: Local Self Government Political System (3)
Programme 17: Energy Efficiency and Renewable Energy Sources (1)

MATERIAL AND METHODS

The programme budgeting is based on the following logic:

- Two levels: Programme and Programme activity and projects
- Programme presents the set of measures budget users carry out in accordance its key responsibilities, permanently
- Programme consists of maximum tree program activity and independent number of projects.
- Programme activity presents budget users' set of on going rensponsibillities, realization which the contribute to its and programme goals acchievement. It is defined in the statute of ghe budget users and can refer to the public serrvice providing, preparation and adoption o normative and strategic document, inspection department operation, the measured of public policy realization, administrative activities. Program activitiy has to be part of the Program, carried out by only one budget user and it is not time limited.
- The project is time limited achievement of the budget user, realization which the contribute to the goals of the Program
- The programme, programme activity and project is defined in ghe programe budget by the following data: The name, The purpose, relevance, person in charge and maximum three goals, and maximum three indicators per goal.
- There are two types of indicators: outputs/efficiency indicators (Programme activity and project level) and result indicators (Programme level / effectivens measure)
- For each of the program, program activity the set of goals and indicators has been prepared by the Standing Conference of Towns and Municipalites (http://www.skgo.org/reports/details/1542)

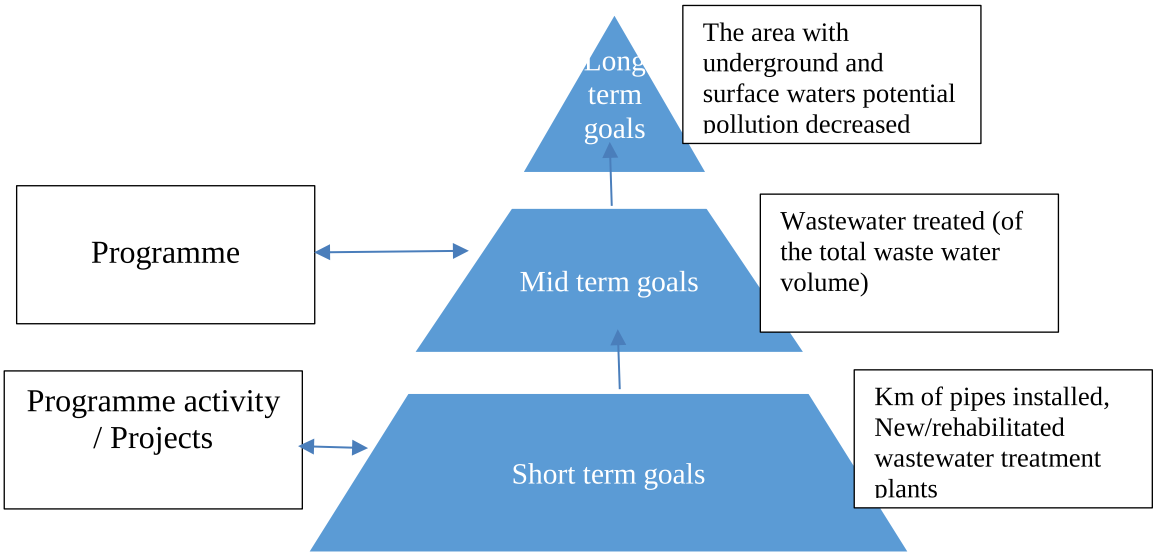

Figure 2. Goals, indicators hierarchy

Table 1. Efficiency and Effectiveness [2]

		Resources consumption	
		HIGH	LOW
Goals achievement	HIGH	Effective but not efficient (some of resources has been waisted i.e. used more then normal/requested)	Effective and effficient (the goals acchieved and the factors/resources well/optimally used. The area of hith productiviey)
	LOW	Not effective and not efficient (the goals not achieved and resources wasted/not well used)	Efficient but not effective (resources have not been unused, but goals have not been achieved)

Table 1. Monitoring and evaluation

	Monitoring and regular review	Evaluation	Audit
Who?	Internal management rensponsibility – all levels	Usually incoprorates external inputs (objectivity)	Incorporates external inputs
When?	Ongoing	Periodic – mid-term completion, Ex-post	Ex-ante (systematic reviws), ongoing and upon completion
Why?	Check progress, take remadial action, update plans	Learn broad lessons applicable to other programmes/programme activities / projects and as an input to policy review Provide accountability	Provide assurance and accountability to stakeholders Provide recommendation for improvement of current and future activities
Link to goals/inputs hierarch	Inputs, activities, results	Results, purpose, overall objective and link back to relevance	Inputs, activities and results

Table 2. Needs for the investments per sector[3]

Environmental protection sector	investment costs € million	Operational costs	Administrative costs	Total
Drinking water	3.505	1.901	146	5.552
Communal Solid Waste	555	2.071	171	2.796
Industrial Pollution and Noise	1.101	344	93	1540

[2] N. Ćurić, Borislav O., “Efikasnost i efektivnost regionalnog društveno-ekonomskog razvoja” NAUČNO-stručni skup “Menadžment, inovacije i razvoj”, (Vrnjačka Banja; 2008)
[3] National Approximation Strategy for Environmental Protection, Official Gazette R.SR. 55/05, 101/07, 65/08 and 16/11)

Nature protection	56	73	10	139
Air Quality and climate changes	214	145	93	452
Chemicals and GMF	59	23	23	105
Total	5.490	4.558	536	10.584

The risks

The risks represent the outside of the parties' involvement into the activity (project) influence and will event, which can cause damage. It is obvious that in the process of programme/programme activities and projects (budget consumptions) planning the risk identification is part as well, as it was written in the Guidelines for programme budget preparation[4]

Considering that in the Environmental protection Programme the number of projects will be expected in the programme budget, the kay risks by the type of the projects, can be identified as follows[5]:

- Water distribution: Land purchase and site risk, maintenance risk, Strategic risk, force majeure risk, exchange and interest rate risk, insurance risk, political risk, regulatory (change in the law risk), inflation risk, disruptive technology risk, early termination (including any compensation risk),
- Solid waste collection, disposal, landfill and recycling risks: Land purchase and site risk, envirovnemntal and social risk, design risk, construction risk, completition (including delay in cost overrun) risk, performance/price risk, resource or input risk, demand risk, maintenance risk, force majeure risk, exchange and interest rate risk, insurance risk, political risk, regulatory/change in law risk, inflation ris, strategic risk, disruptive technology risk, early termination (including any compensation risk),

Valid risk identification and its involvement into the monitoring and evaluation can provide transparent basis for private public project (PPP) in the future.

For the budget 2017. year the Ministry of finance has prepared the reporting system contain information shown on the table 4, omitting information about the risks.

RESULTS AND DISCUSSION

Considering the definition of effectiveness and efficiency and information on identification, and measurement of the risks' influence of programme goals achievement, the additional data of the Ministry's reporting system is suggested to be included into the monitoring and evaluation of programme budgets, including Environmental protection programme, as well:

[4] The Guidelines for programme budget preparation, Ministry of Finance the Government of the Republic of Serbia, February 2014.
[5] Global infrastructure Hub Ltd, Allocation Risks in Public-Private Partnership Contracts, 2016 (The Global Infrastructure Hub Ltd (GI Hub) has a G20 mandate to grow the global pipeline of quality, bankable infrastructure projects.

Table 3. Additional data on goals achievement (mark with pink color)

	Goal	***Indicator name***	***Baseline***	***Target in the (next year).*** ***CV***	***Data source***	The risk	The impact of the risk occur (estimation 0.01-1.00) ZR	achieved OV	The difference OV - CV	The risks occur (mark X)	% of achievement WITH the risks OR=OV/CV	% of achievement without risk OR * ZR	Corrective measure	Person rensponsible	*The type fo indicator (IR / R)*[6]	*% fo Goal achievement*
1																
											UIR-R	UIR-BR				
											UR-R	UR-BR				OC[7]

[6] IR – Indicator of the output
R – result indicator
[7] Calculates as average for all Goals of the Programme Activity Level

Additional data on resource used

(1) Self-resources / Budget consumption (RBS)
(2) Other resources consumption (RSOD)
(3) The difference between planned and consumed self-sources budget (RBS-BS)
(4) The difference between planned and consumed other resources (RSOD-SOD)
(5) The total difference between planned and consumed resources = (3) + (4)
(6) The sum of % of budget consumed (PPB)

Efficiency analyses in correlation with the risks

	With the risk	Without the risk
Efficiency	(UIR-R)/PPB	(UIR-BR)/PPB
Effectiveness	(UR-R)/OC	(UR-BR)/OC

CONCLUSION

Considering that programme budgeting implementation in Serbia is part of the whither public finances management reform, emphasizing the prioritization and optimization of public budget consumption in order to economy growth boost and effective and efficient public service to the citizen increasing, it is justified that based on the information on budget planning, to expand data as it was described. This is especially considered that 60% of legislative in the environmental protection sector is implementing on the local level.

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HYDROMETEOROLOGICAL MONITORING IN WEST MORAVA RIVER BASIN (SERBIA)

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Abstract: Due to the unfavorable environment conditions that Serbia, and mainly Čačak, have been experiencing in the last few years (such as frequent floods, droughts and fires), as well to the particularly underdeveloped monitoring system that can't properly envisage and prevent such situations, it is essential for Serbia to get familiar with the application of new and up-to-date technologies in this field. This paper has the aim to analyze the situation in the area of Čačak, in particular in the West Morava river basin, to collect data about the hydrometeorological monitoring standards in Serbia and the methodology of monitoring the main hydrometeorological parameters. The paper shows some climatic trend with the data available for precipitation and runoff in the area of West Morava river basin. The results of the research can contribute to the prevention of floods in the West Morava river basin.
Key words: hydrometeorological monitoring, West Morava river, rainfall and runoff regime

INTRODUCTION

Streamflow serves man in many ways. It supplies water for domestic, commercial and industrial use; irrigation water for crops; dilution and transport of wastes; energy for hydroelectric power; transport channels for commerce; and a medium for recreation. Records of streamflow are the basic data used in developing reliable surface water supplies because the records provide information on the availability of streamflow and its variability in time and space. The records are therefore used in the planning and design of surface water related projects, and they are also used in the management or operation of such projects after the projects have been completed.
Streamflow records are also used for calibrating hydrological models, which are used for forecasting, such as flood forecasting. Streamflow, when it occurs in excess, can create a hazard and floods cause extensive damage and hardship. Records of flood events obtained at gauging stations serve as the basis for the design of bridges, culverts, dams and flood control reservoirs, and for flood plain delineation and flood warning systems. Likewise, extreme low flow and drought conditions occur in natural streams, and should be documented with reliable streamflow records to provide data for design of water supply systems. It is therefore essential to have valid records of all variations in streamflow. In May 2014 Serbia was hit with floods and as a consequence, the importance of an efficient hydro meteorological and environmental monitoring system in strategic areas, as that close to Čačak, became vital [1-2].
West Morava river basin includes a significant part of the western and southwestern Serbia, and covers an area of 15,805 km2. From a morphological point of view, in the basin stand mountains, plateaus and valleys. The highest point on the mountain basin is Hajle (2400 meters above sea level), while the lowest part of the West Morava river is 127 meters above sea level. Measured from the source West Morava is 208 km long. The average width of the river is about 35 m, with maximum depths of up to 4 meters. The bottom frame is changed depending on the surface of the terrain through which it flows, and can be rocky, gravelly, sandy to muddy the downstream part of the course. The highest mountains in the basin are Kopaonik (2017 m) and Mokra Gora (2155 m). High mountain formations occupy the western, northern and central parts of the basin, while the lower formations are in the south. A regards valleys and ravines, in the West Morava river basin we found the greatest depression Polje, in Kosovo. In the river basin take place different valleys: Part of the basin around the lower courses of the West Morava has the characteristics of plain hilly terrain. This paper shows the results of hydrometeorological monitoring in West Morava river basin on the basis of available hydrological data as well as forecasts that can be expected in the future [3].

MATERIAL AND METHODS

The rating curve, also known as stage-discharge relation, is the empirical or theoretical relationship existing between the water-surface stage and the simultaneous flow discharge in an open channel. The rating curve is a very important tool in surface hydrology because the reliability of discharge data values is highly dependent on a satisfactory stage-discharge relationship at the gauging station. As regards the determinations of rating curves in different section of West Morava river, it is used the method with flow equations of hydraulics. The stage-discharge relation for open-channel flow at a gauging station is governed by channel conditions downstream from the gauge, referred to as a control. Generally, the flow in this area is controlled by a section control, that is a specific cross-section of a stream channel, located downstream from a water level gauge that controls the relation between gauge height and discharge at the gauge [4].
The table 1 shows the Manning's coefficient used to estimate the value of the discharge for each station on West Morava river and rating curve's equations defined by the Ordinary Least Squares method.

Table 1. Manning's coefficient and rating curve's equations in different section of West Morava river

Station name	Manning's coefficient n ($m^{-1/3}s$)	Equation
Jasika	0.036	$Q=63.67(h-136.93)^{1.76}$
Trstenik	0.038	$Q=74.42(h-159.81)^{1.94}$
Miločaj	0.050	$Q=59.53(h-194.89)^{1.58}$
Kratovska Stena	0.038	$Q=20.57(h-292.22)^{1.81}$

For the station in Čačak we have a detailed rating curve and the profile of the control section used to calculate the dependence of the discharge from the stage values. This control section is situated in correspondence of a bridge, not too far from the bridge where the stage instruments are set. Figure 1 shows the rating curve for the station in Čačak.

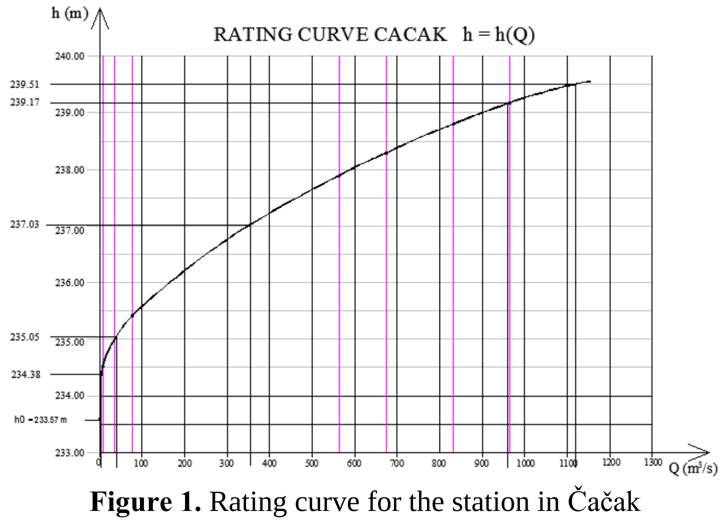
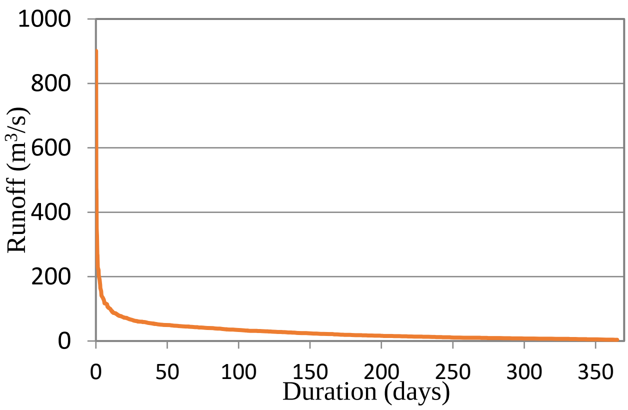


Figure 1. Rating curve for the station in Čačak

The flow duration curve is a plot that shows the percentage of time that flow in a stream is likely to equal or exceed some specified value of interest. Although the flow duration curve does not show the chronological sequence of flows, it is useful for many studies. It can be used to show the percentage of time river flow can be expected to exceed a design flow of some specified value, or to show the discharge of the stream that occurs or is exceeded some percent of the time. A flow duration curve characterizes the ability of the basin to provide flows of various magnitudes. Information concerning the relative amount of time that flows past a site are likely to equal or exceed a specified value of interest is extremely useful for the design of structures on a stream [5].

The shape of a flow-duration curve in its upper and lower regions is particularly significant in evaluating the stream and basin characteristics. The shape of the curve in the high-flow region indicates the type of flood regime the basin is likely to have, whereas, the shape of the low-flow region characterizes the ability of the basin to sustain low flows during dry seasons. A very steep curve (high flows for short periods) would be expected for rain-caused floods on small watersheds. Snowmelt floods, which last for several days, or regulation of floods with reservoir storage, will generally result in a much flatter curve near the upper limit. In the low-flow region, an intermittent stream would exhibit periods of no flow, whereas, a very flat curve indicates that moderate flows are sustained throughout the year due to natural or artificial streamflow regulation, or due to a large groundwater capacity which sustains the base flow to the stream [6].
For the station in Čačak, are available the daily value of discharge for the years 1991, 1992, 1993, 1999, 2002, 2003 and 2005. Figure 2 shows the average duration curves for all the period and the characteristic values for the monitoring stations in Čačak.



Discharge	Value (m^3/s)
Q_{max}	901
Q_{min}	3.8
Q_{91}	36.5
Q_{182}	18.4
Q_{247}	9.4

Figure 2. Flow duration curve and characteristic Q values for the station in Čačak

RESULTS AND DISCUSSION

The probability distribution of annual maxima it's a procedure to estimate the maximum water flow for a fixed time return period, starting from hydrometric observations. A series of maximum observed flow forms, on a statistical point of view, a sample of all the possible values that flow can have, so it is the so called population. The probability distribution functions most used in the hydrological practice for fitting the values of extremes, as annual rainfall and runoff maxima, are the lognormal distribution and the Gumbel distribution. For that purpose we will use the Gumbel distribution, also known as distribution of extreme values type 1 (EV1). For the station in Čačak, the analysis on the annual maxima, is made with a series of 21 data. In some cases there is just the value for river level, so we calculate the discharge with the rating curve. The Figure 3 shows the probability distribution for this station. We calculated also the maximum flow for fixed return period of 5, 10, 20, 50, 100, 200, 250, 300 and 500 years.

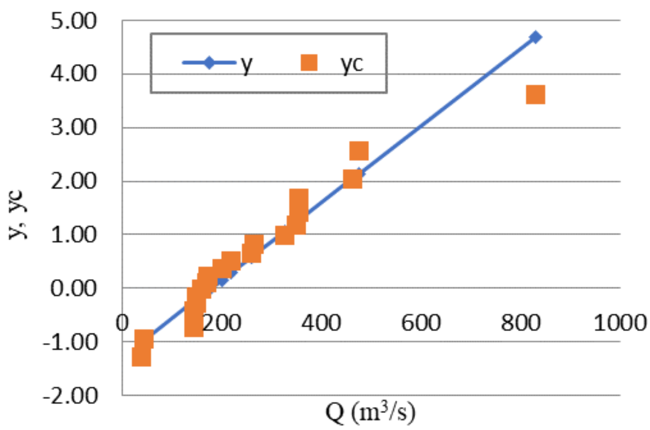


Figure 3. EV1 Gumbel for Čačak station

Table 2. The maximum flow Qc values for Čačak for fixed return periods

T in years	Qc in ($m^{3/}s$)
5	386.7
10	491.1
20	591.3
50	720.9
100	818.1
200	914.9
250	946.0
300	971.4
500	1042.6

Figure 4 reports the variability of the flood peaks as a function of the basin area. We can see that the experimental points can be approximated as a linear function.

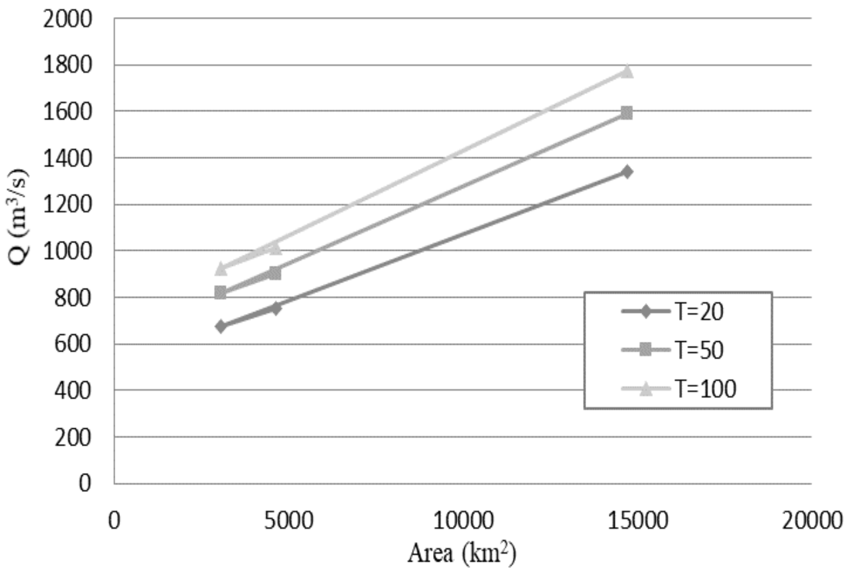


Figure 4. Variability of the T-quantiles of flood peaks as a function of the West Morava river basin

About the characterization of the climatology in this area, we have to discuss some results from specific statistical tests. In order to assess a possible trend in the historical series considered in the analysis, several statistical tests are available in the literature: among them, Mann Kendall (MK) and Spearman's rho tests are widely used. These tests are nonparametric test, one of their primary merits being that they do not assume that the data under analysis were drawn from a given distribution. MK test was selected in our analysis since it has been extensively used in hydrology; on the other hand the performances of MK and Spearman's rho tests are almost identical in terms of power. To compute a trend slope of the runoff series, we used the Sen Theil test for the estimation of the regression line [7].
From the obtained results for the stations Miločaj and Jasika, the values for both the tests Man Kendall and Spearman are out of the confidence interval. In fact, the values are both less than 1.76 (for Miločaj is -2.153 the Man Kendall and -2.121 the Spearman and for Jasika is -2.296 the Man Kendall and -2.289 the Spearman), so it means that there is a significant decreasing in the runoff regime. For the other station Kratovska Stena, the nearest station to Čačak city, the results of tests and the linear trend show a constant trend with small scraps.

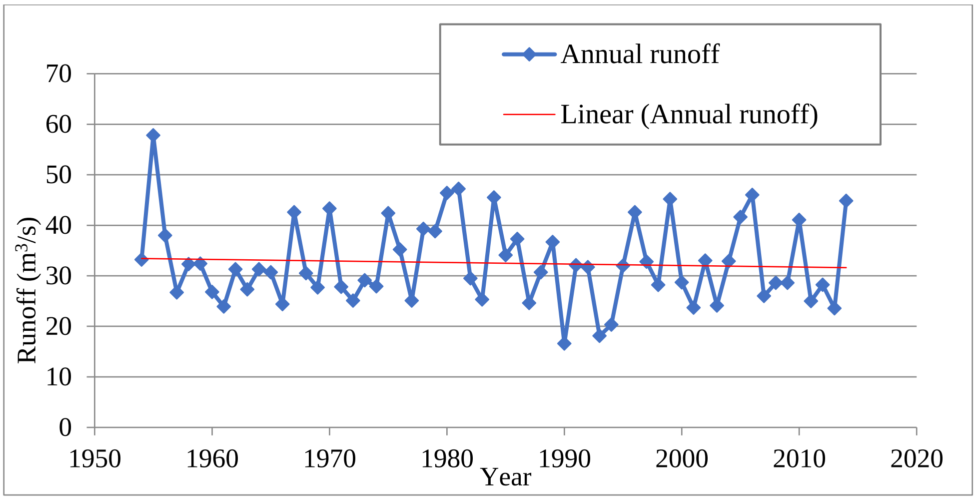


Figure 5. Linear runoff trend for Kratovska Stena station

CONCLUSION

Rainfall and runoff regimes in the West Morava basin were investigated to understand the hydrology of this catchment in view of the improvement of its hydrometeorological monitoring system. Monthly rainfall and runoff data were analyzed to detect regimes and trends. It was observed that for two out of five rainfall stations a significant increasing trend results from the application of Mann-Kendall and Spearman statistical tests. Runoff data exhibit that for two of the three runoff station with a enough big range of data, there is a significant decreasing trend results from the application of Mann-Kendall and Spearman statistical tests. To make some conclusions about this work, it is necessary also to underline that the monitoring in the city of Čačak is not exhaustive. This entails that it's very difficult to prevent some dangerous situations. The installation of a meteorological and hydrological station in the city of Čačak will help, in the years, having a more complete perspective of the meteorological and hydrological situation in the area, in particular in the West Morava river basin.

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CONTROL OF THE WATER WELLS

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Abstract: This paper describes a supervisory and control system that provides the acquisition of data from remote wells and the control of pump units. All elements that make up the control system (discrete- and continuous-time level sensors, flow meters, electromotor valve, pumps) are connected to the appropriate inputs and outputs of the local programmable logic controller. Setting and reviewing characteristic variables and parameters are performed on the touch panel. The controllers provide the autonomous work of well stations as well as connection, through the data transmission system with the central control and supervisory system at the dispatch center. Measured values of significant variables and parameters, all turning on and off of devices and equipment, are recorded in daily, monthly and annual archives. These records are in the form of appropriate diagrams and tables. A dispatcher or an authorized person has easy access to the archives. Some parameters can be changed; the auxiliary files which are related to system functionality and characteristic data for each well station can be monitored on-line. It is possible to generate and print reports. The parameters and variables which are characteristic for the work of the well plant can also be monitored at the dispatch center within SCADA system. SCADA also displays alarms from all wells with light and sound signalization, and a text message about the possible cause of the alarm appearance.
Key words: wells, pump, electromotor valve, level, flow rate

INTRODUCTION

Well plants are often integral parts of water supply systems. The operation of these plants is managed by the PLC (programmable logic controller) [3] and the operator panel which is used for setting and review of parameters. The Siemens S7 1200 controller is used with a certain number of digital and analogue inputs and outputs. The operator panel is Siemens KTP 600. Supervision and control (if it is allowed by the appropriate position of the switch in the local electrical cubicle - EC) of the whole system, is performed by the SCADA (supervisory, control and data acquisition) application [2] at the dispatch center (DC) [8]. Communication between SCADA and PLC is carried out by using a specific protocol (in this case wireless communication) [1], [6]. The components of the plant are: pump station (working pump M1 and spare pump M2) whose motors are frequency controlled), electromotor control valve YV1, discrete water level sensors in the well (lower L_d, upper L_u) and continuous level Lc1, continuous water yield meter (level Lc2) nearby the well, flow meters for continuous flow measurement F1 - at the entrance (filling water wells) and F2 - at the exit (pumping water from wells) [7], [9]. From the continuous measurement elements, 4-20 mA signals are led via analogue inputs to the PLC. Analogue output signals of 4 - 20 mA are references for the valve YV1 and the frequency converter. Flow meters via RS485 ports send data about current and cumulative flow values to the PLC.

Water well plant is a multivariable system, where is: $r^T = [T_1, T_2, T_3, L_u, L_d, I_{TS1}, I_{TS2}, Q_{p1}, Q_{n1}]$ - input vector, setting values, where reaching L_d value (lower water level in the well - the danger of pumping dry) and L_u (upper water level in the well - overflow) cause the activation of alarms (exceeding the water level limit values in the well), I_{TS2} - overcurrent protection of pump motors in which reaching causes an unplanned shutdown of pump aggregates, $eT = [\pm dL_u, \pm dL_d, \pm dQ1, \pm dQ2, \pm dI_{TS1}, \pm dI_{TS2}]$ - vector of deviations (errors), $y_T = [y_{d1}, y_{d2}, y_{d3}, y_{d4}, y_{d4}, y_{d5}, y_{d6}, y_{a3}, y_{a4}, y_{a5}, y_{a6}, y_{a7}, y_{a8}]$ - output vector; discrete outputs - lower level L_d, upper level L_u, limit left valve position, limit position of the valve, right end position of the valve, RI_{TS1} – overcurrent protection of pump motor M1, RI_{TS2} - overcurrent protection of pump motor M2; vibration of motor M1, vibration of motor M2: and analogue output (valve position YV1, water levels L_{c1} and L_{c2}, water flows Q1, Q2), uT = [DO1, DO2, DO3, AO1, AO2, AO3] - control vector (digital and analogue values), where digital signals are used

for turn on pump units M1, M2 and control valve YV1, and analogue signals are references to the frequency controller F1, or control valve YV1, $d^T = [d_1, d_2, ..., d_p]$ – disturbances vector [7], [8].
The structure block diagram of the supervisory and control system is shown in Fig. 1. The pump station can be operated in manual or automatic mode.

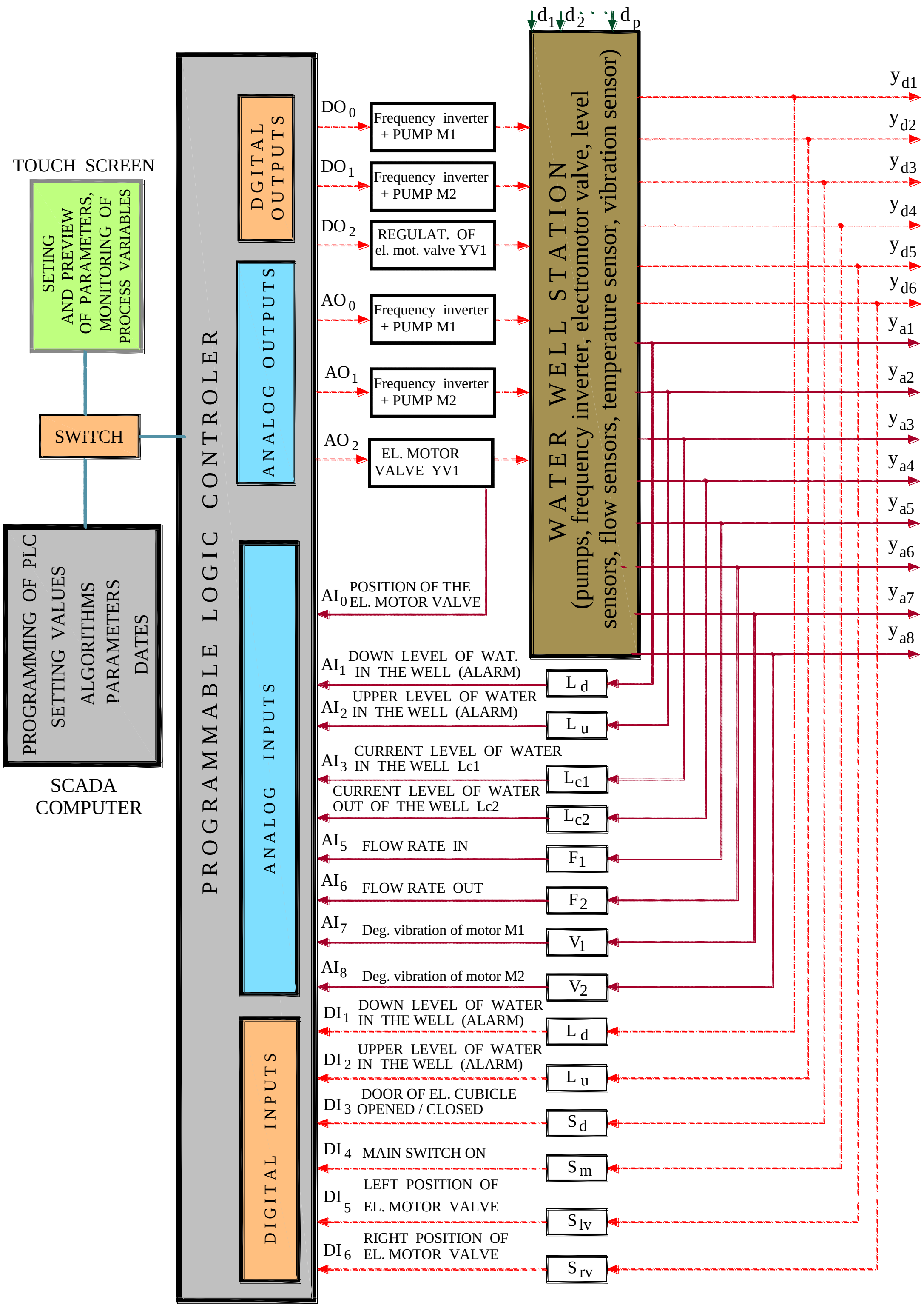

Figure 1. Structure block diagram of the control and supervisor system of the well plant

SUPERVISION AND CONTROL OF THE SYSTEM

Water pumping from the wells is performed by a pump M1 or pump M2 (depending on the current status - working/spare), where the pump continuously draws water (in an adjustable time interval - T1, which in this case is about 70 hours). The continuous level meter (L_{c1}) monitors the water level in the well, and if the level down to a certain value, the pump is switched off even before this interval expires, to protect itself against dry running. As an additional protection against dry running, the signal of contact level meter (L_d) is used, when the MIN level signal is activated. The water overflow in the well is detected by the maximum level (L_u) and the L_{c1}.

The flow controller at the entrance is a electromotor control valve by which the well is filled with oxygen-enriched water. The process of filling wells with this water, which is supplied gravitational, lasts about 10 hours, i.e., to reach the upper water level in the well (L_{c1} meter). Upon reaching this level, the valve will close even before the expiration of this period, in order to avoid overflow. Additional overflow protection is discrete-time measuring the L_u level. The data about the degree of openness/closing of the valve is led to the analogue input, and the data from the valve limit positions are led to the digital inputs of the PLC. Discrete-time meters are also connected on these inputs.

The program in the PLC disables the simultaneous activation of the working well pump and the opening of the YV1 electromotor valve on the inlet to the well, where there is a pause between the two activities. The operation of the well plant is performed in the following steps:

• After completing the process of pumping water from wells, a pause is required (usually about 30 minutes - adjustable time period- T2) before the well is pumped. During this period, the well pump is not running and the solenoid valve on the filling line is closed.

• When the well is filled with water, it is necessary to provide a "hibernation" for about 4 hours (adjustable time period- T3). During this period, the well pump is not running and the electromotor valve is closed.

• two cycles are performed per week.

The touch panel displays the following variables and parameters:

• T_{pc1}, T_{pc2} – the operating time periods of the well pumps in one pump cycle,
• T_p – total pump operation time,
• current pump status - work/pause,
• pump failures,
• T_{nc} – the time period of filling wells in one cycle (YV1 valve openness on water supply to well, 0 ÷ 10 hours),
• T_n – total filling time period of wells,
• T_{pcr1} – duration of pause between the process of pumping and the start of regeneration (about 30 minutes),
• T_{prc2} – duration of pause between the process of regeneration and the start of pumping (about 4 hours),
• Q_{p1} – flow on the pressure pipeline from the well to the pump station in one cycle,
• Q_p – total flow on the pressure pipeline from the well to the pump station,
• Q_{pc} – current flow on the pressure pipeline from the well to the pump station,
• Q_{n1} – flow on the supply pipeline for pouring (regeneration) of the wells in one cycle,
• Q_n – total flow on the supply pipeline for the pouring (regeneration) of wells,
• Q_{nc} – current flow on the supply pipeline for pouring (regeneration) wells,
• L_{c1} – continuous measurement of the water level in the well,
• L_{c2} – continuous measurement of the water level outside the well,
• T_{empw} – water temperature in the well,
• V_1 – degree of vibration of the pump motor M1,
• V_2 – degree of vibration of the pump motor M2,
• the statuses of the switch of cubicle door, main switch and contactors,
• alarms of interest for system work.

The flow diagram of a well plant is shown in Fig. 2 [7].

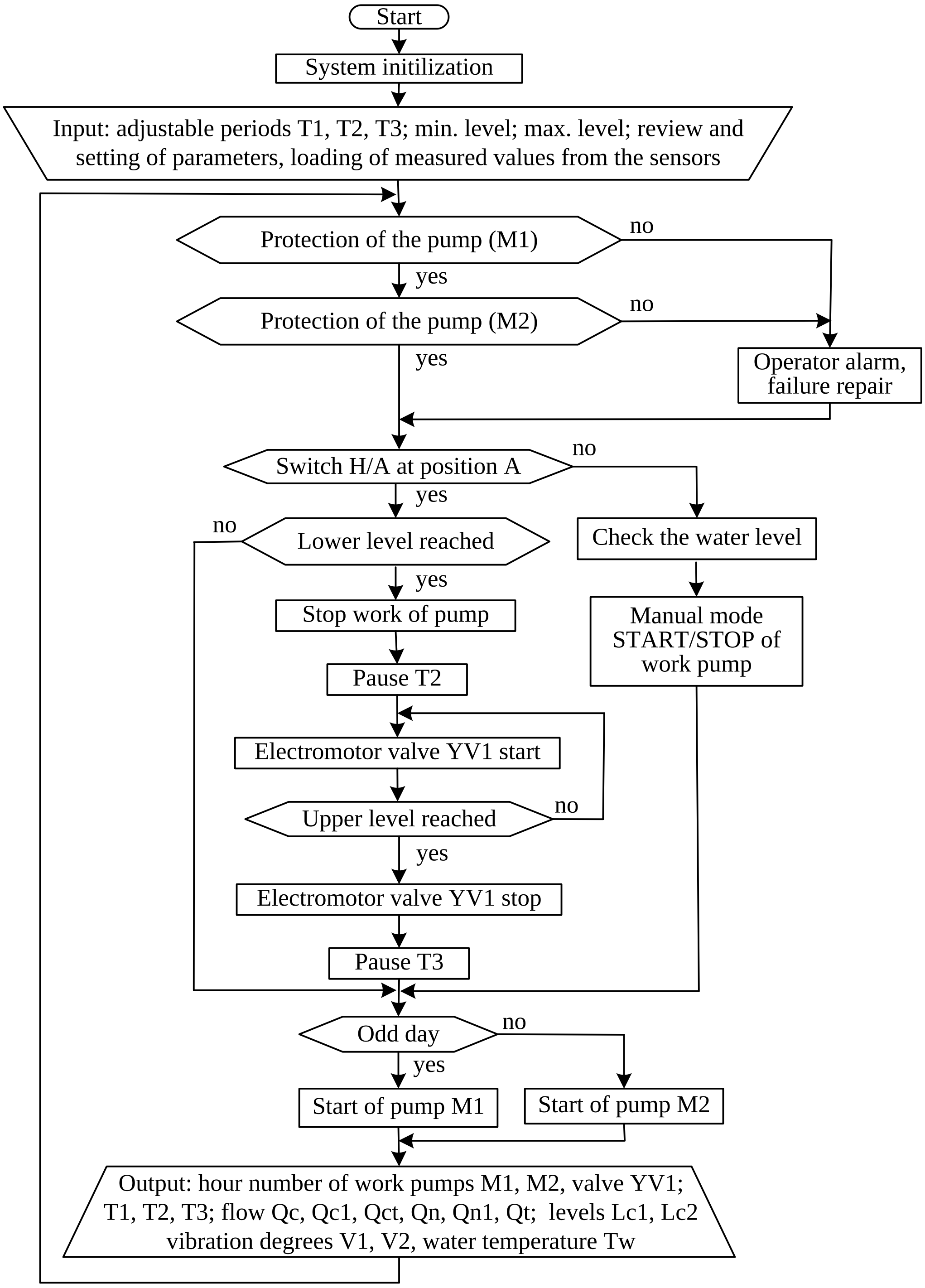

Figure 2. Flow diagram of work of well plant

DATA TRANSMISSION WITHIN THE SYSTEM

Data transmission between well stations and the dispatch center in the administrative building is of wireless type (Fig. 3). Controllable Fast Ethernet switches for connecting devices, have installed in the electrical cubicles of the wells. These switches have Ethernet ports with a speed of 10/100MB/s. The wireless bridge connects an Ethernet switch in a well plant with an Ethernet switch in the dispatch center via a wireless link. The connection between the wireless bridge and the POE (power over Ethernet) element in the distribution cubicle of the well plant is established by the STP cable (schirm twisted pair). The wireless bridge is connected with an integrated panel antenna by an antenna cable [1], [6], [7].

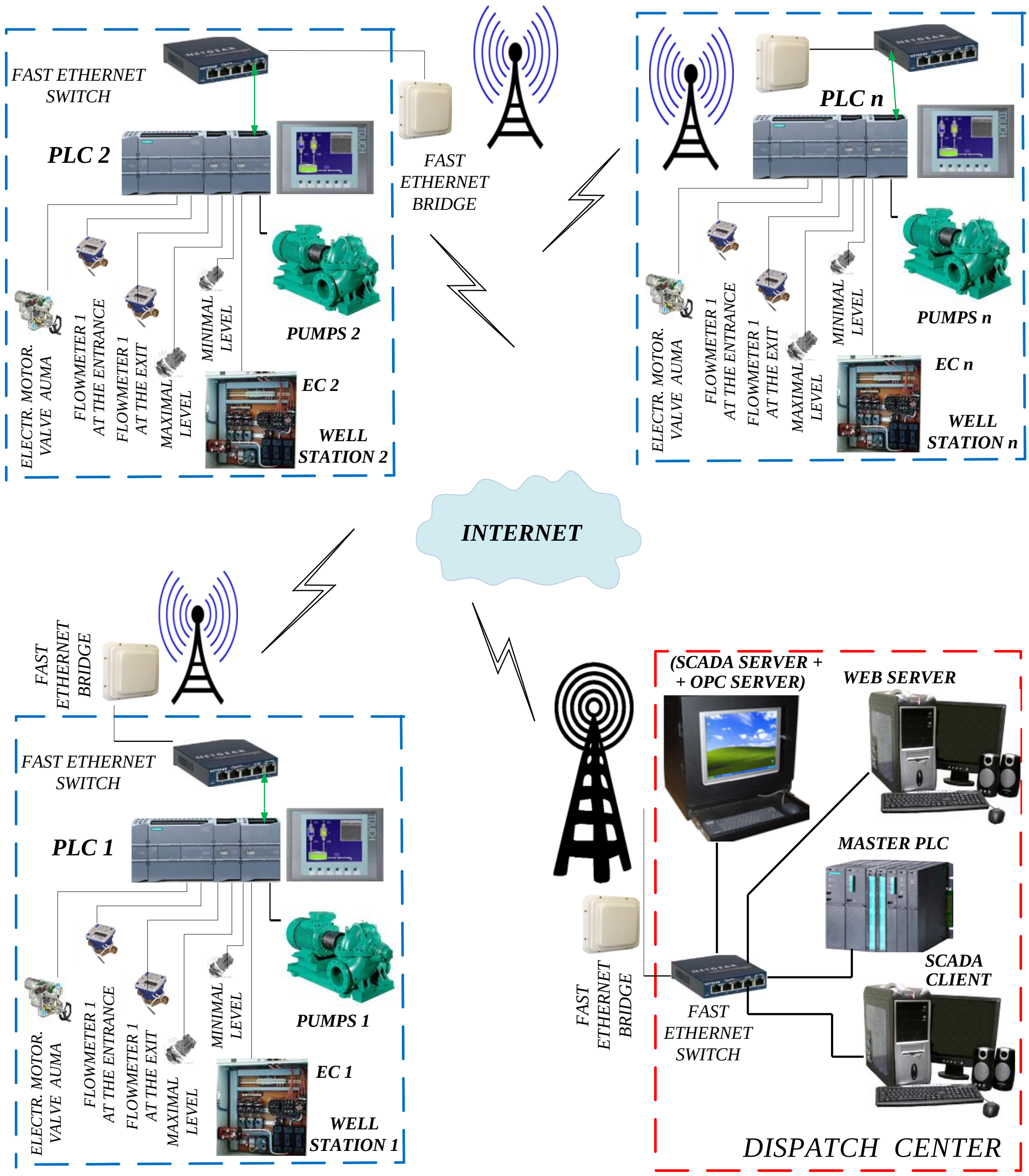

Figure 3. Principle scheme of data transmission process between well stations and dispatch center

SCADA SYSTEM OF THE WELL PLANT

SCADA is a computer system whose role is in real-time tracking and acquiring data, data storing processing, comparing work parameters with given limit values and automatically adjustment of parameters. This enables monitoring of the technical condition of installed devices and equipment, and timely elimination of potential problems. The hardware control configuration as well as the input and output variables and parameters of the controlled plant are base of design of the SCADA system. The following functional units are considered:

- electrical cubicle with the status of the installed elements,
- measuring elements (level meters, temperature meters and flow meters),
- actuators: pump units and an electromotor control valve.

Based on this, the number of input and output signals (digital and analogue) is determined and the number of SCADA tags is planned. Bearing in mind the fact that the number of wells in the concrete case is 30, and the number of tags per one well is 51, so total number is 51*30 = 1530 tags. This is the reason why SCADA system has been adopted with 2048 tags [7], [8], SCADA system consists of two industrial PCs - SCADA servers, which are operating in redundant mode. Within these servers, OPC server, Web server and client servers are installed. PCs of the appropriate performance have the role of Web server and SCADA clients. Computers (two SCADA servers, a Web server and client computers with a certain number of monitors were installed in the dispatch center and the administrative building (Fig. 3) [7].

Well stations can work in the following operating modes:

- locally manually,
- local automatically,
- remote manual, and
- remote automatically.

The local manual mode is designed for servicing and overhauling. It works without control of the level of water in the well, but with appropriate protections (protection of the pump from operation to dry, asymmetry and phase voltage failure). Control is performed via the touch panel. The local automatic mode runs through the PLC. The remote manual mode allows the control of the plant from the dispatch center, where pump or electromotive drive of the valve can be individually included, for example. The normal mode of operation of the plant is automatically remotely, when the work is programmable via the PLC and under the supervision of the SCADA system [4], [5].

A certain number of SCADA screens were designed (the client computers at the dispatch center - one such screen is shown in Fig. 4), where certain elements of the well plant, with characteristic variables and parameters, are presented.

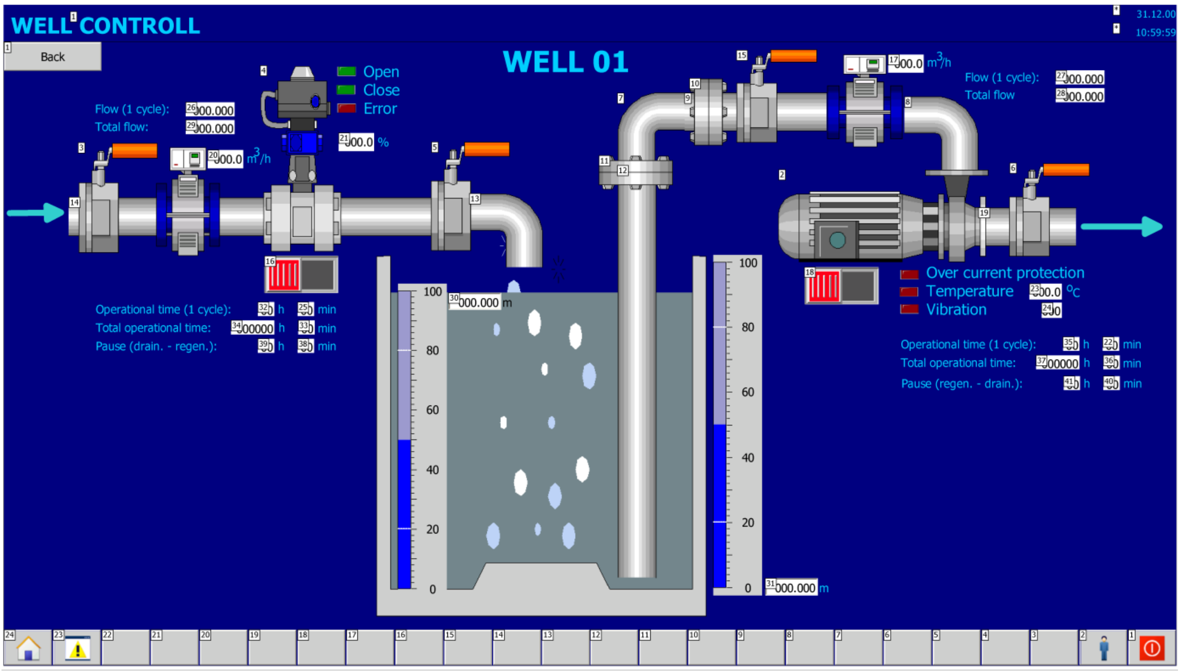

Figure 4. A SCADA screen of the well plant

The trend of the flow rate of water flowing from the well to the water factory is shown in Fig. 5. The capacity of the pump (in this case 20 - 40 m^3/h) is determined by the speed of the motor controlled by the frequency controller. The DN 80 pipeline allows to reach the water flow rate of 2.2 m/s for a pump capacity of 40 m^3/h. The control system of the well plant is placed in the cubicle (Fig. 6) on which the door touch panel is installed.

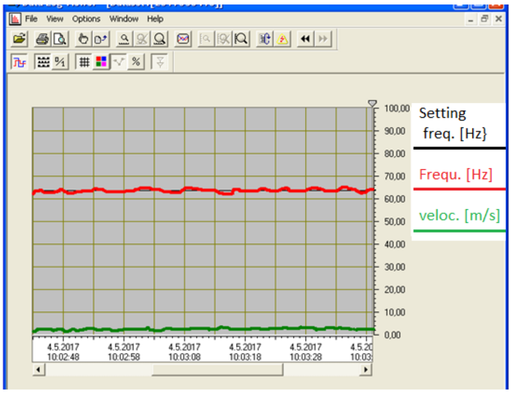

Figure 5. A trend of the water flow rate drawn from the wells and the frequency of the well motor of the working pump

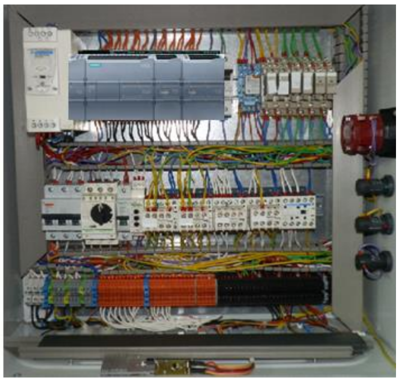

Figure 6. Electrical cubicle of water well

SCADA is organized in the form of menus and submenus, allowing the functionality of the system with certain animations (e.g. work of pump or electromotor valve), giving a view of changing some variable in real time in the form of a trend graph or in a digital form (values of the level, flow, engine speed, etc.), reaching the limit values is signalized as an alarm message with sound and light signaling. There is also a certain number of screens of the operator panel (Figs 7, 8, 9 and 10) [4], [7]. Figure 7. shows level of water in the well and yield of it. Flow rates at the entrance of the well and at the exit of it are shown in Fig. 8.

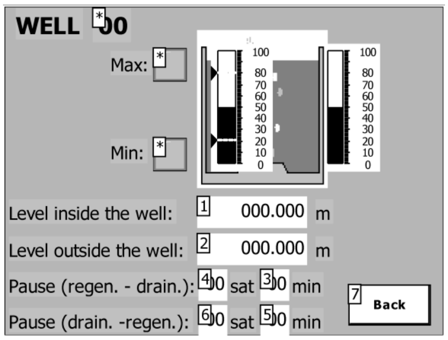

Figure 7. Displaying of water level of well plant

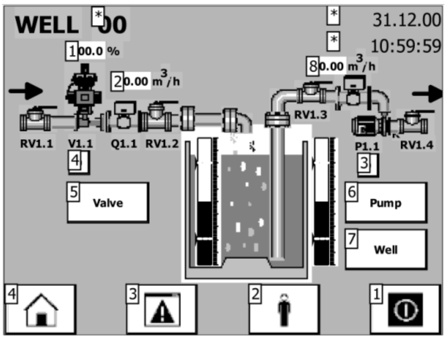

Figure 8. Displaying of electromor valve and pump

Figure 9. shows the temperature of the water in the well, the degree of vibration of the pump motor and the pump operating time. Figure 10. shows the flow rate at the entrance and exit from the well.

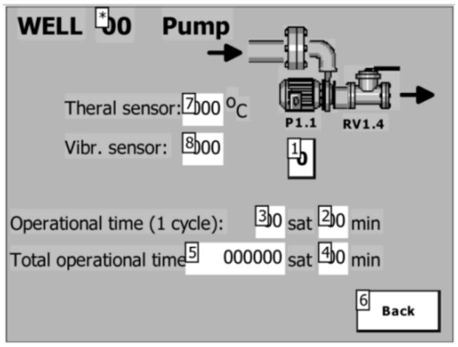

Figure 9. Measurement of water temperature and degree of vibration of the pump motor

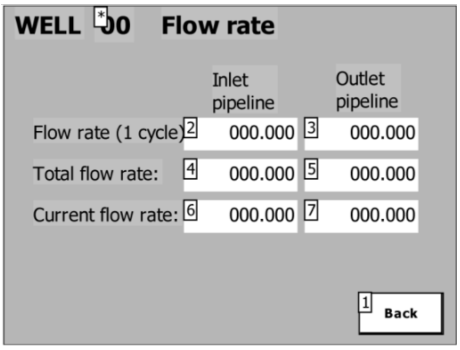

Figure 10. An overview of the flow measurement

CONCLUSION

The paper presents the configuration of the control and monitoring system of wells that are part of a water supply complex. The system enables real-time control, whereby measuring the relevant process variables and parameters, appropriate the controller settings, and transmitting data are performed. The information system provides the prediction of certain events through acquisition, processing and analysis of data, which ensures optimal work of the well plant. Alarm signals are generated in case of deviation of the parameters from the specified limit values, certain data are archived, the visual image of the controlled object is given, as well as the graphical and/or tabular interpretation of the data at a specific time point or period. SCADA system provides detection of failures, data about operating conditions and condition of devices and equipment of remote objects, thus providing the possibility of sending signals about the failure location and eventual cause, which enables a quick reaction between the operator and the maintenance service in order to solve the problem (e.g. shooting pipelines, electrical and/or mechanical failures, or major devastating situations). In this way, the water supply stoppage is reduced.

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TECHNO-ENVIRONMENTAL AND ECONOMIC CONSIDERATIONS OF WASTEWATER TREATMENT TRENDS OBSERVED FROM CITY OF NIS SPECIFICS

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Abstract: With the development of modern society, the problem of generated wastewater is getting bigger. Polluting substances from wastewater directly affect both the quality of surface water (directly) and indirectly the quality of groundwater. Wastewater contains pollutant substances that can greatly endanger the ecological status of surface waters if they are not adequately threated before being dispersed into the recipient. The basic prerequisites for the protection of ecological status of surface water is achieved by connecting the population to the sewage network, followed by constructing a wastewater treatment plant for collected wastewater from the settlement, accomplished by pre-purifying (pre-treatment) of industrial wastewater before entering the sewage network of the settlement, and, finally, by monitoring the quality of dispersed wastewater. Ecosystem disorders caused by the release of untreated wastewater have gradually increased to such a degree that the purification has been imposed as a necessity.
Key words: wastewater, ecological status, treatment, Niš, Nišava river

INTRODUCTION

Previous research and evaluation of human pressure on water resources in Serbia, both in sense of quality and quantity, clearly indicates a necessity of advanced water resources management system development that should be developed with respect to EU Water Framework Directive demands. The EU Water Framework Directive implementation process (WFD, 2000/60/EC) in Serbia started at the early beginning of 2004. With regard to implementation process, it is necessary to evaluate both the basics of sustainable-integrative water management, and the international legislation and praxis. In accordance with Directive, monitoring, assessment process and integral management of surface waters quality should be based on ecosystem-combined approach, meaning both emission control and assessment of ecological status parameters. That field of research is related to pressure identification redesign and establishment of new priority network, having in mind ecosystem approach defined in Common implementation strategy documents for the Water Framework Directive (CIS, 2003). Basic aim of abovementioned system redesign is to identify cases with highest so-called “specific hydro-anthropogenic pressure”, meaning cases where relatively large agglomeration (expresses in total people equivalent, P.E.) are locates on relatively small recipient of discharged wastewater, particularly during the low-water period (COM, 2012; McCuen, 1998). Also, during the research, it is recognized that city of Niš, with its specifics, represents exceelent example of specific hydro-anthropogenic pressure location.

TECHNICAL AND ENVIRONMENTAL CONSIDERATIONS

City of Niš is a city located on the both sides of the river Nišava, about 10 km from the river Južna Morava. There are roughly 280 000 inhabitants and the city has significant economic and industrial potential. Therefore, significant consequences arise from the environmental perspective including problems of evacuation, disposition and treatment of used water and atmospheric water which is released from the city.

The existing sewage system provides quite adequate evacuation of the water from the city. The largest part has been carried out by the general system, jointly eliminating communal, industrial and atmospheric wastewater. According to the characteristics of the current wastewater and the expected quality and quantity of wastewater in the future, Niš is considered as an important source of the biological and organic concentrated pollutants.

The typical problems of the city are:

- The industries discharge their wastewater in the urban sewer. At the present the previous purification (pre-treatment) of the wastewater is performed only by some industries, although it is already required that all the industries whose wastewater contains harmful substances over the acceptable limits previously perform purification. Requirements for the previous treatment of industrial wastewater are defined by the National regulations on technical and sanitary conditions for the release of wastewater into city sewers. Industrial wastewaters are loaded with organic pollution, sediment and suspended matter, biologically hardly degradable or non-degradable compounds, emulsified or floating oils, heavy metals, cyanide and other toxic compounds,
- Many pollutants from the soil are washed out by the atmospheric waters which are also discharged into the joint sewage, mixing with the industrial and communal wastewater,
- Most time of the year sanitary conditions of the river, from the aspect of the biological quality, are unsatisfactory. Today, all the wastewaters from Niš are eliminated trough the 3 outlets on the left and right side of the Nišava river (one large main collector and 2 supporting smaller collectors). At the entrance to the Niš the river Nišava is already burdened by the pollution from the settlements and cities on the upstream flow of the river. In addition, one very important characteristic of the river is a relatively small minimal monthly flow with the probability of 95% (Q95%) which is 2,54m^3/s. As a consequence of all these factors, on flow in river Južna Morava, Nišava belongs to the worst ecological status category, by many parameters.

As previously concluded the crucial problem in city of Niš is lack of central wastewater treatment facility and pre-treatment operations. By the construction of the treatment facility, the wastewaters (including communal, industrial and atmospheric) would be collected and processed before discharging into the Nišava river. It is expected that the disturbed quality of the river, as the recipient of the wastewater from all the settlements on its flow, could be improved up to the required level of quality by the construction of the wastewater treatment facility.

As discussed in (Stuetz, 2005; Malenovic Nikolic, 2015) a modern wastewater treatment facility requires the identification of environmental aspects (in sense of wastewater impact), calculus of their impacts and financial considerations (ISO 14001, 2015).

Wastewater treatment facility should be able to operate with organic loading of at least 300 000 PE. Present situation is that some 210 000 inhabitants are connected to sewage system and industry contributes to total number of 250 000 PE. We have reasons to believe that both of this numbers are likely to increase (Vasovic, 2016).

FINANCIAL CONSIDERATIONS

Financial policies of our country in the domain of water resources management define the following instruments:

- Regulatory Instruments - Assessment of environmental impact is the most effective instrument from the beginning of its implementation. Using this instrument, it is possible to predict and prevent any kind of pollution that eventually came from the future plant, or from some other activities,
- Inspection control - inspection in the field of water management is performed by the inspectors from the Directorate for Water. Coordination of inspection activities include monitoring of the Law on water implementation,
- Economic instruments - economic instruments that are applied in the water sector include fees for water abstraction, drainage and irrigation, and fees for water use, water protection (fees for effluents), as well as fees for taking material from the waterways. Water sector is mainly funded from these fees, and minimally is financed from the state budget funds which are intend for projects in the water sector. Revenues (finances, expenses, resources) from fees for the drainage and irrigation and fees for the water resources management are paid to public utility companies. Essentially, these revenues should be used to finance operation and maintenance of infrastructure and as a contribution to investment in new infrastructure in this

area of the water sector. Fees and revenues from fees are generally too low to provide adequate maintenance of plant and equipment (Jager et al, 2016).

In recent years the Sector of municipal water supply and sewage suffered budgetary constraints. The result of such situation is that most of the facilities for water supply and sewage system is currently in critical condition and requires emergency repair, rehabilitation or replacement.

Rates (Tariffs) for water and sanitation services on annual basis are proposed by public utilities for water supply to (on) the town hall for approval. Ministry of Finance since 2004 limited growth rates: they can’t exceed the inflation rate given by the program. Rates and fines for discharge of waste water above the allowable limit is very low compared with the costs of maintenance treatment, and punishment for breaches of regulations are not applied. Therefore, Sectors of industry and Sector of agriculture don’t respect the law in the way that should.

EU Water Framework Directive sets the principle of sustainable development of water resources. In such a concept of development, this industry must provide most of their own revenues by charging “water services” (Spray and Blackstock, 2016). This term includes the entire water supply (from the protection of water sources, construction of water management infrastructure to the municipal water distribution systems), as well as drainage and purification. European directive will certainly have to become a starting point for the water management regarding the self-financing and real, the economic cost of water management.

At the local level, waterworks company “Naissus" which produces water, water supply and sanitation pays annual rent of water to the city and at (on) the state level. Fees for the price of water are adopted at (on) the city level since Waterworks Company propose cost to the city Assembly for adoption. Production of water annually is about 35 million m3 (limit error is 0.4%). Annually, part of produced water on legal consumption of water goes up to 18 million m3, while losses are about 17.5 million m3. Invoiced (calculated) water consumption on an annual basis is 15 million m3, and un-invoiced is about 3 million m3. Utility company operates with losses, commercial and physical. Also, important role plays consumer debt used for water supply services, which is about 60% of the invoiced consumption (State Audit Institution, 2010).

CONCLUSION

Price of the water in our country is depressed, so that it covers only a minimal part of the huge costs of securing sources of surface water (related to the construction of large reservoirs) or groundwater (with a system of deep wells), bringing the water to populated areas, the technological process for water purification and distribution in communal systems, as well as the cost of waste removal and wastewater treatment. Water in our country must become on economic categories, because this is an important precondition for the development of water resources. It is very important that each country has to take care of social, economic and environmental effects of the pricing of the water and water services.

One of the important activities that should be achieved is the sanctioning of illegal users (those who do not pay), where the legal basis exists, but problem is the long period of time for payment.

In the future, financing of Water Management should be provided from the following sources:

- funds from the national budget (must tend to be at least 1% of total assets),
- means of water management fees (revenue source water),
- any additional funds from taxes and contributions,
- Funds from foreign sources (in the form of grants, loans or concessions).

The ultimate goal of reforming the financing system is that water resources management has to be financed from its own income and to be unbudgeted and non-profit activity. This means that the cost of services must be economic in all domains of use of water, water protection and protection from harmful effects of water. The stated aim can be achieved if we will be established with the world long ago accepted principle: "user pays" and "polluter pays". For a quick transition to this way of financing, all conditions are not satisfied. Therefore, the water resources have to go through a transition period in which has to increase the economic power of the population, when it will be possible to apply the European model of financing the use and protection of water.

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OVERVIEW OF HARMOIZATION OF THE SERBIAN LAW WITH THE EUROPEAN UNION LAW IN THE FIELD OF AIR QUALITY PROTECTION

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Abstract: In the Republic of Serbia, the harmonization of regulations with the European Union acquis is in progress. The authors give an overview and analyse the current regulation adaptation in the field of air quality in the Republic of Serbia with the European Union legislation. The adoption of the Law on Air Protection from 2013, the regulations of the European Union, primarily Directive 2008/50, which regulates air quality, has been transposed into national legislation and practice. Although the reporting on environment is constantly improving, it is necessary to strengthen administrative capacities. Also, to eliminate disharmony and legislative deficiencies which prevent their implementation and an efficient and stable financial system for Environmental and Climate policy.
Keywords: the quality protection of ambient air, Serbian law and EU legislation.

INTRODUCTION

Contemporary Environmental policy of the European Union (hereinafter: EU) is a very important part of the EU's activities. There is a great necessity of establishing European standards in order to ensure protection and improvement of environmental quality, human health protection and rational usage of the natural resources.
In the Republic of Serbia (hereinafter: RS), the harmonization of regulations with EU regulations is in progress. Since May 2012, the RS has been harmonizing its regulations as a country candidate and chapter 27 - Environment is one of the chapters of the EU acquis. The EU integration in the field of environmental protection is being processed within three sections: harmonization of regulations, administrative capacity development and capacity of institutions in the field of environmental protection, as well as providing financial resources. Therefore, this chapter is extremely demanding in the financial and administrative terms, especially in the terms of well-equipped and trained judicial and administrative structure.
Over the last few years, the RS has passed several laws that have taken over or have established legal basis for the adoption of environmental quality standards of the EU Directives. [1] Such laws also regulate air quality standards as protected natural values of the common interest.
In that way, the legal norms that are compatible with the European have been adopted. Its goals, standards and requirements can be applied directly or implemented through the set procedures of decision-making in relation to plans, programs and projects which can have a significant impact on the environment. Also, through the procedures of issuing integrated permits which provided *modus operandi* harmonized with the European one. [2]
Besides the field of air quality, RS legislation needs to be harmonized with EU legislation when it comes to other fields of environmental protection. In that sense, horizontal legislation, waste management, water quality, nature protection, industrial pollution monitoring and risk management, chemicals, noise, nuclear safety and radiation protection, climate changes, environmental protection policy, international cooperation are defined. However, Member States are not being prevented from maintaining and introducing measures that are more stringent than measures established at EU level as long as they are compatible with its overall objectives and principles of the Single European Market. [3]
Significant investments are essential for the implementation and adoption of EU acquis in the field of environment, as well as well-organized and well-equipped administration at national and local levels. Member States have to establish a specific framework for financial management and control, including audit.

THE PROTECTION AND IMPROVEMENT OF AIR QUALITY IN THE EU LEGISLATION

Considering the importance of the air quality, this issue is regulated in EU law. The Thematic Strategy on Air Pollution, as the basic strategy document of the EU in this field, defines objectives for the reduction of certain pollutants, emphasizing the importance of legislative regulation in the fight against pollution.[4] The strategy is one of the seven strategies which development is predetermined by the Sixth Action Programme. It is based on the researches which were conducted in the framework of CAFE Programme (Clean Air for Europe) and other programmes. (Commission communication of 4 May 2001 „The Clean Air for Europe (CAFE) Programme: Towards a Thematic Strategy for Air Quality.) This document regulates objectives in the field of air pollution and proposes measures for their implementation by 2020 in the EU.

Among the significant EU regulations in the field of atmospheric pollution is the Directive on ambient air quality and cleaner air for Europe (2008/50 /EC) – Cleaner Air for Europe (CAFE) Directive [5], which establishes harmonized health standards for air pollutants that cause the greatest concern. This Directive requires governments to define air quality zones for the entire state. The zone boundaries are set according to the population density and exposure criteria. If the standards are not met, air quality management plans must be defined by the authority in charge of a particular zone which goal is to reach the quality standards in the territory of the zone as soon as possible. Directive 96/61 / EEC on Integrated Pollution Prevention and Control (IPPC) [6] is applied to the industrial and other facilities and activities that are classified according to the pollution level and to the risk level these activities may have on the environment and health. The general framework for the regulation of the air quality is the Council Directive 96/62/EC on ambient air quality assessment and management which has been transposed into our law. This Directive defines the list of pollutants including SO_2, NO_2, CO, particles, lead, ozone, cadmium, arsenic, nickel, mercury, benzene for which the maximum allowed concentrations are further determined. The important Directives related to the air quality: Air Quality (Framework) Directive – 96/62/EC, Daughter Directives (SO_2, NOx, Pb) – 99/30/EEC**,** Volatile Organic Compounds – 99/13/EC**,** Quality of Fuels – 98/70/EEC**,** Emissions of Non-Road Mobile Machinery – 97/68/EC**,** Carbon Dioxide and Other Greenhouse Gas Emissions – 93/389/EEC**,** Emission from motor vehicles – 70/220/EEC.

THE AIR QUALITY PROTECTION IN THE RS LEGISLATION

The harmonization of the national legislation with the *acquis communautaire* is carried out on the basis of the Article 107 of the RS Constitution, the Article 72. Stabilization and Association Agreement [7] and the Chapter III of the Transitional Agreement [8]. That is the way how the RS agreed to gradually harmonize current and future laws and regulations with EU legislation in the forthcoming period, thus ensuring the proper application of the valid as well as of the future legislation. [3]

The Government of the RS adopted the National Programme for Environmental Protection (Official Gazette of the RS, No. 12/10) (hereinafter: NPEP) which is based on the Environmental Protection Act (Official Gazette of the RS, No. 135/2004, 36/2009, 72/2009, 43/2011 and 14/2016) and represents a strategy document based on which planning and management is carried out and its goal is the development of the contemporary Environmental protection policy in the RS. Also, one of the significant documents in the harmonization process in this field is the National Environmental Approximation Strategy (NEAS) [9] which goal is to assure the basis for accession negotiations within Chapter 27. NEAS is based on the National Programme for Integration of the RS in the EU (NPI), the National Programme for Environmental Protection (NPEP) and National Sustainable Development Strategy (NSDS).

Since the beginning of the harmonization process, the RS has made a progress when it comes to adjustment of domestic regulations with EU law. In the field of the air quality in the RS, the Law on Air Protection ("Official Gazette of the RS", No. 36/2009 and 10/2013) (hereinafter: LAP) is adopted in May 2009, amended in 2013. By adopting the Law on Air Protection, EU regulation, primarily, the Directive 2008/50, which regulates air quality, has been taken over and incorporated int national regulations. That is how the harmonization of the national and EU legislation and practice has been ensured. However, there also has to be adjustment with the other Directives: 2004/107 / EC, 94/63 /

EC, 2001/80 / EC, 1999/32 / EC, 2003/17 / EC, 98/70 / EC, 2001/81 / 2003/87 / EC, 1999/13 / EC, Commission Decision 2004/224 / EC, Commission Decision 2001/839 / EC, Regulation 2037/2000 / EC, Directive 2006/40 / EC, Regulation 842/2006 / EC, 2007 / EC, 1494/2007 / EC, 1497/2007 / EC, 1516/2007 / EC, 303/2008 / EC, 304/2008 / EC, 305/2008 / EC, 306 / 2008 / EC. LAP regulates air quality management and determines measures, the way of organizing and controlling the implementation of protection and improvement of the air quality as a natural value of the common interest that has special protection. (Article 1 pg.1 LAP). The LAP provisions are not applied to pollution caused by radioactive materials, industrial accidents and natural disasters. The main goal of the law is to prevent or reduce harmful consequences for human health and/or environment through the measures of protection and improvement of the air quality. Some segments of the field covered by the LAP are regulated by sub-legal acts in detail: the Regulation on the Conditions for Monitoring and Requirements for Air Quality ("Official Gazette of the RS" No. 11/10, 75/2010 and 63/2013), the Regulation on Establishing the Air Quality Control Programme in the state network ("Official Gazette of the RS "No.58/2011 and 98/2012) and the Regulation on Determining Zones and Agglomerations ("Official Gazette of the RS "No. 58/2011). Also, the LAP determines the adoption of the Air Protection Strategy as a document “that provides conditions for establishment of an institutional system based on which certain measures are taken in order to avoid, prevent or reduce air pollution and harmful effects on the human health and/or environment as a whole, on the territory of the RS” (Article 27 pg.1 LAP).

According to the LAP, in order to efficiently manage the air quality, a unique functional system for monitoring and controlling the degree of air pollution and maintaining an air quality database (hereinafter: air quality monitoring) is being established. (Article 9 pg. 1 of the LAP). The RS, autonomous province and local self-government, within the framework of their jurisdiction as defined by the law, provide air quality monitoring. The conditions for the air quality monitoring in the territory of the RS are proposed by the Ministry and then determined by the Government.

The LAP determines that the system of monitoring air quality establishes the national and the local network of measuring stations and/or measuring stations for fixed measurements. Air quality monitoring can be carried out with targeted, indicative measurements based on the act of the competent authorities for environmental protection, when it is necessary to determine the degree of air pollution in a certain area that is not covered by the air quality monitoring network. The national network of measuring stations and/or measuring points is set up to monitor air quality in the RS. The monitoring of the air quality in the national network, within its competencies, is performed by EPA, the Republic Hydro-meteorological Service of Serbia (RHSS) and authorized legal entities. The Republic Hydro-meteorological Service of Serbia can, in accordance with the regulations and the Air Quality Control Programme, establish one or more mutual measuring stations which cover neighboring zones in the RS and surrounding countries, in order to get necessary spatial resolution. In addition to the national network, it is possible to establish a local network of measuring stations and/or measuring points for the air quality monitoring at the level of the autonomous province and the local self-government. [10]

The competent authority of the autonomous province, the competent authority of the local self-government, RHSS and authorized legal entities are obliged to submit data on the quality of air obtained by air quality control from the national and local network as well as the measurement results for special purposes, are submitted to EPA by the 15th of the month. Annual reports should be submitted not later than 60 days from the beginning of the current year. The EPA, the competent authority of the Autonomous Province and the competent local self-government are obliged to make the data available to the public and publish them in the media, electronic media, as well as on their own websites. These data are used to assess air quality but also to make reports on the air quality state and are an integral part of the air quality information system.

For the purposes of the air quality management, based on the Ministry suggestion, the Government establishes air quality requirements. Those are numerical values of the limit values of the pollutant levels in the air, the lower and upper limits of the air quality assessment, critical levels, tolerance and its values, target values and (national) long-term objectives on the air pollutants, certain concentrations that are dangerous for the health and are presented to the public.11 The air quality category list by zones and agglomerations in the territory of the RS is passed by the Government and published in the

"Official Gazette of the Republic of Serbia", electronic media, as well as on the website of the Government and the Ministry.
Operational monitoring, using automatic reference methods, is carried out in accordance with the Regulation on establishing the air quality control programme in the national network ("Official Gazette of the RS" No. 58/2011) and the Regulation on conditions for monitoring and air quality requirements ("Official Gazette of the RS" "No. 11/2010, 75/2010 and 63/2013). By informing the public on the air quality, EPA gives an overview of the results of the automatic air quality monitoring in the real time. [12] Preliminary, unverified values of the air quality parameters are presented. Verified values and assessment of the air quality in agglomerations and zones are given in the Annual report on the air quality in the RS. Also, the Air Quality index, SAQI_11, was developed for quality assessment and air quality presentation. The CARDS project “Supply of Equipment for Air Quality Monitoring” was of the major importance when it comes to the automatic air quality monitoring in the RS. [13]
When it comes to making reports on the environment, a significant improvement has been recorded. Data on the National Pollutant Emission Register (NPER) has been, since January 20, 2014, entered in the new information system which should provide the users with simpler reports, a more functional system as well as a higher level of data protection. An on-line application was set for the entities to fulfill their legal obligations. That is how a progress has been made, thus achieving transparency of environmental data.
Realization of the 2012 IPA project *Establishment of an integrated environmental monitoring system for air and water quality*, the part *Supply of ICT equipment and software for Air Quality Monitoring System* EPA as the competent national institution for air quality monitoring, presents an overview of the data on the automatic air quality monitoring in the RS on its website in real time. The display contains data from the national network and local network in Vojvodina, Belgrade and Pančevo. The project has an on-line access to the current pollutant concentrations in ambient air in the territory of the RS. (Figure 1)

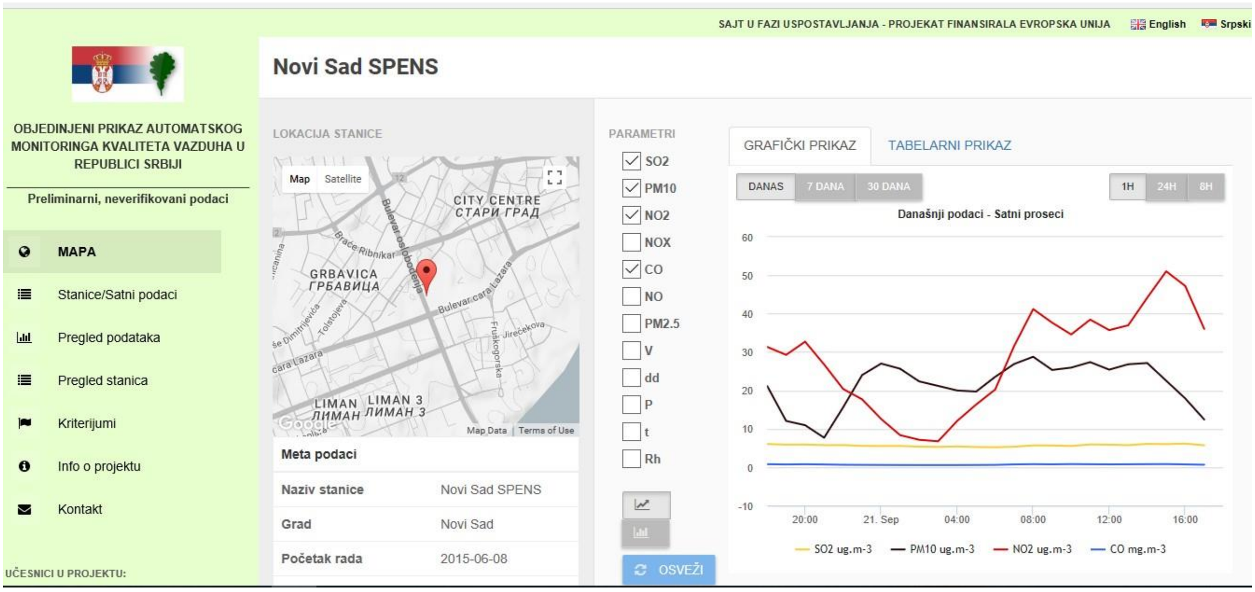

Figure 1. The example of display of the real data on automatic air quality monitoring [13]

The RS has a good cooperation with the European Environment Agency (EEA) within the European environment information and observation network (EIONET). EPA exchanges data on the air quality with the EEA, EIONET and the European Monitoring and Evaluation Programme (EMEP Protocol) for reporting in accordance with the international obligations. However, it is necessary to strengthen the involvement and consultation of the public in the decision-making process. In accordance with the adopted Law on Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (hereinafter: the Aarhus Convention) on May 12, 2009 ("Official Gazette of the Republic of Serbia - International Agreements" No. 38/09), an European

standard is introduced and it refers to the public participation in the procedures of importance for environmental protection, involvement of the public at all stages of the procedure, enabling the public to express their attitude and to have access to information. [14] According to the Aarhus Convention, Environmental Rights, as essential human rights, should provide access to information, legal protection and public involvement as the basic conditions for sustainable development.
The RS has made a significant process in the harmonization of its legislation with the EU *acquis communautarie* in the field of environmental protection which is related to horizontal legislation. But, a considerable investment and strengthening of administrative capacities is necessary in order to adopt the legislation system.

CONCLUSION

In the RS, the harmonization of regulations with the EU is in progress. During the last few years, the RS has passed several laws that were incorporated and represent a legal basis for adopting environmental quality standards from the EU Directive. By adopting the LAP, the RS, the EU regulation, primarily the Directive 2008/50, which regulates air quality, was transposed into national legislation. In accordance with these regulations, operational monitoring and assessment of air quality in the RS is carried out. When it comes to providing information on the environment, there has been a significant improvement. However, strategic planning, strengthening of administrative capacities and greater investment in relation to strategic priorities are necessary, in order to further harmonize with the EU policies in the field of environment. Strengthening of the inspection and enforcement of regulations should eliminate disharmony and law deficiencies that prevent its adoption. Also, an efficient and sustained financial system is essential for the environment and climate policy.

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THE ANALYSIS OF ECONOMY CAPACITIES FOR THE SUPPORT OF ELV RECYCLING

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Abstract: ELV recycling has been observed mostly through spectrum of the environmental pollution and reusing materials and parts partially. However, nowadays, the accent is placed to the complete process, starting from automotive production, to the end of its life cycle. This creates a foundation for establishing sustainable development of the system. This paper, partially presents stimulation methods of a country to the producers and final users of the aged used automobiles. The processes in the ELV recycling industries are presented and partially explained, as well as average ages of used automobiles in the Republic of Serbia and the region. Some of the prerequisites for improvement of the economy capacities are also presented.
Key words: ELV, recycling, economy

INTRODUCTION

The treatment of ELVs and the environmental impact of discarding the resulting residues are subjects of worldwide concern, [1].
End of life vehicles (ELVs) are priority in the EU waste flow, [2]. In an attempt to particularly reduce waste originating from ELVs, in 2000, the EU enforced the ELV Directive (2000/53/EC). It aims to prevent waste generated by ELVs and protect the environment by promoting the collection, reuse and recycling of ELV components, [3].
In order to realize a circulative society, enhancement on resource productivity has been sought in many ways to upgrade the recycling industry, such as implementing governmental regulations, building up control and management schemes, and improving treatment technologies, [4].
The Republic of Serbia is in the beginning of this process. The level of the national conscience about the importance of the End of Life Vehicles (ELV) is, also rather low, which presents the initial problem for this process. Proper planning of a strategy that has to be harmonized with real possibilities and with short and long term aims is the first step for creating the successful process. In order to obtain properly the harmonization of the planned strategy is needed, as well as the harmonization of the process itself.

ELV CHAIN

Recycling industry as a whole is very diverse and includes a wide range of services and productive economic activities, ranging from waste collection and processing, to those who provide reuse of used parts or provide new products from recycled materials, [5].
Figure 1. is a schematic representation of the participants in the ELV chain, according to the EU Directive. The main actor is the producer, a vehicle manufacturer or professional importer of a vehicle into a member state of the European Union, [6].
Activities at the end of life cycle of a motor vehicles are:
- Collecting;
- Removal of hazardous matter (removal of accumulators or batteries, deployment of explosive components, special collection and storage of fuel, motor oil, brake fluids, etc. and collection of all hazardous matter);
- Dismantling (removal of most valuable of most valuable parts for reuse or remanufacturing);
- Control;

- Balling (balling of automotive body shells);
- Shredding (the most demanding activity in terms of technical, energetic and economic activities);
- Material refabrication.

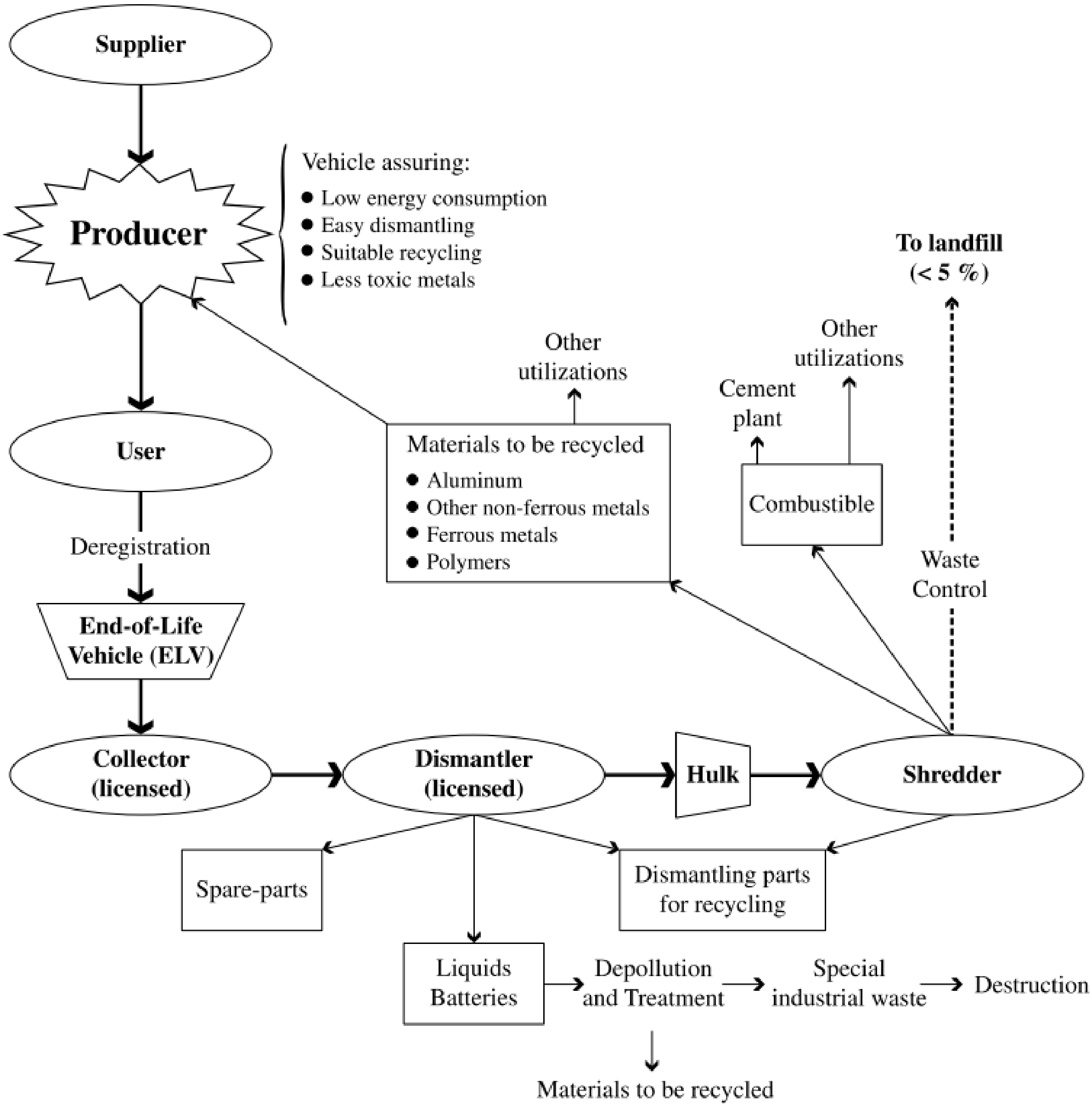

Figure 1. Major steps for ELV recycling according to the EU Directive, [6].

STIMULATION METHODS OF THE STATE AND THE AUTOMOTIVE PRODUCERS

The recycling industry is one of the latest developed ones in our country, the only one that scored slight growth during the world economic crisis. The Serbian Government made a key contribution to the development of the latter industry though the subvention program. Implementing taxes for products that after their life cycle become waste that require special treatment all producers, distributers and importers of latter products are obligatory to pay ecological taxes.
Products that after the end of their life cycle become special waste streams are:

- Tires for motor vehicles (automotive, bus, trucks, motorcycles, etc.), tires for agricultural and civil engineering mechanization, trailers and similar products;
- Asbestos containing products;

- Batteries;
- Mineral and synthetics oils and lubricants that are not suitable for their prior purpose, especially used motor oils and gear shifter oils, and all mineral oils for lubrication, turbine oils, hydraulic oils and other mineral and synthetics oils, as well as any oil that is generated through catering and tourism activities, in the industry, trade and similar activities that require preparation of more than 50 meals a day, as well as the waste sludge worm the production of edible oil;
- Electric and electronic products whose work depend on the electric energy and electromagnetic field, and the products intended for the production, transport and measurement of the electric current and electromagnetic fields for use and voltages that do not exceed 1000 V for the alternate and 1500 V for the direct current;
- Vehicle of the M1 category (motor vehicle for the transport of passengers - passenger vehicle that, beyond the driver seat has maximum eight seats) or N1 (motor vehicle for cargo transport
- Cargo vehicles which maximum allowed mass does not exceed 3.5 t), motor vehicle with three wheels, beyond motor tricycles (L5 category - heavy tricycles) and their unserviceable or scrapped parts, [7].

Along with latter mentioned the subventions for the treatment of special waste streams are implemented. The application of the well known principle "polluter pays" that comes for the EU legislation, through ecological taxation and subventions the proper conditions for the development of the recycling industry and collectors infrastructures should be developed.

Ecological taxation

The Government of the Republic of Serbia has brought a change and an amendment to the Regulation of products that at the end of life cycle become special waste streams. The Regulation is valid since the Year of 2010. According the Regulation producers and importers of products that at the end of life cycle become special waste streams are obliged to pay the ecological taxation. As already mentioned the products included in the Regulation are batteries, accumulators, oils, electric and electronics products, namely, all products that after use become wasted [8].

Scrappage shemes

During the last year in the Republic of Serbia every sixth of the total number of imported automobiles is a new one, which is not an encouraging data from the ecological point of view. In the end of the last year the Fiat Chrysler Automobiles Serbia (FCA) provided a large financial benefit in the scrappage scheme for all the people that wanted to change their old car (older than 10 years) for a new one.
The similar program have being prepared from the Volkswagen Company and brands in their ownership. It is a cash subventions for changing an "old diesel automobile" for a new one that fulfills Euro 6 emission standard in order to reduce the emission of gas pollutants.
The increase of the conscience of buyers and change in "culture" of the population of new "ecological" vehicles are some of the aims of the scrappage subventions.

AVERAGE AGES OF AUTOMOBILES IN SERBIAN AND THE REGION

The assumption is that about 1.9 million of motor vehicles is being used in Serbia. Their average age is about 17 years, [9], which is, right after average ages of automobile in Bosnia the highest one. In Montenegro and average automobile is 14 years old, while the “newest” automobiles are driven in Croatia, Hungary and Albania, with the average age of 12.
Just for comparison, the last data of the Association of European Automotive manufacturers [10] show that average ages in Estonia are 14, Finland 12.3, Portugal 10.5, Sweden 10.5, Germany 8.5, France 8.3, Belgium 8 and Austria 7,7. Also, the average ages in Great Brittan are 7.8 and in Slovenia 8.7. The average automotive age in the EU countries is 8.6, while the Americans mostly drive 11 to 12 years old automobiles.

The average number of ELVs in the Republic of Serbian is about 5.35% of the newly registered motor vehicles (numbers form Table 1)

Table 1. The number of registered and waste vehicles in the Republic of Serbia in the last 14 years, period 2001-2014 [11]

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Average number of ELV-a	73959	71886	74294	77567	79260	80883	79001	79534	87580	83757	89747	92352	94704	96153

Based on the presented numbers of ELVs, the number of licensed recyclers of ELV in the Republic of Serbia is very low, which makes precondition for the development of this industrial branch, along with the non developed market.

POSSIBILITIES FOR INCREASING CAPACITIES OF ECONOMY

The recycling industry in general is a very diverse one and includes wide spectrum of obligingly, productive and economic activities. These activities are widely spread through collecting, processing and reusing of used spare parts, or through providing new products of recycled materials.

For increasing the economy capacities the prerequisite is a quality of the existing recycling system. In order to provide such a system it is necessary to:

- Fully respect legislative acts;
- Create a sustainable market for reuse of the dismantled parts and material in the EU standards (control levels, specifications of parts, warranties etc.);
- Solve existing problems of landfill of hazardous matter;
- Integrate economy subjects and research capacities;
- Integrate economy interests through national and international institutions;
- Implement developing projects;
- Achieve international cooperation etc., [12].

By the fulfillment of latter mentioned conditions the terms for increasing the recycling industries are achieved. Thus one of the youngest economy branches in the Republic of Serbia may be developed along with its capacities.

The improvement of basic infrastructure would contribute to the industrial development through the new investments and setting up technological process aligned to the regulations. Also, introduction to systematic solutions in the area of automotive recycling would result in the reduction of pollutants and improvement of traffic safety and energy consumption because newer automobiles would be used.

All this requires a different structure of professional staff, a variety of recycling technologies and different composition of objects and relevant requirements for their location.

The creation of industrial sector like this, would create conditions for employment of a significant number of workers in jobs of collection, transport, handling, dismantling, etc., [13].

CONCLUSION

Prerequisites in terms of the number of ELVs and licensed recyclers for development of the specific branch of recycling industry, namely ELV recycling industry do exist. However, there are many “brakes” for its development that may be observed through trough some issues of the overabundant import of used automobiles and the highest problem that observes through low economy standard so most of the population is not able to finance buying new vehicles. Still, the continual work may solve this problem with larger involvement of the country because quality work leads to improvements and increases.

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ANALYSIS OF SAFETY OF MATERIAL BY APPLICATION ELV-A RECYCLES TECHNOLOGY

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Abstract: Using recycled materials saves energy and natural resources. Recycling creates less air and water pollution than primary production of raw materials. Recycling saves storage space, create new jobs in companies engaged in the collection, production and distribution of raw materials. In the paper the analysis of the recycling of motor vehicles. Motor vehicle recycling industry contributes to sustainability, environmental protection and energy saving. Recycling of cars includes a variety of procedures, which allow obtaining products floricane materials (metals, plastics, rubber, glass), suitable for the production of new material goods.
Key words: motor vehicles, sustainability recycling.

1. INTRODUCTION

Also, the introduction of system solutions in the field of automobile recycling contributes to the renewal of the fleet and the consequent reduction of pollutant emissions, traffic safety and saving energentics and raw material resources [1]. Huge amounts of automotive scrap today a major issue in all countries of the world. To ensure the successful recycling of motor vehicles is necessary to create an appropriate legal framework and basic infrastructural requirements, which undoubtedly contributed to its development through attracting investments and building technology resources in accordance with the regulations. With the start of mass production of cars and waste from the car, which ended his life, the idea emerged that certain parts of such cars can be re-used (as spares). However, the number of these parts are so small that they appeared large dump cars. These landfills affect the environment, and on the other hand represent a large amount of raw materials that could certain technological processing be re-used for different purposes. Thus, in recent years in developed countries (the U.S., Japan, etc.). There are large corporations that take on the responsibility that this job entails. One of the major contributions of this new industry is to reduce environmental pollution. On the other hand, recycling of cars has been hiring large numbers of workers. These problems occur in all parts of the world so that in all countries a need for companies to deal with the recycling of old cars [2].

ANALYSIS OF SCIENTIFIC KNOWLEDGE IN THE LITERATURE

Energy consumption for the production of secondary raw materials from the recycling process produced significantly lower than those used to obtain material from mining primary production [3]. Recycling of used motor vehicles (ELV) in high-income countries is very successful, especially after the introduction of the shredder in the recycling process of used cars. The rate of recycling in developed countries more than 90% of the used motor vehicles. ELV Recycling helps protect the environment [4]. ELV recycling reduces the minerals from natural sources and generates a source of raw materials for the production of new products derived from recycled materials [5]. Removing environmentally harmful components and materials, specialty oils, brake fluid, antifreeze, air bags, mercury, Freon and similar substances require special treatment and expertise in areas such waste dismantling. In Germany, Centers for dismantling vehicles covering a circle with a radius of 50 kilometers. In Serbia there are about 1.4 million passenger cars and light commercial vehicles. The estimated number of annual waste produced by 120.000 cars a year, which means that a larger number of equipped recycling operators [6]. Recycling of used motor vehicles in the world, is an efficient process which recycles more than 75% of the cars, along with the rate of used cars collected by 95%. In the United States, is recycled about 11 million units, representing a $ 5 billion of revenue. Automobile Recycling Industry in the United States employs more than 40.000 employees in more than 7.000 companies. In the EU, the number of recycled car reaches 9 million per year, equivalent to 2.2 million tons of waste. As in the U.S., profit mainly by selling used parts and metal. Based on the data [7], the number of used cars in the Republic of Serbia, is approximately 100.000 per year. Taking this estimate of the number of used cars, as well as the percentage utilization of certain materials per vehicle, obtained 68.000 tons of ferrous metals, nonferrous metals 6.000 tons, 8.000 tons of plastics and composites, 1.400 tons of fluids, 5.000 tons of rubber, 3.500 tons of glass, 1.000 tonnes of textiles, 1000 battery tons and 6.100 tons of other waste from the used car. In the Republic of Serbia, during the process - recycles 14% of used motor vehicles, because the capacity for industry remains underdeveloped. In the domestic market ELV recycling, demand for secondary raw materials is high, and the level of recycling of 14%, should increase to European levels by 75%. On the basis of the ELV recycling system, we need new investment of over 20 million, in several plants shredder and mobile Balir presses, and increase the efficiency of the [8].

2. CAR RECYCLING TECHNOLOGIES

In Serbia, there are over a million vehicles whose average age is over 10 years. The collection and disposal of waste vehicles mostly depends on supply and demand. Parts with use value is extracted in smaller amount, depending on their age and condition of end. The automobile recycling facilities in the world it is possible to recycle about 80% by weight of the car. The process of recycling cars is complex because of the variety of materials that are part of the car. Middle-class car, on average, consists of 76% metal, plastic 8%, 4% rubber, fluid 6%, 3% glass and other materials 3%, [9]. Apply two car recycling technologies, which differ in the way of sorting the material that make up the car. The first technology is based on optical (manually) separation, and other technology uses multiple methods (grinding, gravity separation methods and special). A third possibility is that the whole car pressed in one piece, using mobile balir presses [10].
Further classification of non-metals and non-ferrous metals in fruiting material, achieved through a combination of gravity and special separation methods (electrostatic, optical, etc.), [11].

3. RESULTS AND DISCUSSION

Motor vehicle recycling of end of life, according to [12], is still at an early stage and does not engage a significant number of workers. The research within the project of technological development is defined by a model of integrated and sustainable recycling of motor vehicles at the end of the life cycle [13]. Thus the set basis for the development of new industries and thus create real conditions for intensive employment in jobs recycling. These tasks include collection and transportation of waste motor vehicles, their removal, selection of components and materials, recovery of components for reuse, crushing shells and chassis, separation of materials, recycling materials, the final disposal of waste. All this requires a different structure of professional personnel, various recycling technologies and the different composition of objects and corresponding requirements for their location [14]. In Serbia, so far no systematic not address this problem in solving environmental and social, and economic problems when it comes to preserving the natural resources of our country. The project aims to [15, 16], to localize potential waste motor vehicles, which can be recycled or used for energy. The most important thing is to determine the scope and structure of the permanent disposal of motor vehicles, especially hazardous waste and suggest measures for their removal or safe storage [17, 18]. The papers [19, 20], is predicted to form an appropriate centers for the breakdown of used motor vehicles by the respective regions. The significance of the project is big, because it provides savings in the form of recycled materials. If we know now about 120 thousand cars a year off, and thus are ready for the recycling process, the weight of every vehicle around 1 ton, of which about 70% feromagnetics materials, there are also non-ferrous metals, plastics, rubber; We can not imagine how it is stored resources. Obtaining metals from recycling leads to saving power generation, such as: steel 74%, aluminum 95%, copper 85%, lead 65%. Getting metal recycling reduces water consumption by 40%, reduces water pollution by 76% and air pollution by 86%. In developed countries (35 to 45) % of the new steel is obtained by recycling [21]. Recycling is the future to solve the problem of waste motor vehicles, in terms of sustainable development. A clear example that proves the previous statement is given in Table 1, [22, 23].

Table 1. Saving energy by using recycled materials

Materials	**(%)**
Copper	85
Lead	65
Zinc	60
Aluminum	95
Iron and steel	74
Magnesium	98
Titanium	58
Paper	64
Plastic	80

As can be seen from Table 1, the energy savings by using recycled materials is very important. The investment costs for the construction of waste treatment plants and metal production only (16 to 20) % of the cost to build a plant for processing the raw materials - minerals. In addition, manufacturing technologies based on the processing of secondary metals are much easier and more acceptable for the environment as the example of iron and steel clearly seen in Table 2.

Table 2. The benefits of using iron and steel from waste materials

Benefits	**(%)**
Energy savings	74
Saving material from ore	90
Reducing air pollution	86
Reduction of water consumption	40
The reduction of water pollution	76
Reduction of mining waste (tailings)	97

4. CONCLUSION

Motor vehicle recycling of end of life, according to the proposed model is based on the principles of sustainable development [24]. The establishment of this model in Serbia, in addition to environmental and economic effects of providing a high level of employment, which is very important for social policy. Thus, the number of employees in the entire cycle of recycling of motor vehicles at the end of the life cycle ranges from 6.000 to 20.000 employees. Number of employees varies as a function of:

- ELV available number in the current year,
- the degree of recyclability,
- the level of motor vehicle dismantling,
- available recycling technologies,
- New products from materials provided by ELV.

Since the operators are to be deployed on the territory of Serbia, so that citizens in their old cars can be submitted at the nearest recycling center which will be issued and a receipt which can be realized certain benefits when purchasing a new car. In this way, the action will involve all those involved in the recycling of batteries, waste oil, antifreeze, glass, plastic and everything that makes a car, and it is necessary to invest a total of over 20 million Euros [25]. Metals and energy consumption in the world has a great trend. The reserves are rapidly being depleted. Scrap metal is a very important secondary resource, whose collection and return of the reprocessing process significantly reduces the consumption of primary raw materials, extends the life of the reserves and reduce environmental pollution. Re-use of metals from waste and general reuse of other materials has great economic justification.

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THE INFLUENCE OF VIBRATIONS ON THE NEUROSENSORY SYSTEM THAT IS TRANSMITTED TO THE HANDS AND ARMS

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Abstract: At the beginning of the work, it is given in general about vibrations. Some examples of vibrations are transferred to the hands and arms. The highest part of the work is related to the effect of vibrations on the neurosensory system. It is given what modifies vascular problems what a doctor will do in that case
Key words: Hand-arm vibration, neurosensory system

1. INTRODUCTION

Hand-arm vibration is caused by vibration transmitted into the hand and arms through the palm and fingers. Vibrations arise when a body oscillates due to external and internal forces Figure 1. In the case of hand-arm vibration, the handle of a machine or the surface of a work piece vibrates rapidly, and this motion is transmitted into the hand and arm.

Figure 1. Hand-arm vibration[1]

Vibration is defined by its magnitude and frequency. The magnitude of vibration could be expressed as the vibration displacement (in meters), the vibration velocity (in meters per second) or the vibration acceleration (in meters per second per second or m/s^2). Most vibration transducers produce an output that is related to acceleration; so acceleration has traditionally been used to describe vibration.
Frequency is the number of times per second the vibrating body moves back and forth. It is expressed as a value in cycles per second, more usually known as hertz (abbreviated to Hz). For rotating tools the dominant frequency is usually determined by the speed at which the tool rotates (usually expressed as the number of revolutions per minute or rpm; dividing the rpm by 60 gives the frequency in Hz). For hand-arm vibration, the frequencies thought to be important range from about 8 Hz to 1000 Hz. However, because the risk of damage to the hand is not equal at all frequencies a *frequency-weighting* is used to represent the likelihood of damage from the different frequencies. As a result, the weighted acceleration decreases when the frequency increases. For hand-arm vibration, only one frequency-weighting curve is used for all three axes [1].
The risks from hand-arm vibration affect people across many industries and occupations. The risks are greatly increased with use of higher vibration equipment and with prolonged and regular use of the

equipment. However, investigations have shown that vibration hazards can be controlled and risks reduced by good management. They have also shown that the costs of such controls need not be high and can usually be offset by the benefits of keeping workers healthy. Additionally, the vibration control measures have, in many cases, led to improved efficiency[1].

2. EFFECTS ON HUMAN BODY – NEUROLOGICAL DISORDERS

Workers exposed to hand-transmitted arm vibration may experience tingling and numbness in their fingers and hands. If vibration exposure continues, these symptoms tend to worsen and can interfere with work capacity and life activities. Vibrationexposed workers may exhibit a reduction in the normal sense of touch and temperature as well as an impairment of manual dexterity [2].

Effects on human performance(some problem)

- The motor control problem - vibration may make it difficult to maintain control over the instrument or tool being used.
- The tactile problem - both short and long term exposure to hand-arm vibration may cause a loss of sensitivity in the fingers and hand.

The motor control problem

- The proprioceptive system conveys information about the joint angles. The brain calculates the position in space of the hand or arm.
- The kinaesthetic system conveys a sense of motion of the limbs to the brain. This information is necessary for the brain to coordinate motion.

Because most tasks become more difficult to complete the worker has to devote more mental effort to the task, which in turn:

- Increases the likelihood of accidents and injuries
- Decreases the comfort level experienced by the worker
- Mental fatigue reduces the amount of time that worker can continue to work in such an environment.

Combating the motor control problem

- Avoid or minimize exposure
- Isolate or dampen the vibration

– Machine side - Changes can be made to the tool or instrument, e.g. adding better grip to tool
– User side - These interventions can include teaching workers better grips and working positions.

- Training can improve performance on almost any motor skill.
- Accuracy in a skilled motor task can be improved by increasing the amount time available to complete the task.

The tactile problem

- The result of prolonged exposure and are most problematic in fine motor activity.
- Typically, tactile problems are most obvious directly after exposure.
- The loss of sensitivity in the fingers makes it more difficult to make judgments of texture, weight and form of the objects being handled.

In extreme cases, permanent damage may occur and sensitivity will never return.

Combating the tactile problem

- Eliminating or minimize the exposure
- Ensure proper recovery times.
- Complete as many fine motor movements as possible before using power tools.
- Looking directly at the hands while performing a task can compensate for some sensitivity loss [3].

2.1 Temporary neurosensory effects

The acute responses revealed in experiments with vibration exposure include the following: temporary threshold shift (TTS) for vibrotactile, thermal perception, and two-point discrimination, vascular tone change, nerve conduction impairment, increased axon excitability experienced as postexposure paresthesia, altered sensorimotor reflexes such as the tonic vibration reflex and g-loop interference indicated by disillusion of limb position with deranged performance.

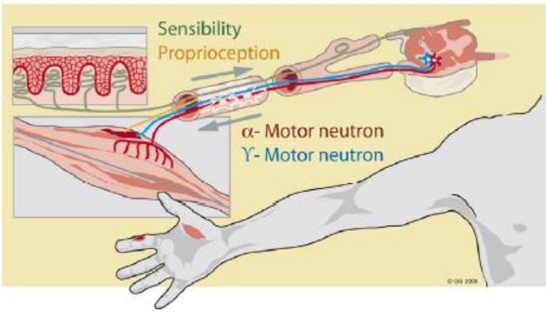

Figure 2. Temporary neurosensory effects[2]

2.2 Permanent effects: neurosensory shift

Disturbances in hand function (commonly reported as numbness, paresthesia, and difficulty in performing manipulative tasks) have been witnessed by workers handling vibrating power-machines and among ordinary manual workers. The association between reported symptoms and vibrotactile acuity is not straightforward. One study noted that these symptoms were predicted by questions relating to hand function, a finding that is compatible with basic somatosensory concepts of negative (loss of function) and positive phenomena (additional symptoms). Negative symptoms dominate and refer to numbness and other loss or absence of feeling, reduced proprioception, and difficulty with motor skills.

Carpal-tunnel syndrome

Epidemiological research in workers has also shown that use of vibrating tools in combination with repetitive movements, forceful gripping, awkward postures may increase the risk of carpal tunnel syndrome [2].

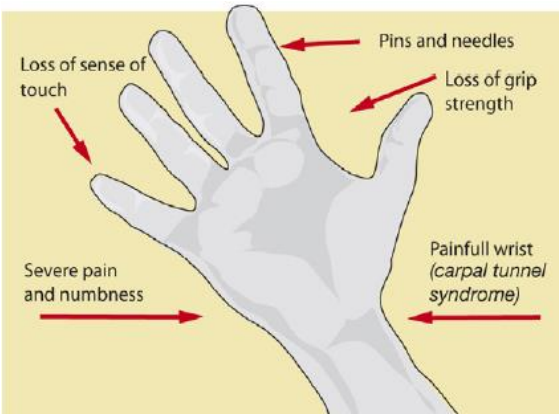

Figure 3. Carpal tunnel syndrome and other effects[2]

Negative sensory symptoms are often late indicators of afferent dysfunction. Positive manifestations also reflect dysfunction and are expressed mostly as symptoms (such as tingling, buzzing, and pricking) without signs. Positive phenomena are largely due to abnormal generation of impulses in sensory channels. Microelectrode recordings from the median nerve on human subjects exposed to vibration and to electric pulse trains indicate that paresthesia could be attributed to disturbances in afferent sensory fibres. A significant category of positive sensory phenomena involves inadequate subjective response to natural stimulation of receptors (e.g., abnormal intolerance of cold in a case series of vibration-exposed patients). The discrepancy between symptoms and signs may entail sensory impairment without subjective recognition or symptoms. Experience suggests that neurological symptoms can exist without detectable signs and there might be signs that avoid detection.

2.3 Neurosensory system

When understood as a sense organ the hand entails peripheral sensory endorgans in the skin and nerves that carry the stimuli to nerve impulses and to the cortex. Disturbances of the sensory system can be located anywhere from the peripheral nerves and sensory end-organs to the central cortex.

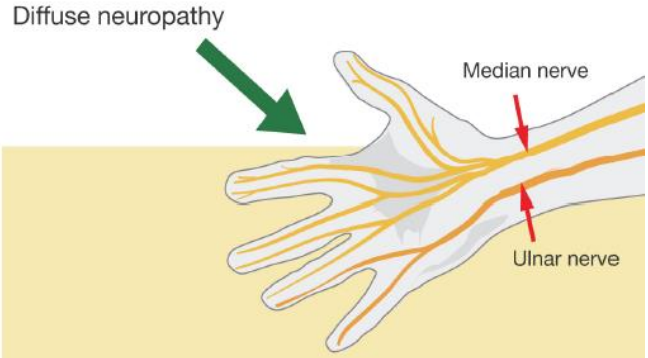

Figure 4. Neurosensory system[2]

Researchers have reported histological changes such as thickening of muscular layers, fibrosis in the peripheral arteries, demyelinating neuropathy, and loss of nerve fibres in the peripheral nerves of workers who used vibrating tools. Excessive vibration exposure of rat-tail resulted in ultra structural changes such as detachment of the myelin sheath, constriction of the axon and deranged paranodal regions accompanied by reduced nerve conduction. These results agree with earlier findings. Finger biopsies from patients with vibration white fingers have a characteristic perineurial fibrosis, thickened perineurium, reduced number of nerve fibres, and reduction in the size of myelinated fibres. The structural nerve injuries associated with vibration are dominated by myelin breakdown and interstitial perineurial fibrosis associated with incomplete regeneration or with organisation of oedema. Experimental evidence of disturbed microcirculation in relation to vibration exposure is revealed by the associated formation of intraneural oedema. The thin (unmyelinated) sympathetic nerve fibres seem to be particularly sensitive to the detrimental effect of vibrating machines [2].

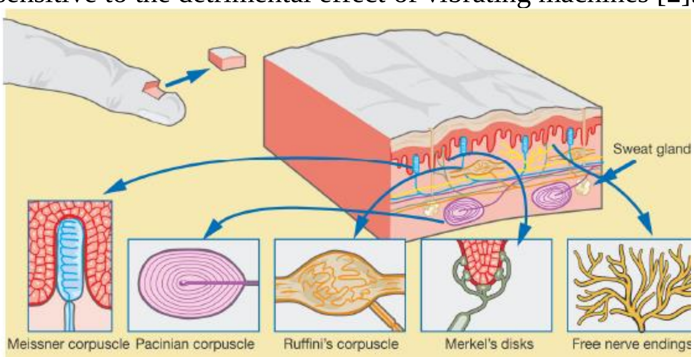

Figure 5. Histological changes such as thickening of muscular layers, fibrosis in the peripheral arteries, demyelinating neuropathy, and loss of nerve fibres in the peripheral nerves of workers who used vibrating tools.

3. HEALTH SURVEILLANCE TECHNIQUES

What do I need to do about the results of health surveillance?

You need to make a decision about an individual employee if the doctor advises you that they are not fit for work with exposure to vibration. The employee is at risk of developing disabling loss of hand function if exposure is allowed to continue. You should consider assigning the employee to alternative work where there is no risk from further exposure to vibration. If you are informed that an employee has been diagnosed with HAVS but is still fit for work with exposure to vibration, it is good practice for you to consider taking further action to reduce that employee's exposure. Health surveillance results should be used to check the long-term effectiveness of your control measures. If the number of employees with HAVS has increased, or if the disease is progressing in affected individuals, you need to review your risk assessment and action plan [1].

What if no symptoms are reported?

If no symptoms are reported on the screening questionnaire, there is no need to refer the employee for further assessment, but they should complete the simple questionnaire again on an annual basis (Tier 2). HSE recommends that after three years of a vibration-exposed employee reporting no symptoms they should be referred for a consultation with an occupational health nurse to provide an opportunity to explore more fully any possible symptoms that the individual may have overlooked.

What type of records should I keep?

You should keep a health record for each individual for as long as they are under health surveillance, although you may wish to retain it for longer. It is good practice to offer individual employees a copy of their health records when they leave your employment, if your business should cease trading or the employee ceases to be exposed to vibration. The record should be kept up to date and should include:

- identification details of the employee;
- the employee's history of exposure to vibration;
- the outcome of previous health surveillance in terms of fitness for work, and any restrictions required;

Health records should not contain personal medical information, which must be kept in confidence in the medical record held by the occupational health professional. The enforcing authority is entitled to ask to see your health records as part of their checks that you are complying with the Vibration Regulations [1].

Could an occupational health service provider carry out a complete health surveillance service?

Health surveillance may consist of an evaluation of the case history for a worker in conjunction with a physical examination conducted by a doctor or suitably qualified health-care professional[3], [4]..

The case history

The case history should focus on:

- family history,
- social history, including smoking habit and alcohol consumption.
- work history, including past and current occupations with exposure to hand-arm vibration, previous jobs with exposure to neurotoxic or angiotoxic agents and any leisure activities involving the use of vibrating tools or machines.
- personal health history.

The physical examination

A physical examination should look in detail at the peripheral vascular, neurological, and musculoskeletal systems, and should be performed by a qualified physician [3], [4].

Clinical tests

In general, clinical tests do not provide reliable proof of vibration injury, however, they may be helpful to exclude other causes of symptoms similar to those of hand-arm vibration syndrome or to monitor progression of injury. Tests for the peripheral vascular system include the Lewis-Prusik test, the Allen test, and the Adson test.
Tests for the peripheral nervous system include the evaluation of manual dexterity (e.g. coin recognition and pick up), the Roos test, the Phalen's test and the Tinel's sign (for carpal tunnel compression)[3], [4].

4. CONCLUSION

Health surveillance is about putting in place systematic, regular and appropriate procedures for the detection of work-related ill health, and acting on the results. The aims are primarily to safeguard the health of workers (including identifying and protecting individuals at increased risk), but also to check the long-term effectiveness of control measures. Health surveillance may consist of an evaluation of the case history for a worker in conjunction with a physical examination conducted by a doctor or suitably qualified health-care professional. Complete health surveillance is: the case history, the physical examination, clinical tests, vascular investigations, neurological investigations, muscle strength investigations, radiological investigations and laboratory tests.

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THE INFLUENCE OF VIBRATIONS ON THE VASCULAR SYSTEM THAT IS TRANSMITTED TO THE HANDS AND ARMS

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Abstract: At the beginning of the work, it is given in general about vibrations. Some examples of vibrations are transferred to the hands and arms. The highest part of the work is related to the effect of vibrations on the vascular system. It is given what modifies vascular problems what a doctor will do in that case
Key words: Hand-arm vibration, vascular system

1. INTRODUCTION

Hand-arm vibration is caused by vibration transmitted into the hand and arms through the palm and fingers. Vibrations arise when a body oscillates due to external and internal forces Figure 1. In the case of hand-arm vibration, the handle of a machine or the surface of a work piece vibrates rapidly, and this motion is transmitted into the hand and arm.

Figure 1. Hand-arm vibration

Vibration is defined by its magnitude and frequency. The magnitude of vibration could be expressed as the vibration displacement (in meters), the vibration velocity (in meters per second) or the vibration acceleration (in meters per second per second or m/s^2). Most vibration transducers produce an output that is related to acceleration; so acceleration has traditionally been used to describe vibration.
Frequency is the number of times per second the vibrating body moves back and forth. It is expressed as a value in cycles per second, more usually known as hertz (abbreviated to Hz). For rotating tools the dominant frequency is usually determined by the speed at which the tool rotates (usually expressed as the number of revolutions per minute or rpm; dividing the rpm by 60 gives the frequency in Hz). For hand-arm vibration, the frequencies thought to be important range from about
8 Hz to 1000 Hz. However, because the risk of damage to the hand is not equal at all frequencies a *frequency-weighting* is used to represent the likelihood of damage from the different frequencies. As a result, the weighted acceleration decreases when the frequency increases. For hand-arm vibration, only one frequency-weighting curve is used for all three axes.
The risks from hand-arm vibration affect people across many industries and occupations. The risks are greatly increased with use of higher vibration equipment and with prolonged and regular use of the

equipment. However, investigations have shown that vibration hazards can be controlled and risks reduced by good management. They have also shown that the costs of such controls need not be high and can usually be offset by the benefits of keeping workers healthy. Additionally, the vibration control measures have, in many cases, led to improved efficiency.

2. EFFECTS ON HUMAN BODY - VASCULAR SYSTEM

Work with vibrating machines includes exposure to a manifold of possible health hazards among which vibration is only one. Such tasks may introduce the worker to the risk of a variety of disorders in addition to the risk of contracting hand-arm vibration syndrome. Work-related neuro-musculoskeletal disorders are the most common health hazard connected to hand-intensive manual work. There is an established association between the ergonomic load of the work and the contraction of disorders in the upper extremity such as shoulder and hand-wrist tendonitis, epicondylitis, thoracic outlet syndrome, and carpal tunnel syndrome. Under unfavourable conditions, interaction between work, work demands, support, organisation, and the worker may result in sustained stress and eventually in stress-related disorders. High-energy expenditure from power tools relates to noise and dust exposure. The noise may cause noise-induced hearing loss. The content of the dust or the coating of the particles may be hazardous to the lung function. Lubrication from the machines and vapours emitting from cooling liquids may irritate the
mucous membranes in the eyes, nose, throat, and lungs, as well as the skin, an exposure that often causes allergic reactions.

2.1 Hand-arm vibration syndrome (HAVS)

Extensive and long-lasting exposure to manual work involving the use of vibrating power tools has been associated with persistent health disorders. The major health hazards reported include the following: a disorder of the peripheral micro-circulation, cold-induced Raynaud's phenomenon or "vibration white fingers" (VWF), and neurological disorders in the peripheral nervous system, either in the form of nerve entrapment at various locations or as a peripheral nerve effect in the form of diffusely distributed neuropathy. The manifestation of the neuropathy can reduce perception (numbness, impaired sensations of „needles and pins". The musculoskeletal system may also be influenced by vibration, resulting in impaired sensory-motor function or by adverse effects on joints or bones. These health effects are collectively summarised as the hand-arm-vibration syndrome (HAVS).

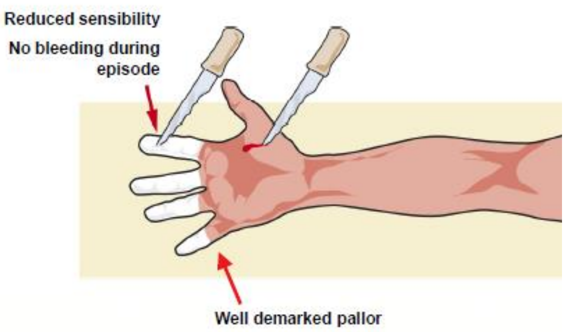

Figure 2. Effects: Vibration white fingers “VWF”

2.2 Vibration and the upper extremity

Physical vibration-exposure characteristics such as frequency and intensity relates to which body-part and how detrimental the effects will be on the worker. The possible hazardous effects from vibration could be mediated by simple mechanical impact or by general physiological responses. Highfrequency vibration exposure mechanically influences the body parts close to the contact area. Low frequency vibration-exposure may exert mechanical influence further away from the contact area, negatively influencing other parts of the body. In figure 3, red-colour indicates areas under mechanical impact from vibration in relation to 1000 Hz 100 Hz and 10 Hz vibration frequency. Effects from general physiological responses could influence both close and distant body parts. The influence of local impact compared to centrally mediated physiological mechanism is not known. In addition to the physical characteristics of vibration, organisational aspects such as continuous or intermittent work and the opportunity to take rest-periods determine the influence of vibration. Individual characteristics in work technique, tool handling, body constitution, posture, skill, and the use of protective equipment also control the influence of vibration on the worker.

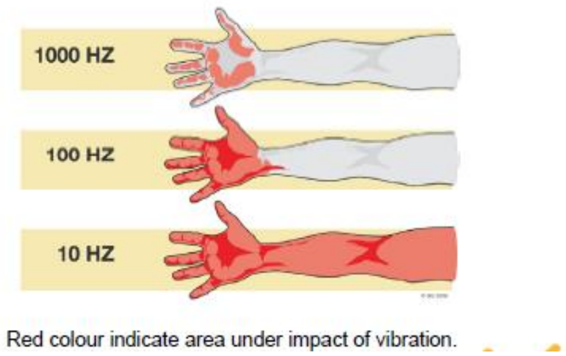

Figure 3. Vibration and the upper extremity

2.3 Permanent effects: Vibration white fingers „VWF"

The principal vascular disorder associated with exposure to hand-arm vibration is traditionally called vibration-induced „white fingers". That is, workers using hand-held vibrating machines may experience episodic attacks of clearly demarked finger blanching in response to exposure to body cooling due to cold, cooling conditions such as windy, damp conditions, and vibration exposure or emotional stress. Significant and well-demarked pallor of the affected digits, associated with concomitant numbness, characterizes a „white-finger" episode. In addition, this reduction in peripheral blood-flow inhibits bleeding if cut. A „white-finger" episode often begins with blanching in the distal phalanges and may extend proximally to additional phalanges. Spotted patches of blanching may also occur. There may be a sequence of colour changes in which blanching is followed by redness. Blanching is accompanied with reduced sensibility and redness may be followed by a sensation of pain. People who have contracted an altered vascular function may experience a sensation of increased sensitivity to cold even without noticing „white fingers". This „cold-intolerance" may stem from either neurosensory or vascular dysfunction. The increased sensitivity of the peripheral vascular system resulting in vasospasm is variously called vibration induced white fingers (VWF) or „secondary" RaynaudÊs phenomenon (in contrast to „primary‰ RaynaudÊs phenomenon where the aetiology is unknown).

3. HEALTH SURVEILLANCE TECHNIQUES

Health surveillance is about having procedures to detect work-related ill health at an early stage and acting on the results. The main aims are to safeguard the health of employees (including identifying and protecting people at increased risk), and also to check the long-term effectiveness of control measures. In the case of hand-arm vibration, one of the specific aims is to prevent employees developing an advanced stage of hand-arm vibration syndrome (HAVS) associated with disabling loss of hand function. It is possible that your employees who are exposed to vibration may have mild symptoms of HAVS. If they are not aware that they have the disease, healthsurveillance can help them to recognise that the first symptoms of HAVS have started to develop [1].

When is health surveillance required?

Health surveillance should be provided for vibration-exposed employees who:

- are likely to be regularly exposed above the action value of 2.5 m/s2 A(8);
- are likely to be exposed occasionally above the action value and where the risk assessment identifies that the frequency and severity of exposure may pose a risk to health; or
- have a diagnosis of HAVS (even when exposed below the action value).

If you are self-employed there is no legal requirement for you to have health surveillance for HAVS. However, it is important for your well-being, and for your ability to remain in work, that you identify any early signs of HAVS and take appropriate action. It is therefore recommended that you follow this guidance if you think you are at risk from vibration [1].

What do I actually have to do?

You need to ensure that you achieve an effective health surveillance programme in the workplace, including co-operation from employees. When you plan to introduce health surveillance, explain to your employees and their safety or employee representatives what you are proposing to do and give them the opportunity to comment on your proposals. Employees need to be given information about the reasons for carrying out health surveillance and they need to understand their roles and responsibilities.

What do I need to do about the results of health surveillance?

You need to make a decision about an individual employee if the doctor advises you that they are not fit for work with exposure to vibration. The employee is at risk of developing disabling loss of hand function if exposure is allowed to continue. You should consider assigning the employee to alternative work where there is no risk from further exposure to vibration. If you are informed that an employee has been diagnosed with HAVS but is still fit for work with exposure to vibration, it is good practice for you to consider taking further action to reduce that employee's exposure. Health surveillance results should be used to check the long-term effectiveness of your control measures. If the number of employees with HAVS has increased, or if the disease is progressing in affected individuals, you need to review your risk assessment and action plan [1].

What if no symptoms are reported?

If no symptoms are reported on the screening questionnaire, there is no need to refer the employee for further assessment, but they should complete the simple questionnaire again on an annual basis (Tier 2). HSE recommends that after three years of a vibration-exposed employee reporting no symptoms they should be referred for a consultation with an occupational health nurse to provide an opportunity to explore more fully any possible symptoms that the individual may have overlooked.

What type of records should I keep?

You should keep a health record for each individual for as long as they are under health surveillance, although you may wish to retain it for longer. It is good practice to offer individual employees a copy of their health records when they leave your employment, if your business should cease trading or the employee ceases to be exposed to vibration. The record should be kept up to date and should include:

- identification details of the employee;
- the employee's history of exposure to vibration;
- the outcome of previous health surveillance in terms of fitness for work, and any restrictions required;

Health records should not contain personal medical information, which must be kept in confidence in the medical record held by the occupational health professional. The enforcing authority is entitled to ask to see your health records as part of their checks that you are complying with the Vibration Regulations [1].

Could an occupational health service provider carry out a complete health surveillance service?

Health surveillance may consist of an evaluation of the case history for a worker in conjunction with a physical examination conducted by a doctor or suitably qualified health-care professional[3], [4]..

The case history

The case history should focus on:

- family history,
- social history, including smoking habit and alcohol consumption.
- work history, including past and current occupations with exposure to hand-arm vibration, previous jobs with exposure to neurotoxic or angiotoxic agents and any leisure activities involving the use of vibrating tools or machines.
- personal health history.

The physical examination

A physical examination should look in detail at the peripheral vascular, neurological, and musculoskeletal systems, and should be performed by a qualified physician [3], [4].

Clinical tests

In general, clinical tests do not provide reliable proof of vibration injury, however, they may be helpful to exclude other causes of symptoms similar to those of hand-arm vibration syndrome or to monitor progression of injury. Tests for the peripheral vascular system include the Lewis-Prusik test, the Allen test, and the Adson test.
Tests for the peripheral nervous system include the evaluation of manual dexterity (e.g. coin recognition and pick up), the Roos test, the Phalen's test and the Tinel's sign (for carpal tunnel compression)[3], [4].

Vascular investigations

The vascular assessment of the hand-arm vibration syndrome is mainly based on cold provocation tests: assessing changes in finger colour, recording recovery times of finger skin temperature, and measuring finger systolic blood pressure. Other noninvasive diagnostic tests, such as Doppler recording of arm and finger blood-flow and pressure, may also be useful [3], [4].

CONCLUSION

Hand-arm vibration syndrome has an impact on social and family life. Periodic attacks of impaired blood circulation will take place not only at work, but also during activities such as car washing or watching outdoor sports. Everyday tasks, for example managing small buttons on clothes may become difficult. Health surveillance is about putting in place systematic, regular and appropriate procedures for the detection of work-related ill health, and acting on the results. The aims are primarily to safeguard the health of workers (including identifying and protecting individuals at increased risk), but also to check the long-term effectiveness of control measures. Health surveillance may consist of an evaluation of the case history for a worker in conjunction with a physical examination conducted by a doctor or suitably qualified health-care professional. Complete health surveillance is: the case history, the physical examination, clinical tests, vascular investigations, neurological investigations, muscle strength investigations, radiological investigations and laboratory tests.

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Session 3.

Process Technique

APPLICATION OF THE PLC FOR VACUUM PUMP MANAGEMENT

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Abstract: Specialized enhanced computers, called programmable logic controllers (PLCs), are often used to automate production processes. This leads to precise management that allows strict control of almost all industrial processes. This paper presents the necessary hardware and software equipment for controlling four vacuum pumps using a PLC.
Key words: vacuum pump, PLC control

1.0 INTRODUCTION

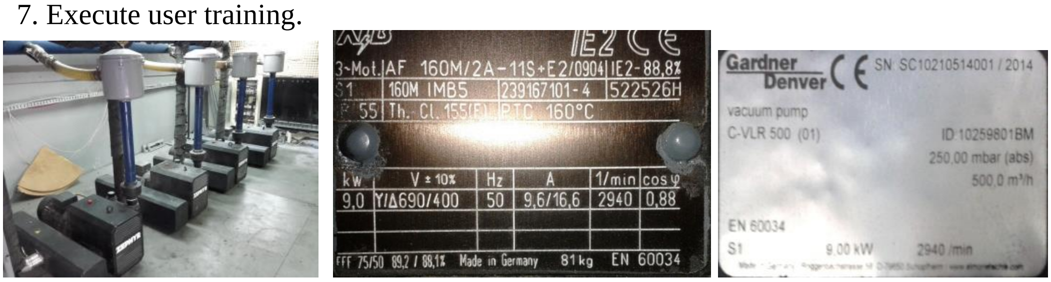
Automation, robotics, industrial automation or numerical control is the use of control systems like computers to control industrial machinery and processes in order to replace human operators.
In this paper we will consider the existing vacuum pump system, which has only manual control, i.e. switching on and off of each pump is done manually, directly via the keys from the control box. This increases production costs because workers in the production include pumps (as needed), but often do not exclude them when they are not needed, which significantly increases the costs due to high electricity consumption. Also, if an insufficient number of pumps are switched on, this will affect vacuum variations, which has negative consequences in the production process (increasing the number of non-compliant products).
Due to previous deficiencies, it is necessary to reconstruct the automation and regulation of vacuum pumps of the existing system with four vacuum pumps, installation of new equipment (PLC-Programmable logic controller).

2.0 APPLICATION OF THE PUMP VACUUM PUMP UPDATES

2.1 Hardware structure for management VAKUUM PUMP assistance PLC

For the reconstruction of the existing system, four vacuum pumps of clay type Fig. 1. a), whose characteristics are given in Fig. 1. b) and c), which are controlled exclusively by manual means, reengineering is required to be controlled by PLC. In order to achieve this, it is necessary to do the following:

1. Record the existing state in the closet - wiring, number of terminals, buttons and bulbs.
2. Make a new electro-project in accordance with the set requirements.
3. Install the new equipment according to the new electro-project and make the change of the wiring.
4. Examine the control cabinet - wiring.
5. Program the PLC.
6. Start the automatic system.
7. Execute user training.



a) б) c)

Figure 1. Four-vacuum pump system

2.2 SOFTWARE structure for the realization of defined tasks

2.2.1 Easysoft PRO 6

The program used to write software for PLC is "Easysoft PRO 6". When starting the program, the home screen opens where it is first necessary to define the hardware configuration of the PLC. By selecting from the submenu group (Figure 2., numbers 1 and 2) of the corresponding hardware components and dragging to the right part of the screen, we form the hardware configuration of the PLC.

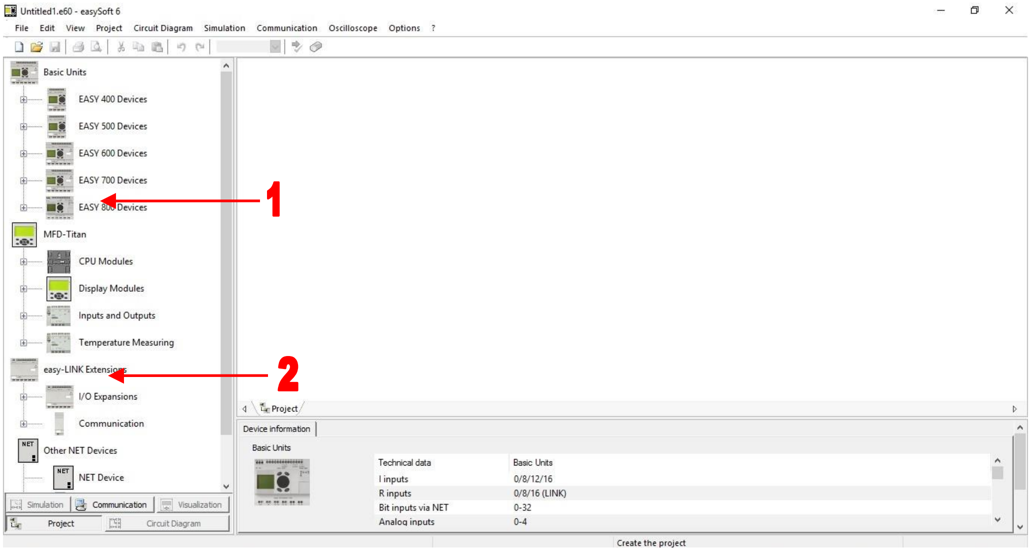


Figure 2. The appearance of the home screen with the submenu display

1. Submenu for selecting an additional card
2. Submenu for selecting the CPU, display and U / I card

In the following Figures 3., 4., 5., the procedure for establishing the hardware configuration of the PLC.
First, it is necessary to select the CPU, then the U / I unit, the panel and the additional module.
When we select an additional card (in our case EASY 821-DC-TCX), the program will automatically connect an additional card with the rest of the configuration.
When we created the hardware configuration of the PLC, clicking on the "Circuit Diagram" tab opens a new window (within the main screen) in which we write PLC software. (Figure 6).
By clicking on the appropriate contact inputs, outputs, timers, comparators or some other element, by dragging them into the ledger window, we create the PLC software. It is necessary to define in the software the appropriate input / output corresponding to the physical input / output in accordance with the electro project.
"Circuit diagram elements" (in Figure 6, labeled by the number (1) when added to the ledger diagram, it is only necessary to define their regular number depending on the function in the software, while for functional blocks (2) it is necessary beside adding to the ledger diagram, perform and define their parameters (Figure 7.) For some it is necessary to make their "enabling", for example, for PID regulation (Figure 8.)
After that, clicking on the "Visualization" tab opens a new window (in the home screen). Figure 9. It defines user screens to allow the user to easily manage and inspect the plant. User screens can be more. They do not have to have too much to make it difficult for the user to manage it. On the screens, parameters are set, over which work is supervised, and the control and inspection of the plant. In our case, there are information about the vacuum (vacuum values), the operation of the pump whether they are included, the operating time, which is selected). It is also possible to set PID parameters.

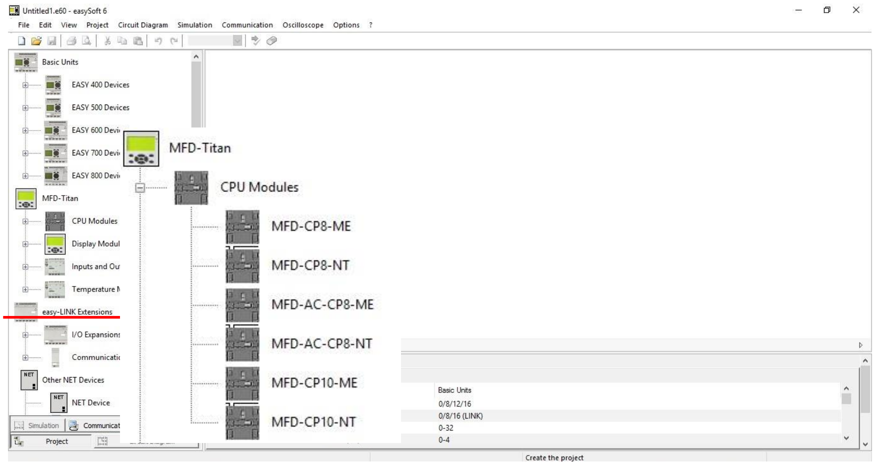


Figure 3. Selecting a CPU

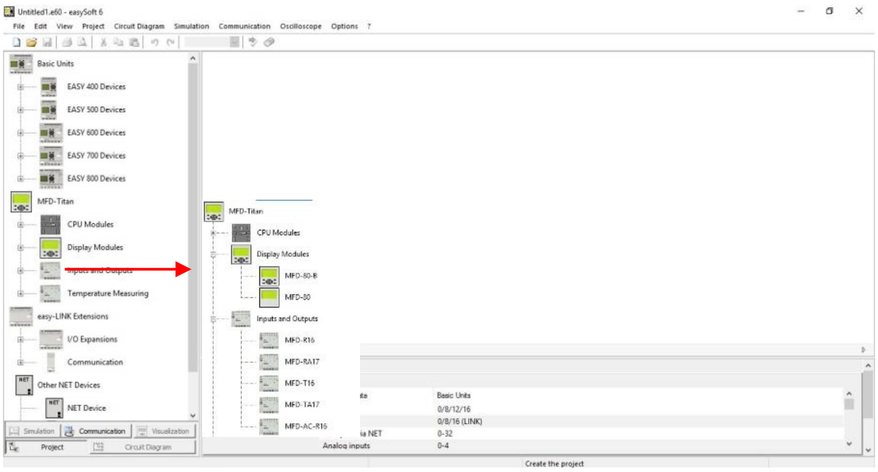


Figure 4. Selecting the display and I / O cards

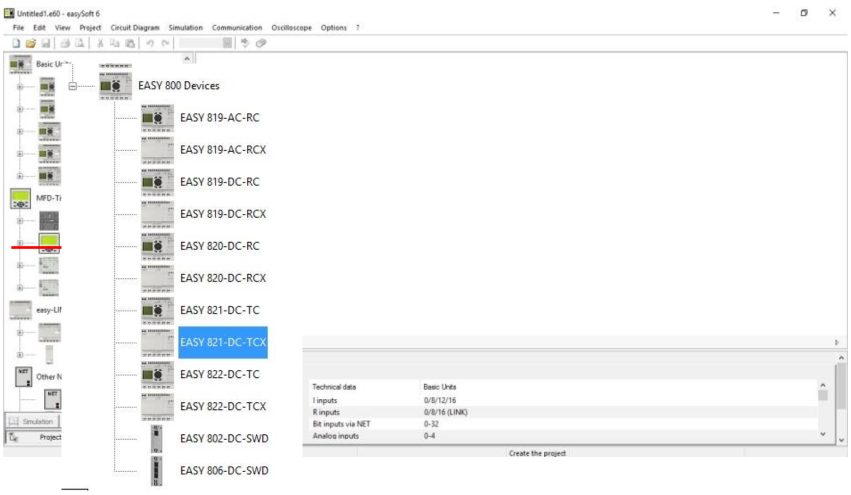


Figure 5. Selecting an additional module

The MFD 80 - B display has several function keys that can be used for different purposes. It is possible to turn on some of the outputs of the PLC through them, which in some applications can be useful because it is not necessary to add new keys. They can also be used in the program. In our case, we use them to display values or to change the value of parameters for setting the vacuum or PID parameters.

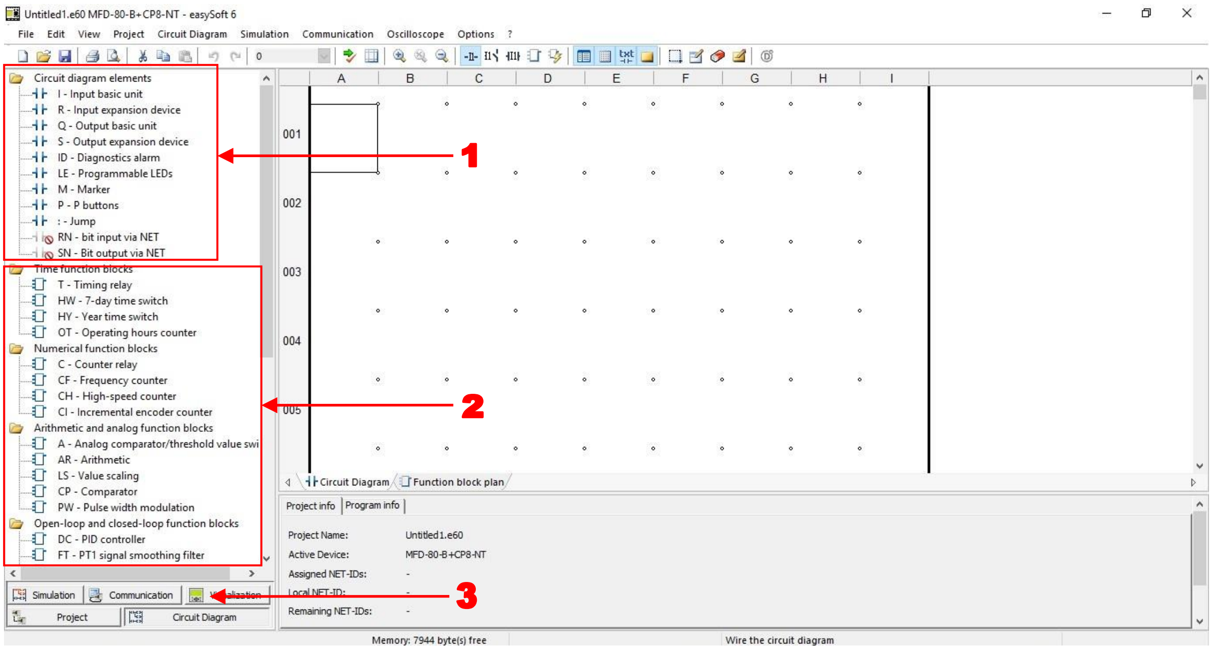


Figure 6. "Circuit diagram elements" and function blocks

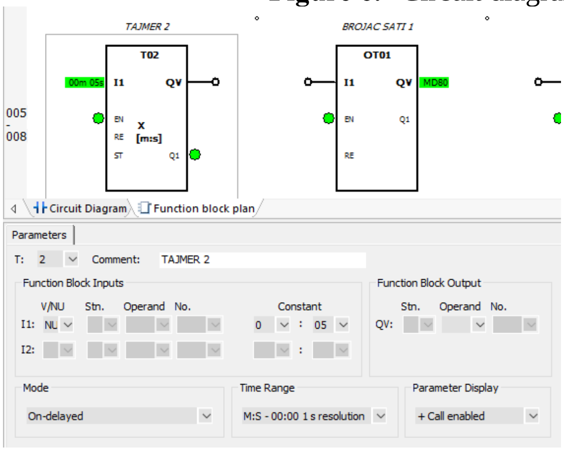


Figure 7. Defining parameters for the timer functional block

Figure 8. Adding the PID controller to the ledger diagram

When we wrote the software for PLC, it is necessary to check it in the program in which we created it before loading it into PLC. This is done in a simulator. By clicking the "Simulation" tab, a new window opens (within the Home screen) (Figure 10)

In the simulation window, we can simulate digital inputs to the PLC, analog inputs, function keys, memory locations in the program, and follow the ledger diagram.

On the display in the simulation program we can monitor the change of analog values, which makes it easy to find faults in the program.

After testing the software in the simulator, we load the program into PLC. Clicking the "Connection" tab opens a new window (in the home screen) (Figure 11).

2.2.2 Principle of operation and regulation of four vacuum pumps

The principle of operation and regulation of four vacuum pumps can be manually and automatically controlled.

Manual operation: By pressing the corresponding button on the electrical circuit, we turn on or off each pump separately. By switching on each pump, the corresponding lamp is switched on. Also in the display of the user screen, the pump name that is included is written in text. Manual work is most often used when we want to examine one of the pumps (in the case of its overhaul or checking the direction of the engine when installing a new pump) or if we want only certain pumps to work for us.

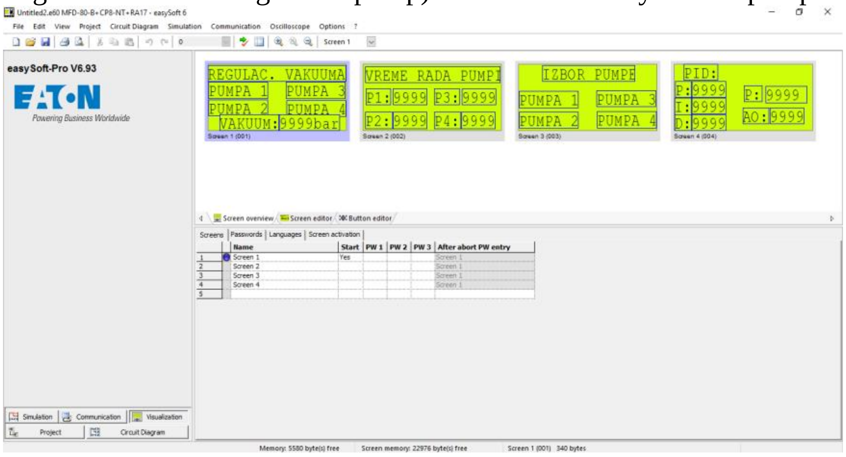


Figure 9. Display of user screnss

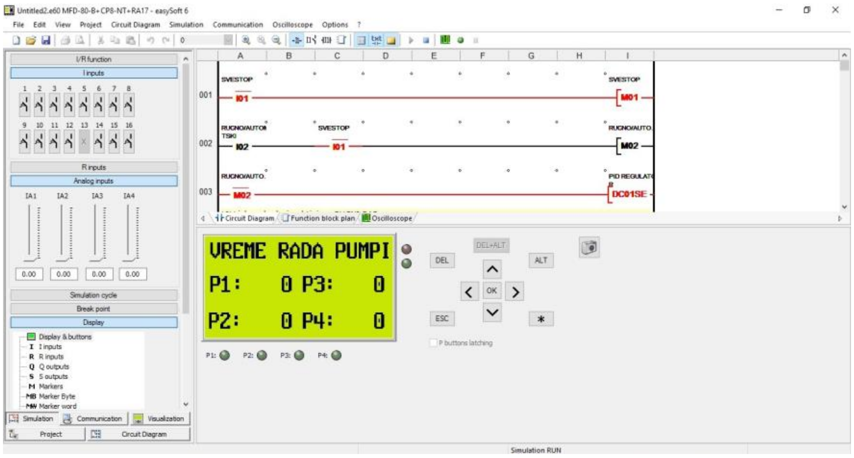


Figure 10. Simulation screen

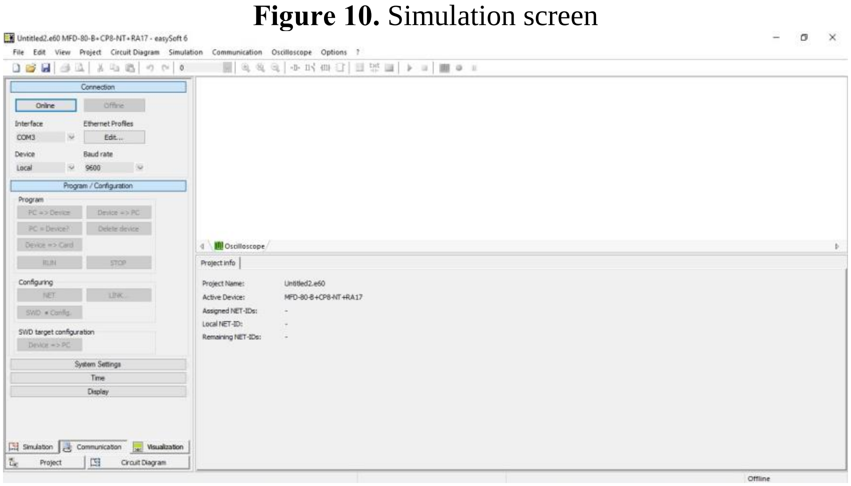


Figure 11. Connection

Automatic operation: Switching the mode switch to the automatic operation position, we enable automatic operation. In automatic operation, based on the input value of the vacuum, pumps are switched on / off. To enable this, you must first choose which pump to turn on first. This is done by activating the corresponding button on the electrical circuit (as when we want to turn on the pumps in manual operation). The display will show which pump is activated. If the value of the vacuum is set by the given (in the case of a vacuum it is negative) for a certain time (set in the program), then the next pump is activated until the value of the vacuum is below the given limit. If pump 1 is selected to be first activated, then the pump 2, then the pump 3 and the end of the pump 4 will be switched on. If, for

example, pump 3, then pump 4 will be switched on, pump 1 and end of pump 2. In order to switch on the next pump, the vacuum value must be above the set time set in the program.
In order to select one of the pumps to be switched on first, all others must be switched off (no pump-in message is displayed on the display).
Most preferably, pumps with the least number of operating hours are selected first. There is a time counter for each pump. The timer counts values are displayed on the user's screen.
The pump is switched on by a functional block for comparison. It has a digital output that is activated depending on whether the condition is fulfilled that the input signal (the value of the vacuum) is higher / lower than the given one. This signal is used in the pump program on / off.
When the value of the vacuum is below the set, for a certain time (set in the program), the pumps are turned off, the first one that was last activated, and if the vacuum value is still below the set for a certain time.
The existing PLC program allows the regulation of the vacuum and the inclusion of pumps within narrow limits, but still with small jumps in the value of the vacuum. More precise control with smaller jumps in the value of the vacuum can be achieved by installing the frequency converter for each pump individually.

3.0 CONCLUSION

For years, technology has progressed more and more, and the tendency is to make it easier for a person to work. There is no single process or production facility where we will not meet the automated production system. The pursuit of perfection of production and production has led to these facts. Automation also reduces the participation of man in the production process, and hence the possibility of mistakes due to human factors.
Since electro-mechanical systems are becoming more and more numerous, more complex and more sophisticated (the degree of "built-in" automatic operation or as often said - the level of intelligence is becoming more and more important) so that in their creation it is necessary, in addition to knowledge in electrical engineering and mechanical engineering, management and programming as shown in this paper on the case of managing four vacuum pumps using a PLC.

Acknowledgment

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AUTOMATIZATION OF THE ENGINE DIESEL CONTROL AND ERROR CONTROL

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Abstract: The development of technology, the increase in the degree of automation of the management process, the increase in the role and the value of the tasks solved led to the creation of complex multifunctional systems. Modern diesel engines have a large number of motor assemblies, systems for switching on and off, system for controlling parameters, in which different processes occur - thermal, mechanical, electrical and others. Therefore, the motor unit according to its composition is complex multifunctional system. Complex systems also require a new approach to their exploitation and a new approach to solving tasks of exploitation and technical control. The new approach dictates and significantly increases the volume of information, characterized by the state of the system, the speed of the flow of workflows, which exceeds the human capabilities of controlling the working ability of the system. The new approach in the first place reflects the methods of exercising control. It requires the development of new systems, which will ensure objective control of the state of objects without human interference, actually automatic control. A system that is subject to automatic control will further be called a control object or simply an object. Automatic control is the performance of operations for determining working ability, detection of malfunction, recognition of failure and forecasting changes in the condition of a controlled object, without the participation of a person. Special control systems are created to solve the tasks of automatic control. The automatic control system is based on the assumption that the objects are determined, that is, that each state of the object corresponds to its fully defined external manifestations, and vice versa to each diagnostic signal corresponds the completely determined technical condition of the object. Depending on the tasks to be addressed, automatic control systems can be classified according to their purpose.
Key words: diesel engine, reliability, control, automatic system, faults.

WORKING CAPABILITY CONTROL SYSTEMS

Working ability is the condition of the object in which it meets all the requirements, which are determined by the relations of the basic parameters. The system of work ability control establishes the fact of having a working ability or its loss. Control of the working ability of diesel engines can be accomplished by various methods.

1. *By state of the elements*. The state of the individual elements is determined as the result of all parameter measurements, which characterize the work of the elements, and the analysis of the results of these measurements.
2. *According to the reaction to working or special signals.*

Signals are falling at the entrance of the object and its state is determined by the degree of deviation of statistical and dynamic characteristics during the period of control from the nominal value.
Statistical characteristics can be obtained by bringing in the entrance of the object of special control signals. Dynamic characteristics, time and frequency - are determined in the control mode according to the reaction of the object to the stimulating signals or in the working regime by statistical methods. Stimulating or impulsive inputs can be selected as stimulating signals, by which time characteristics and harmonic signals are determined, which determine the frequency characteristics.

Defect detection systems:

In detecting defects, the task of causing the loss of working capacity of diesel engines is solved. All methods of detecting defects can be divided into three groups:
- methods of indication,

- methods of searching for malfunction and
- methods of acoustic diagnostics.

The indication method assigns a certain number of sensors in the controlled object to provide an indication of failure if it occurs. Sensors can be constructively integrated into a controlled object or control system. In the first case, the sensors are built in, and in the other they are not built. Sometimes, sensors are applied that perform functions in a controlled object, and such sensors are referred to as modules of the indication of malfunction

The method of searching for malfunctions is revealed in the process of performing a series of control operations, realized according to the elaborated strategy. The search strategy is based on known statistical characteristics of the components of the system or on the analysis data of the structure of the controlled object. Statistics enable research to be conducted at the level of reliability of controlled parts of the system, and by maximum information acquisition. An analysis of the structure of the object can be performed on the basis of research of methods of mathematical statistics or methods of engineering analysis with record keeping of the construction and exploitation conditions.

With the acoustic method on the state of the object, it is possible to speak about the noise characteristics that the diesel engine creates in operation. Therefore, noise analysis is performed and autocorrelation functions are determined. According to the characteristics of the correlation function, the state of the system can be determined.

Failure recognition system / type recognition systems

The systems listed above record only certain phenomena, such as working ability or malfunction, but not their quantitative characteristics. In certain, complex and responsible objects, operating under specific conditions without an operator, the solution of the task is not to determine the fact of working ability or failure. For example, during the processing of objects of first degree importance, the task is to establish the cause of loss of working ability and failure. This is necessary in order to determine the organizational and constructive character for discovering the causes of loss of working ability and increasing the level of reliability of the facility.

In solving these tasks, a system of identifying types (images) is applied, which must have the following possibilities:

- a greater number of adopted parameters of external action
- a wide range of parameter changes
- ability of the system to adapt to the conditions of application and to self-adjust.

The automatic failover system must include:

- input device that receives all parameters of the work process;
- a device for making a solution that compares the existing situation with a previously fixed one and makes decisions about the presence of this or other phenomenon;
- a "training" device that manages the setting of the recognition system.

The type recognition system solves the following task:

- according to the results of a limited number of parameters, it is necessary to make an optimal solution for belonging to its state to this or that class of the general set of conditions.

1. **Systems of forecasting the condition of objects.** In order to prevent the loss of the working ability of diesel engines, according to control results, changes in its condition can be predicted, that is, to predict the character of changes in working capacity in the future.

2. **System of damage protection** In the event that, in addition to forecasting the status of the facility, during the system's awakening condition, it should also affect it in order to stop operation or switch to safe mode, special systems that we call protection systems apply. Safety systems represent the overall system of forecasting systems with devices that affect the object in the event of a hazardous situation.

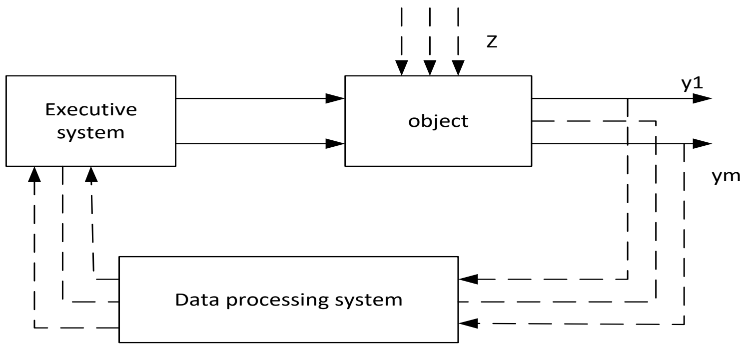

Figure 1. Scheme of the control system

Information on the state of the diesel engine in the form of a signal $\bar{y}_j(j = 1, 2, \ldots, m)$ is transferred to the control system. The system of receiving and processing information whose structure depends on the purpose of the control system, processes the received information and makes the solution in the form of a control signal X_i. The executive system transforms control signals into control actions that act on the object in case of application of the protection system or are forwarded to the operator in order to apply the solution to the state of the object. All control systems are information systems in which errors occur. Control systems are composed of sensors, transformation and resolution devices, control chains . [8]

From this it follows that sources of error in the work can be:
- accuracy of the control algorithm, structural reliability,
- the accuracy of regulation and speed of the system

As is known for all control systems, two types of errors apply:

1. Type I faults. The control system does not determine the accidental state of the engine. In the theory of reliability, such a mistake is referred to as the risk of a contracting entity, when a facility that has lost working ability is taken as a working ability.

2. Type II Errors. The control system forms a false control signal and the working-ability object is recognized as an object without working ability - supplier risk.

Controlled errors arise due to:
- limited accuracy of control of the parameters of the working process due to errors in the operation of the system sensors;
- unreliability of the control system as a technical device;
- the ultimate fast action of the control system;
- errors in the selection of control parameters.

ERROR SYSTEM OF CONTROL

Control errors based on one parameter

The control system checks the working ability of an object based on one parameter. The condition of the working ability of an object based on one parameter can be written in the form:

$y - Y < 0,$

where y - is the control parameter;

Y - the allowed value of the parameter being controlled.

The condition can be interpreted in the general case in the following way: Y is the engine power, y is the load; When the load is less than the power, the engine is capable of working. If the load that acts higher than the power will lose working ability.
In the process of work, on load and power, many random factors are affected, these are random functions that have their distribution laws φ (y) and φ (Y). The working ability of an object is

controlled by measuring the operating process parameters y by the sensor of the control. Sensor readings are also random in size and have a distribution function φ (D). In general, the distribution laws φ (y), φ (Y) and φ (D) can be represented as shown in Figure 2.

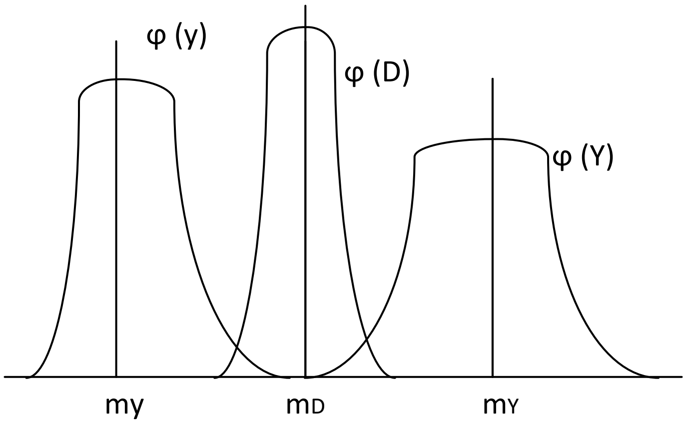

Figure 2. Distribution Laws

The control system sensor adjusts to the m_D size so that when the conditions m_D-m_Y> 0 are met, the control system fixes the loss of engine performance. In different combinations of the distribution laws φ (y), φ (Y) and φ (D), the control system can form a false signal, or in general not detect loss of working ability. We will discuss events that may arise in the process of control.

A occvurence, when y <Y - the object is capable of working;
Ā occurrence when y> Y - the object has lost its working ability;
L_D occur when y> D
$\overline{L_D}$ occur when y< D
N_D occur when Y< D and
$\overline{N}_D$ occur when Y> D

The control system forms a false signal of loss of working ability, if the relationship between the event L = A⋂L_D is realized and if it does not reveal a loss of working ability under the condition N = Ā⋂N_D.

Moving from the correlation of events to their probability, we obtain the probability of a false signal Q_{L_D} = P (L) = P (A⋂L_D), and the probability of undetected failure$Q_{N_D} = P(N) = P(\bar{A} \cap N_D)$
The probability of these events will be determined by the addiction:

$$q_{L_D} = \mathrm{P}(L_D / A) = \frac{P(A \cap L_D)}{P(A)} \tag{1}$$

$$q_{N_D} = \mathrm{P}(N_D / \bar{A}) = \frac{P(\bar{A} \cap L_D)}{P(\bar{A})} \tag{2}$$

We'll switch from event to random size:

$$z_1 = y - Y;\ z_2 = \mathrm{D} - \mathrm{y};\ z_3 = \mathrm{Y} - \mathrm{y};\ z_4 = \mathrm{Y} - \mathrm{D}$$

The probability of false and undiscovered quit in the general case

$$Q_{L_D} = verovatnoća\ (z_1 < 0; z_2 < 0) = \int_{-\infty}^{\infty}\left[\int_y^{\infty}\varphi_y(\tau)d\tau \int_y^{\infty}\varphi_D(\tau)d\tau\right]\varphi(y)dy \tag{3}$$

$$Q_{N_D} = verovatnoća\ (z_3 < 0; z_4 < 0) = \int_{-\infty}^{\infty}\left[\int_y^{\infty}\varphi_y(\tau)d\tau \int_y^{\infty}\varphi_D(\tau)d\tau\right]\varphi(Y)dy \tag{4}$$

Equations (3) and (4) allow to determine the probability of errors in any law of the y, Y, D distribution. [5]

$$Q_{L_D} = 0{,}5\ [\Phi(h_{z_1}) + \Phi(h_{z_2})] - \mathrm{T}\ (h_{z_1}, a_{z_1}) - \mathrm{T}\ (h_{z_2}, a_{z_2}) \tag{5}$$

$$Q_{N_D}=0{,}5\ [\Phi(h_{z_3})+\Phi(h_{z_4})]\text{-T}\ (h_{z_3}\ ,a_{z_3}\ )\text{- T}\ (h_{z_4}\ ,a_{z_4}\ ) \quad (6)$$

Where is:

$$h_{z_1}=-\frac{m_y-m_Y}{\sqrt{\sigma_y^2+\sigma_Y^2}};\ h_{z_2}=-\frac{m_D-m_y}{\sqrt{\sigma_D^2+\sigma_y^2}};$$

$$h_{z_3}=-\frac{m_Y-m_y}{\sqrt{\sigma_Y^2+\sigma_y^2}};\ h_{z_4}=-\frac{m_y-m_Y}{\sqrt{\sigma_y^2+\sigma_Y^2}}\ ;$$

$$a_{z_1}=\frac{h_{z_2}-h_{z_1}\varrho_{z_1z_2}}{h_{z_1}\sqrt{1-\varrho^2{}_{z_1z_2}}};\ a_{z_2}=\frac{h_{z_1}-h_{z_2}\varrho_{z_1z_2}}{h_{z_2}\sqrt{1-\varrho^2{}_{z_1z_2}}};$$

$$a_{z_3}=\frac{h_{z_4}-h_{z_3}\varrho_{z_3z_4}}{h_{z_3}\sqrt{1-\varrho^2{}_{z_3z_4}}};\ a_{z_4}=\frac{h_{z_3}-h_{z_4}\varrho_{z_3z_4}}{h_{z_4}\sqrt{1-\varrho^2{}_{z_3z_4}}};$$

$$\varrho_{z_1z_2}=-\frac{\sigma_y^2}{\sqrt{\sigma_Y^2+\sigma_y^2}\sqrt{\sigma_y^2+\sigma_D^2}}$$

$$\varrho_{z_3z_4}=-\frac{\sigma_Y^2}{\sqrt{\sigma_Y^2+\sigma_y^2}\sqrt{\sigma_Y^2+\sigma_D^2}}$$

The probability of errors Q_{L_D} and Q_{N_D} can be calculated according to approximate dependencies.

$$Q_{L_D}=1{,}35(1-P_{z_1})\left[\left(1-2P_{z_2}\right)\sqrt[3]{1-\varrho_{z_1z_2}}+\left(1{,}26P_{z_2}-0.26\right)(1+\varrho_{z_1z_2}\right]+P_{z_1}+P_{z_2}-1 \quad (7)$$

$$Q_{N_D}=\frac{P_{z_3}}{14}\left[\left(1-2P_{z_4}\right)(1-\varrho_{z_3z_4})^4+\left(16P_{z_4}-1\right)(1-\varrho_{z_3z_4}\right] \quad (8)$$

Where is:
P_{z_1} = probability $(z_1<0)=0{,}5+\ \Phi(h_{z_1})$;
P_{z_2} = probabbility $(z_2<0)=0{,}5+\ \Phi(h_{z_2})$;
P_{z_3} = probability $(z_3<0)=0{,}5+\ \Phi(h_3)$;
P_{z_4} = probability $(z_4<0)=0{,}5+\ \Phi(h_{z_4})$;
Conditional probability will be:

$$q_{L_D}=1{,}35\frac{(1-P_{z_1})}{P_{z_1}}\left[\left(1-2P_{z_2}\right)\sqrt[3]{1-\varrho_{z_1z_2}}+\left(1{,}26P_{z_2}-0.26\right)(1+\varrho_{z_1z_2}\right]+P_{z_1}+P_{z_2}-1 \quad (9)$$

$$Q_{N_D}=0{,}0715\left[\left(1-2P_{z_4}\right)(1-\varrho_{z_3z_4})^4+\left(16P_{z_4}-1\right)(1-\varrho_{z_3z_4}\right] \quad (10)$$

The probability of errors depends on the statistical characteristics of the distribution laws m_j and σ_j. Figure 3 shows the dependence of control errors on the size of the parameter controller m_D

From the q_{L_D} , q_{N_D} dependence analysis, the change in sensor control can not simultaneously reduce the probability of errors. By reducing the likelihood of false signals, the probability of undetected failure is increased, and vice versa. However, the aggregate accuracy characteristic of the system $Y_D=q_{L_D}+q_{N_D}$, which has a minimum size at certain values of the parameters of the sensor control m_D., can be introduced.

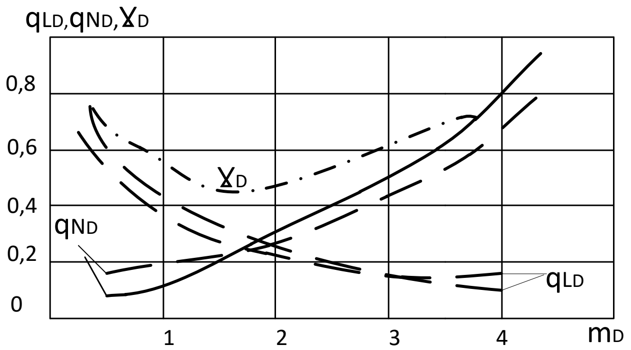

Figure 3. dependence of control errors on the size of the control parameters
$\sigma_D = 1; \sigma_D = 0; \ \ \sigma_Y = \sigma_y = 1; \ \ \ m_y = 0; m_Y = 0.$ [6]

CONCLUSION

In each specific case, the application of the sensor control system must be determined based on the need for control accuracy. If the control errors are the same, this regulation must be derived from the conditions of obtainingγ_{min}. If false cancellations are inconclusive, then m_D is determined from the conditions for obtaining $q_{L_D min}$ .When the speeds of changing the operating system parameters of the control system are high, they will have more probability of undiscovered accidental or diesel engine failure.

Control system as a technical system consisting of many elements connected by electric car, can have two types of failure: interruption and short circuit. A break-in type failure leads to undetected failure and a "short circuit" to the formation of a false signal.

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USING SCADA APPLICATIONS IN WATER SUPPLY SYSTEM

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Abstract: The application of information technology has made it easier to apply all other technologies in everyday life. In this paper, the application of SCADA applications in the Pljevlja plumbing system is explained. Its main role is to utilize certain parameters for dosing chlorine in water. In this way, the primary aspect of this work is placed on the ecological aspect and on the preservation of human health. All other factors that are obtained by applying these applications are secondary, and among other things there is a reduction in error options, a reduction in the number of employees and savings. They are based on one or more implementation principles. Also, the paper describes methods, techniques and devices that allow the automated process of chlorine dosing in the water supply system.
Key Words: SCADA, woter supply system, water treatment plants.

INTRODUCTION

Water supply systems use water that needs to be processed to be used as potable. The most commonly needed processes are: sedimentation, filtration, disinfection [7]. The most common form of water disinfection is chlorination [22]. The parameters that are monitored during the treatment of water are variable and depend on the quality of the incoming water in the water treatment plant [14], [17]. The parameters that are monitored are physicochemical and microbiological water treatment plants are automated and the parameters are monitored and recorded continuously [8], [15], [20]. If such a change in the quality of the inlet water occurs, the water treatment devices can not process it to the level of the quality of the drinking water, the probing devices send analogue or digital impulses to PLC ie. programmable logic controller. PLC is a device that is currently stopping water production in order to avoid complications related to the contamination of drinking water [4], [10], [18].
One of the most commonly used methods for water disinfection is the insertion of chlorine (or some chlorine compound) as a strong oxidizing chemical agent. In the water supply facilities, besides dosing various other chemicals for water preparation, chlorine is added as one of the usual disinfectants. The addition of chlorine can be in the form of gas (Cl2) or in the form of a liquid when one of the chlorine compounds is added. After the addition of chlorine, one part is spent on initial disinfection of water in the water supply and the other part remaining in water distributed to consumers. This residual amount of i.e. residual is controlled and maintained at a predetermined level, typically from 0.2 to 0.5 mg / l of chlorine that is in accordance with the oficially legislation [6], [21]. Automation of the chlorination process greatly reduces the influence of the "human error" present during manual regulation. A well-tuned machine maintains an uninterrupted level of residual chlorine in the water, always at a given level, without the intervention of a human being. PLC Controller based on the continuous measurement of chlorine residual in water (using chlorine analyzer) increases or decreases chlorine dosing. This method of operation is called "Residual Management". There is also a different kind of management that is used if the amount of chlorinated water is variable. Less chlorine is added to the smaller amount of water, and in larger, proportionately more. The necessary information about the current flow of the controller is obtained from the appropriate flowmeter, and based on this increases or decreases the dosage. This type of management is called "Flow Control". The most complex management method is used if the water has variable chemical properties over time (and hence chlorine demand) and at the same time, variable flow. Then, "Flow and residual management" is performed, or combined management. Various machines used up to the last ten years have been designed as electromechanical or electronic circuits on an analogous principle of operation. Today, modern, digital, microprocessor devices are used in this field. In addition to the unlimited possibilities

of programming and adjustment of the chlorine problem solving, they also enable remote communication with other computer devices, thus increasing the possibilities of automating and managing all devices on one water supply from a single command center SCADA ie. supervisory control and data acquisition system [4], [9]. Steel chlorine cylinders as well as dosing devices must be placed in a separate room (chlorine station) with forced ventilation, shower and drainage by sewage connection. On the outside of the chlorine station there is a cabinets with a gas mask and shower drain.

MATERIAL AND METHODS

Water disinfection ie. chlorination: involves the removal or destruction of pathogenic and optionally pathogenic microorganisms. In the course of disinfection or sterilization of water in microorganisms, gross disorders of the colloidal balance (due to the effects of physical, physical-chemical and chemical agents), and the disturbances of the balance of their fermentation system occur.

Irreversible physico-chemical changes of breathing fingers and other ferments of the metabolism of microorganisms are expressed in particular, which leads to inactivation and cell death.Water disinfection can be achieved in several ways: physical (prokating, ultraviolet rays - UV, ultrasound), chemical agents (lime, electrolytic silver, ozone, iodine, persistent acid and chlorination) [1], [3], [12], [16]. All the listed methods and agents, other than chlorination, are either expensive or inappropriate, and are rarely considered for the disinfection of large quantities of drinking water. Water is most often disinfected by using Sodium Hypochlorite or by using preparations that release a certain amount of active chlorine in water [13].

Disinfectant based on chlorine, in most cases, is introduced into the water in the form of a solution - dosing or injection. On the supply line through which water enters the facility, there is a pulse water meter, which, depending on the flow of water, sends an electrical impulse to the dosing pump, which disinfects (sputter) a disinfectant into the same tube from the tank with chlorine solution, in the position on which the device is located. The dosing pump is considered to be in the installation to dosage a certain amount of chlorine in the water [19]. Using the digital photometer or some other (less reliable) method at the end of the object, the index of residual chlorine in the tubes is checked. Chlorine acts destructively on the cells of all organisms, especially on microorganisms, because they do not tolerate even very small amounts of chlorine that the human organism does not respond to. The bactericidal effect of chlorine is very fast. Already within minutes or two, this gas inactivates most fermenting microorganisms in their metabolism. Chlorine is a particularly sensitive SH-fermenting microbial. In addition, it acts destructively and on protoplasm. Spores, algae, protozoa and cysts are relatively resistant to the effect of "normal chloride doses". Water chlorination is a cheap, reliable, highly efficient and tried process for water disinfection [5].

The success of chlorination of water depends on:

- Types of chlorine preparations.
- Biological peculiarities of microorganisms - less or higher sensitivity of wet organisms to chlorine. The residual chlorine value was determined at the earliest 30 minutes from the beginning of chlorination.
- Homogenization and contact of the chlorine preparation with water.
- Temperature - at lower temperatures, water disinfection is slower. At 10˚C it is necessary to double the amount of chlorine at 20˚C.
- Meteorological conditions - sunlight accelerates the process of disinfection and the loss of active chlorine from the water.
- pH value of water - The optimum pH of water for chlorination is 6.2 to 6.5 [6], [21].
- Water miscibility - reduces the efficiency of chlorination, and the water must always be cleaned and filtered.
- Organic matter - consumes a certain amount of chlorine, so the dose must be increased. That is why "chlorine test" is performed, that is, the "chlorine demand - chlorine number".

Fig. 1 shows the screen in the control room of the city Pljevlja water supply, which monitors all wells in the city and their parameters (amount of water, etc.) on-line.

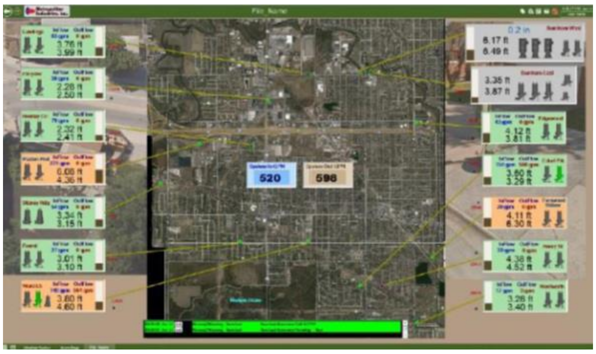

Figure 1. The on-line monitoring wells parameters

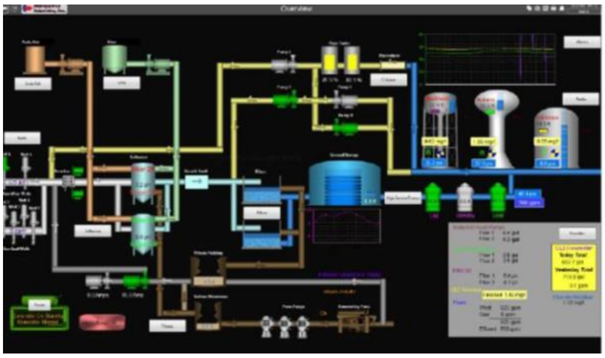

Figure 2. A functional scheme for drinking water

In Fig. 2. is preseted a functional scheme for drinking water. The icons inserted as a parameters are measured within the given devices. The parameters that are measured and monitored are following:

- the amount of raw water entering the system,
- voltage of well pumps (working and spare),
- the acidity of the flywheel (water and chemicals to be dosed),
- new in tanks (water and chemicals),
- the water's water content and the amount of chlorine in the residual,
- the valve position on-off.

Based on the parameters of the system as it automatically corrects itself. The boundaries of the parameters that are monitored can be in permitted intervals or may jump out of the allowed intervals. Upon receipt of signals that the PLC system recognizes and if the associated parameters are equal to the allowed limits, a certain alarm is activated. After that, the system switches to a higher degree of protection.
It is important to note that the complete PLC system can also be connected with mobile devices. Fig. 3. shows the hardware connection with back-up data because the system is in on-line mode and it is necessary to have stored data for a certain period. There is also monitoring one of the wells with data tracking with included data transfer to the mobile device with the android system.

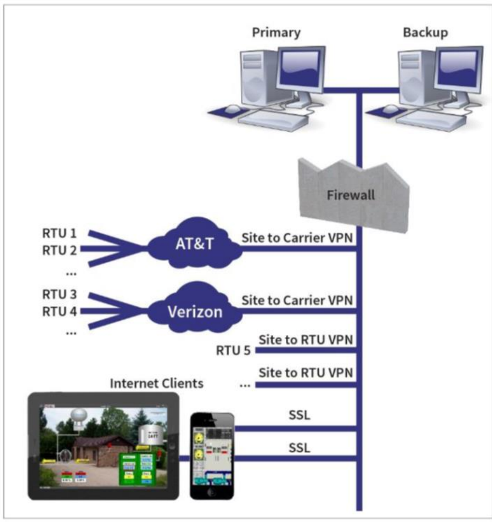

Figure 3. The hardware connection with back-up data

Presentation and description of the automated chlorine dosing system in drinking water

The automatic gassing dosing system consists of the following elements:

- bottles with laced chlorine,
- collecting lines for bottles with chlorine valves, carriers,

- two doses - vacuum regulator mounted on bottles and connected to an automatic switch
  an automatic switch whose function is that once a bottle is emptied, the chlorine is automatically switched over and the chlorine dosage from the other bottle,
- flow meter - rotameter (measuring tube with dosing valve) showing flow in gr / h of chlorine,
- injector from mixing hose,
- pump for increasing the water pressure for securing the formation of a vacuum,
- PLC Device and control valve.

A scheme for chlorination of water with neutral chlorine gas chloride is shown in Fig. 4. while all the schema elements are appended in Table 1.

Table 1. The schema elements for chlorination of water with neutral chlorine gas chloride

The elements for chlorination of water with neutral chlorine gas chloride			
1- bottles for chlorine	6- the chlorine detector probe in the air	11- electrical cabinet	16- diffusers
2- gas vacuum regulators	7- electromotor valve with rotameter	12- electromagnetic valves	17- Reservoir neutralization solution V = 200l
3- collecting line with pressure gauge	8- coupling	13- globe valve manually	18- prick flowmeter
4- flexible tube	9- measuring cell of chlorine in the residual, EMEC	14- coupling for neutralization	19- pump for pressure boosting
5- automatic vacuum switch	10- signal trumpet	15- centrifugal valves	20- PLC

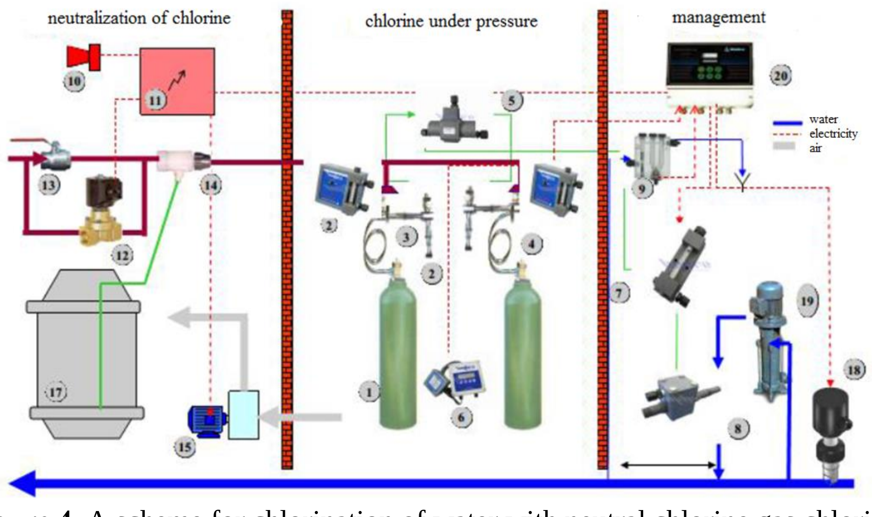

Figure 4. A scheme for chlorination of water with neutral chlorine gas chloride

PLC controller is a Electronic Microprocessor Device. It has its inputs to which electrical information is given on the state of the process, and exits through which it commands the process. Communication with a person is done through the Operational Panel, or a remote digital connection with a PC. Boils with chlorine and dosing equipment must be stored in a separate room (chlorine station) with forced ventilation, shower and drainage with sewage connection. On the outside of the chlorine station there is a cabinet and a switch to turn on the fan. In the room, the free chlorine indicator is connected to the alarm device (chlorine detector), which activates the neutralization system in case of chlorine expulsion. The floor in the chlorine station must be carried out with the fall towards the drainage in the drain. If accidentally, due to some malfunction, the gas chlorine emitted into the atmosphere would result, an environmentally very dangerous situation would occur.The presence of chlorine in the air is controlled by an electronic device - chlorine detector. Special electrochemical probes are used to measure the concentration of chlorine in the air, and the electronic device includes a chlorine neutralization plant from the air. The ejector within the device compulsorily inserts contaminated air through a filler that discharges with the neutralization liquid that is driven by the recirculation pump. In such a forced movement of polluted air and neutralizing liquid, and neutralizing chlorine from the air. This process lasts until the concentration of chlorine in the air drops below the given level. All activities are recorded by PLC device and sends it to the database server and auto-record is done. PLC in addition to data transfer, the device also provides the ability to download data with USB flesh, as shown in Fig. 5.

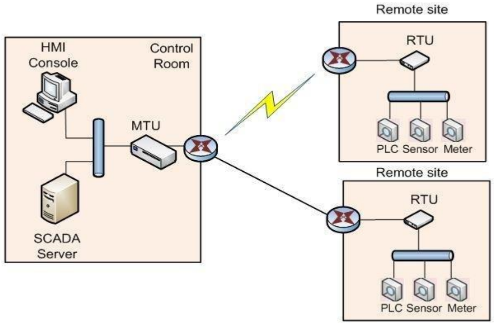

Figure 5. Data transfer and storage

RESULTS AND DISCUSSION

Water entering the city water supply network should be chlorinated continuously, in order to prevent secondary infections. The effective dose of chlorine is determined by experiments. The adjusted concentration is independent of the amount of water flow, because the regulation system automatically maintains a constant concentration of the active chlorine.

In the city Pljevlja core supplied with drinking water from the water supply system there are about 19,000 consumers. The water is provided from the Otilovići Reservoir, the river Cehotina and Breznica and several sites. Considering that Pljevlja is surrounded by mountains in the period from February to May, there is snow melting and accumulation of larger quantities of water. This leads to water blur and deterioration of quality. Then special attention is paid to the water treatment system and quality control.

Raw water is collected in wells. Well pumps pump water into the precipitator. In the precipitator, physical impurities are deposited and aeration is performed. Water meters are installed in the precipitator. Measurement level meters are level ultrasonic or float system. When water is precipitated and reaches a certain level of water, the water is transferred to the filtration. From the filter fields, water is pumped into the reservoirs via filter pumps. Disinfection of water is carried out in the reservoirs and sent via the water supply system to consumers. The work of well and filter pumps, water level measurement and automatic process control are carried out by PLC [2]. Everything is controlled and monitored in the main control room of the water supply system where the SCADA system for control and data transmission is installed [9]. Also, the main operatives, quality managers, laboratory heads, technical directors have the ability to receive signals over a mobile network [11].

Special attention is paid if parameters that deviate from the given parameters, then the system reports an error and sends the alarm signals. In the plant and control room, signal lights and sirens have come down. All employees who have the authorization to monitor and control the value of SMS messages on mobile devices.The most important parameters whose measurement is monitored are:

- chlorine in the water,
- temperature,
- pH value,
- flow,
- chlorine in the air,
- pump working,
- the system of neutralization.

The measured values are stored in the database. Chlorine is dosed with a vacuum system in the reservoir. In the tank after the dosing and disinfection of the chlorine volume measurement probe in the residual measured value, it sends the signal 04-20m. PLC. a controller that opens / closes the electromotor valve on chlorine bottles.
The dosage is also carried out according to the flow of water by applying to PLC the device programmates chlorine dosing through the openness of the electromotor valve. According to the standards it is desirable that water goes to consumers with 0.5 g Cl2 / m3 to consumers.Without the pump, the system could not function. Two pumps are always installed [19]. One pump is working and the other is a spare pump. PLC the screen is monitored which pump is on, the number of hours of operation and the number of pumps turning on.

CONCLUSIONS

Processing information about input water quality includes measurement activities: input, processing via PLC, output, storage and control. An input as a data resource is an activity that determines the operation of an automated system that, with its activities, brings the measured values to an acceptable level. All input and output parameters are stored on the main database every day in real time which is in accordiance with the work of author [14]. Within the SCADA system, applications are integrated: hardware, software, databases, procedures and frames - CASE technology. Also in process discussed in this work, there is an exchange of data exchange among employees and the possibility of common tool access, which allows employees to call a number of different tools in the same way, from the menu and compare the outputs of chemical dosing, pump operation, opening filter the fields in the way they need. In this way, the primary aspect of this work is placed on the ecological aspect and on the preservation of human health. All other factors that are obtained by applying these applications are secondary, and among other things there is a reduction in error options, a reduction in the number of employees and savings.

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USING MOBILE APPLICATIONS FOR BLIND PEOPLE

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Abstract: The emergence of information and communication technologies brings many opportunities for their using in the field of education and electronic learning. The learning process is based on the timely delivery and presentation of information to students. Different forms of bidirectional and multidirectional communication are available, where distance does not play a major role. The field that applies modern technologies makes learning on the move easier, it's called m-learning or mobile learning. This paper describes developed mobile applications that make it easier to perform various activities for people with damaged eyesight and blind people, especially in the electronic learning process.For that reason, users with an android operating system have access to many educational programs. Damaged eyesight reduces the ability of individuals to access information and carry out daily activities. Access to information is significantly important because of electronic students education and future of employment. Different mobile technologies and applications have a major roles because they enable people with damaged eyesight to function independently and equally successful.
Key Words: Mobile education, mobile applications, damaged eyesight.

INTRODUCTION

Many of e-learning tools and technologies are used in the educational process. They can enable the provision of tutoring and education to more students. The fact is that different forms of technology have become a necessity in university cabinets. Teachers use tools and technology in their lectures in order to display more information and raise the motivation of students for the learning and working. The characteristic of this kind of learning is applying different technologies in cabinets so students can focus on the matter itself being processed. The opportunities offered to students when using tools and technologies for e-learning are enormous. In accordance with the fact that most students are actually digital natives, it makes job easier for teachers. Teachers and students are familiar with different forms of technology and they accept well this kind of learning [5].
The availability and accelerated development of information and communication technologies significantly influenced the complete educational process. There are new rules of behavior in education as well as a new way of creating educational strategies. In order to increase the efficiency of learning and teaching, it is necessary to enrich the educational process with more attractive content that would involve students in the education process as active participants. It is also necessary to see which modern technology students use the most, and try to use these technologies in the classroom [2].
Disability implies restrictions associated with speech, movements, damaged eyesight, needs for help in daily life. Such children need additional educational tools during their education. Students with special needs will be a workforce in the future. Computers are a powerful tool, and it is known that people with special needs increase employment opportunities. Integrating access to technology into schools and presenting them to people with special needs from the first school days will not only accelerate their learning but also increase their employment opportunities in the future [4].
In Serbia, there are over 7 000 000 inhabitants and it is estimated that 12 000 are with damaged eyesight, or absolutely without eyesight. Unfortunately, in the coming years this figure is likely to increase. This kind of damage affects the quality of life of each individual, their ability to educate, work and acquire interpersonal relationships. Advances in Information Technology (IT), especially in mobile technology, enable better quality of life for individuals, people with disabilities, including

people with damaged eyesight. Technology has the potential to improve the life of an individual so that he can fully participate in social activities and live independently. With the emergence of the concept of mobile technology, the benefits of portable, personal, light and discreet aids for people with disabilities are also emerging. Through various forms of tools and applications, they can have access to all activities, absolutely identical to those people without disabilities [3], [12], [16].

MATERIAL AND METHODS

Damaged eyesight and information technology

Every day, the market offers more and more aids for people with damaged eyesight to provide greater Independence in daily activities. Many ideas are actually simple technical solutions that can be important in the life of a person with damaged eyesight (for example, magnifiers, telescopes, and the like). However, some of these devices are electronic devices, of which the most popular are those used in the household (for example: sound clocks, various thermometers, scales, radios, color recognition devices, etc.). Each of these devices is intended for other purposes. For example, a color recognition device can serve a person with damaged eyesight as a tool that allows her to choose and combine clothes independently. There are also different devices that help in the movement, such as laser rods that signal an obstacle in front of a person. Intensive and rapid development of technology enables people with damaged eyesight to achieve independence, safety and quality of life. For that reason, more and more mobile smartphone applications are developing for the most popular mobile platforms - Android, iOS, Windows Phone and others. Mobile devices are increasingly used in order to facilitate certain tasks, and as such, the handheld device shows an increasing market potential.

Technologies represent an interdisciplinary field consisting of products, resources, methodologies, strategies, practices, and services aimed at facilitating the functionality of visually impaired people with regard to their autonomy, independence, quality of life and social inclusion. Today, an information technology is the main resource most widely used in the education of pupils and students with person with damaged eyesight, which can be defined as the use of computer software that allow students to access the digital environment, attain individual life, and social and educational inclusion. A great turning point in the life of people with damaged eyesight has caused the emergence of computer technology that enables the work of visually impaired people on the computer. Given the rest of the sight, we can distribute computer programs and devices to those designed for visually impaired people and those who are primarily focused on blind users. Therefore, for the visually impaired people, there are various computer programs for text enhancement that allow the selection of color, thickness, font size, but also the choice of background color. This is significant important because of the impossibility of universal determination of these parameters due to heterogeneity of damage eyesight.

For blind people, there are computer programs like screen readers running on Windows, Linux or OS X (Apple's Mac) operating systems. They usually are working for reading the contents of the screen, allowing the visually impaired people to perceive the contents of the screen through the speaker, and can use the keyboard to control the processes on the computer. Screen readers also use voice synthesizers for the language used by the person. Screen readers can also be used simultaneously with external units that read all the texts that are translated into a Braille letter that a person reads with their fingers (as an additional device connected via a USB device). The biggest advantage of the screen reader is its speed, while the biggest drawback of Braille's letter is its price [8].

During 2015., using of mobile internet has increased globally, and the average time spent on accessing online content from a mobile device has reached 3.26 hours per day. Increasing popularity is attributed to the creation and increased use of mobile applications. Currently, the two largest global application distribution platforms are the Apple App Store, intended for users of iOS and Google Play, belonging to the same company, which is the official store of apps for the Android operating system. The fact that mobile applications are relatively easier to create than computer applications, as well as their significantly lower cost, has caused increasing rapidly growing market. It's impossible to know exactly how many applications there are, but since 2015 there were about 1.8 million applications in Google Play. Apple Store had 800 applications in 2008 and 1.5 million in 2015. Blind and visually impaired people often can not access vital information in the form of written text in our environment, therefore different mobile systems offer different solutions regarding voice support for people with damaged eyesight. The great revolution for the needs of communication with other people was caused by software for mobile phones. Existing programs allow, depending on visual impairment, that a person increases content on a mobile phone or that all content is played soundly for a blind person, as well as a combination of these two options [11].

VoiceOver mobile application

VoiceOver mobile application is a screen reader that allows the use of a mobile phone for visually impaired people, or people who are not able to see the screen. With VoiceOver, you can only triple-click on the Home button to access anywhere in iOS. Listen a description of everything that happens on the screen, from battery level to the name of the application where finger is located. You can also set the speed of speech that is appropriate. Since VoiceOver is integrated in iOS, it works with all embedded iPhone applications. Custom key tags can be created in any application - including third-party applications. And Apple works with the community of iOS developers to make even more applications compatible with VoiceOver [1].

With built-in Accessibility APIs, development tools, IOS provides an exceptional opportunity to cutting-edge mobile experience to every customer, including those with special needs. IOS allows users to configure titles and sound descriptions during video playback. IOS offers a variety of display customization features, including Bold Tekst, High Contrast Cursors, Reduce Transparency, Dark Mode and Reduce Motion. Using APIs, allows you to find applications on your mobile phone. IOS devices can read the selected text from the selected application in more than 30 languages, and you can set the voice dial and speech speed. Class AVSpeechSinthesizer produces synthesized speech from text on an iOS device and provides methods for controlling or monitoring the progress of ongoing speech.

VoiceOver is a screen reader that communicates with objects in applications, so users can manage the interface even if they do not see it. VoiceOver can be controlled using a simple set of movements, tapping or dragging the finger around the VoiceOver screen tells you what's there. By tapping the button, a description is heard, and in order to select a particular application, it is necessary to double-tap the application. Or shake left and right to move from one element to another in an application. When VoiceOver is enabled, each character on the keyboard is read out loud when touched. Moving up or down moves the cursor so it can be edited as desired. To get faster and more precise text, IOS supports multi-character methods - including handwriting - and corrects misspelled words. VoiceOver has virtual control called rotor. Rotating the rotor - rotating two fingers on the screen allows the user to efficiently move through a web page or document. When a user is on a web page, rotating the rotor can hear settings such as "headers", "links" and "pictures" [6].

With the included VoiceOver software, words and phrases will be pronounced loudly by a favorite excuse in documents, messages, web pages, and other texts. IOS also allows color recognition, white dot reduction, shine, or a choice color. When a larger dynamic type is activated, the text in a series of applications, including calendar, contacts, mail, messages, music, notes and settings, and even some application of independent manufacturers, turns into greater and it’s easier to read. We can also select bold text to make the text look better.

Zoom is a built-in screen magnifier that works no matter where it is in iOS. It works with all apps from the App Store. Turning on full-screen zoom or image zoom allows you to zoom in as much as possible in a separate window. The size can be increased between 100 and 1500 percent and access multiple filtering options in any view. Viewing movies with detailed sound descriptions of each scene on the iPhone is displayed using the AD icon in iTunes Store. There is also a digital magnifier, which increases the size of everything the user chooses to be able to see the details, there is also a flash that gives the brightness to the screen. If there is a problem with reading text on the iPhone, it is necessary to use Speak Screen so that the user can read emails, iMessages, web pages, books, school materials, etc. There is an option dictation, which allows the user to write his words, whether it is necessary to respond by mail, make a note, or respond to school tests and the like [18].

TalkBack mobile application

TalkBack mobile application is Google's screen reader on Android devices as shown in Fig. 1. This application provides spoken feedback to use the Android device without viewing the screen, using specific process gestures on your mobile device. TalkBack is a type of Accessibility Service that helps people with damaged eyesight when interact with their device. It adds feedback in the form of speech, vibrations and sound to the device to give information what it is on the screen, what the user touches and what can do with it [19], [13], [14].
TalkBack mobile application can be downloaded from the official web site software group Eyes Free Project, a software development project that allows you to use your device without looking at the phone's screen. TalkBack mobile application is an application that is preinstalled on the device in the Google Apps app for Android and is routinely updated with enhanced through Google Play. TalkBack works by using a user's finger to explore what's on the screen (when a user encounters any item that can be used or any part of the text that can be read, TalkBack is included). TalkBack readers read the text accurately and literally. TalkBack tells what is touched and allows the item to be activated by dual touch. This mobile application has four categories of items [15]:

- Speech: These settings manage control speaking feedback;
- Other feedback: These settings control vibration and non-verbal sounds;
- Touch exploration: These settings are controlled by touch and movement;
- Miscellaneous: These settings include keyboard shortcuts, stopping, and restarting the other features.

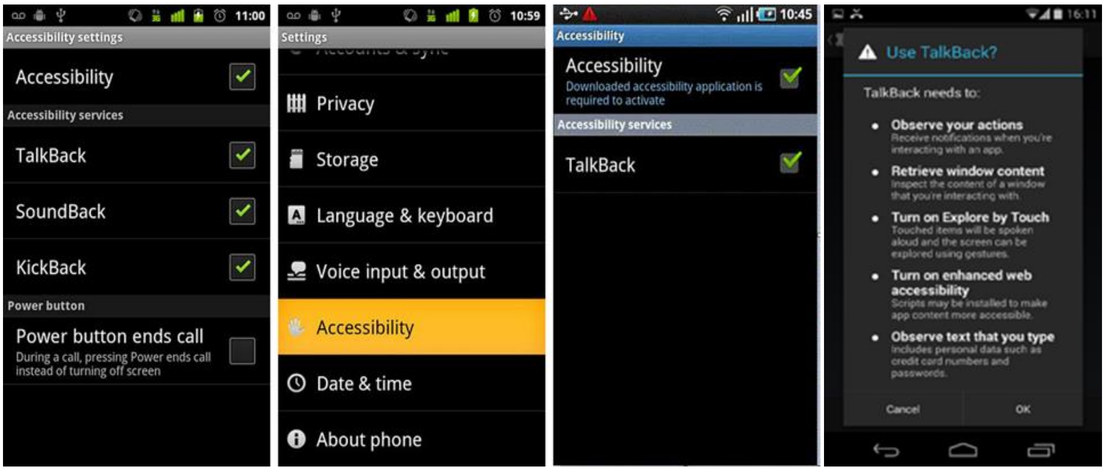

Figure 1. Settings in the TalkBack mobile application for blind people

Vocalizer Expressive mobile application

Vocalizer Expressive is mobile application which is intended for devices with Android operating system, converts text to speech translated into more than 40 languages as shown in Fig.2. Each voice can be purchased with a simple purchase process in the application. It enriches the user's experience with the different applications it has on mobile device, such as GPS navigation, reading e-books, and so on [7]. The main characteristics of this mobile application for blind people are [17]:

- Supports over 80 votes in more than 40 different languages;
- Easy to customize pronunciation through the user dictionary;
- Speed of reading and setting points;
- Reading numbers and punctuation.

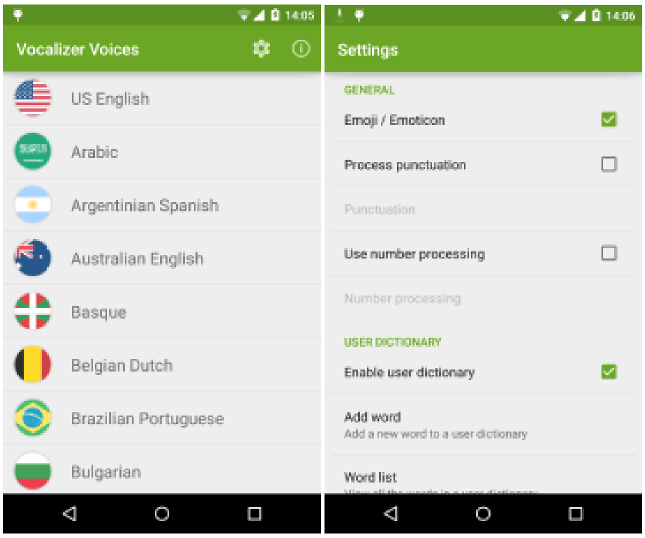

Figure 2. Settings in Vocalizer Expressive mobile application for blind people

Mobile accessibility functions for Android

Mobile accessibility functions for Android operating system is two products in one: android reader that allows users movement outside home using a mobile device and a set of 12 available applications (phone, contacts, SMS, alarm, calendar, email, web, other applications, settings, notes and explorer). The emphasis is on navigation with the touch of the touch screen, moving the finger around the screen, the reader will read the text below the finger. It is also easy to enter text, can be used touch QWERTY keypad, as well as speech recognition for quick and easy writing of text.

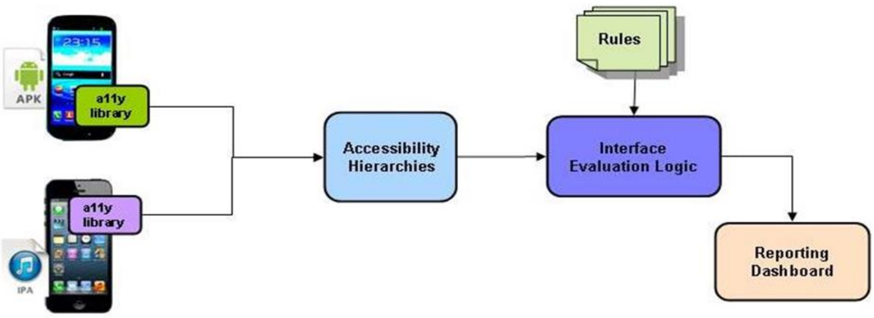

Figure 3. The levels of architecture of mobile accessibility for Android

Mobile Accessibility provides a library, as well as tools that integrate a library into mobile tools. When a user launches an application on a simulator or device, the library automatically downloads the hierarchy accessibility for each user interface of the app's for evaluation. The evaluation uses the accessibility rules that are generated from the accessibility report [9] as shown in Fig. 3.

Mobile Speak mobile application

Mobile Speak is a mobile application that allows the user to read everything that is written on his device by screen reader. The revolutionary Mobile Speak was launched in 2004 for Symbian and Windows mobile devices. Allows users full access to smartphone technology. The information displayed on the screen is generated into speech, i.e. Text is converted to speech (TTS) using technology. Speech can be heard through the loudspeaker or through the headphones. It can also be displayed in the Braille if the Braille device for the user's mobile is connected, so that the user has the ability to perform multiple tasks on the phone simultaneously and independently [10], [7] as shown in Fig. 4.

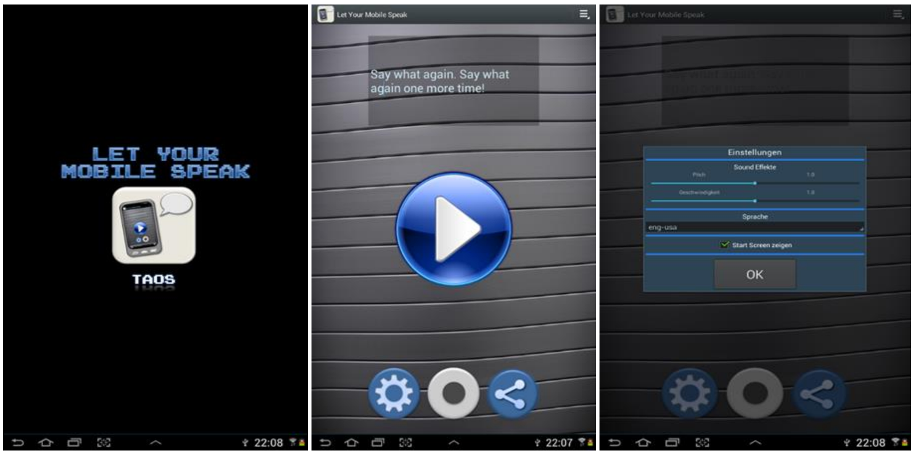

Figure 4. Appearance of Mobile Speak mobile application for blind people

CONCLUSIONS

Mobile learning offers many possibilities with hundreds of mobile applications from different areas, for users around the world. It is necessary to develop channel of communication between teaching staff and students better, to establish legal frameworks for using mobile phones as an equal participant in the teaching-scientific process and to adapt part of the teaching in the direction of using mobile applications. Due to the insufficient development of support services in practice, as well as numerous other obstacles, only a small percentage of the student population consists the students with disabilities. There are disability student associations that provide various practical support policies through roundtables with the subject of inclusion, meetings with faculty, university and other stakeholders. In this way, it is still working to eliminate social barriers, but national strategies for improving the social dimension have not been developed yet. The society should take some measures to increase the chances of people with some sort of handicap, thus eliminating existing educational inequalities among students. The Web and the information -communication technologies are increasingly gaining relevance and use in education. The development of mobile applications as well as other types of tools has been increasingly advanced, all for the purpose of helping people with disabilities, in this case blind persons. Developed mobile applications and tools allow them to receive educational electronic content electronically, listen to and learn, communicate with professors and other colleagues, and do tests online.The use of mobile application development software is a new challenge for electronic learning and especially for people who has some problems with speach, vision or hearing. There are a hugh number of free electronic courses that allow relatively fast adoption of new educational content. Due to the continuous increase in the number of mobile users, predictions are that standard PCs will be replaced by smartphones. An extensive range of tools and e-learning mobile applications can be found on the web. In this paper we axplained some of them for blind people. In future research, our research can focus on mobile applications for people with impaired speech or hearing

Acknowledgments

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CHIP SHAPE AS MACHINABILITY PARAMETER IN THERMOPLASTIC TURNING

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Abstract: The paper discusses the possibility of obtaining the chip shape that would be the most acceptable for easy removal from the cutting zone when processing thermoplastic materials. It is considered that with adequate choice of cutting regime parameters, it could be obtained the ideal chip shape, with small length and low percentage of twisting, which is confirmed by experiment.
Key words: thermoplastic materials, regime of cutting, chip, machining

INTRODUCTION

Chip shape, as a parameter of machinability, can be one of the most important parameters during certain machining processes. Different shapes of chip in steel machining can be obtain by removing chip to outside of machining zone, different geometry of cutting tool, defining chip breaker on tool face and similar [1 - 3]. Problem appears with materials that have much lower mechanical properties comparing to steel. This includes almost all non-metals, and the most prominent among them are thermoplastic materials.
A special problem is to get acceptable chip shape for easy removal from cutting zone when machining thermoplastic materials. Thermoplastic materials have high toughness but low hardness and strength, and with that kind of material the most common is striped and long chip shape that wound around the cutting zone on coupled elements, i.e. tool and workpiece. That kind of chip is hard to remove from cutting zone, and piling it around the cutting edge of tool increase the temperature on face of tool and increase surface pressure on contact surface between tool and workpiece. The question arises as to whether the adequate choice of cutting regime parameters can lead to most acceptable chip shape, with small length and low percentage of twisting. In this paper the researches on subject and results of measurement are presented.
The wide application of thermoplastic materials is conditioned by the possibility to recycle, low cost, machining with small resistance force and low machining temperature, resistance to external influences and many other acceptable properties [4].
Many contemporary researchers of today are dealing with the problem of testing the characteristic values of the machining process, such as cutting force, the shape of chip, the temperature in the cutting zone [5 - 8], and many have made a full contribution with similar research in their time.

MATERIAL AND METHODS

In the experiment, a CNC machine with the following technical characteristics was used (Table 1).

Table 1. Technical characteristics of the EMCO F5 CNC

Name	Unit of measure	Value
The power of the EM	W	440
Travel over X axis	mm	150
Travel over Z axis	mm	300
Machine accuracy	mm	0.01
Feedrate	(mm / min)	5 - 400
Main spindle speed	rpm	50 - 3000
Connector	RS 232	

The values of the input parameters of the turning cutting regime are given in Table 2, and the measurement method used in the experiment is based on eight measurements by variation of the given variable parameters of the turning cutting regime in Table 3.

Table 2. Value of input parameters

	min	max
a_p (mm)	1,5	2
v_f (mm/min)	80	300
n (rpm)	600	1200

Where:
a_p (mm) – cutting depth
v_f (mm / min) - feedrate
n (rpm) - main spindle speed

Table 3. Experiment plan

		Measurements							
		1	2	3	4	5	6	7	8
a_p	(mm)	2	2	2	2	1,5	1,5	1,5	1,5
v_f	(mm/min)	80	80	300	300	80	80	300	300
n	(rpm)	600	1200	600	1200	600	1200	600	1200

Tool used in the experiment is made of HM (hard metal) with a handle of HSS (high speed steel). The HM turning insert is hard solder connected to the handle of the tool.
The workpiece material is PTFE (polytetrafluoroethylene).
Other technical characteristics of the tool are given in Table 4:

Table 4. Characteristic sizes of rotary knife

Characteristic value	mark	Dimension
Tool handle	DIN 4976	1010 P10
Turning insert	SPGN	12 07 08
Side cutting edge angle	κ	45^0
Auxiliary side cutting edge angle	κ_1	45^0
Back rake angle	γ	10^0
End relief angle	α	11^0
Angle of the patch surface	λ	4^0
Nose radius	r (mm)	0,8

RESULTS AND DISCUSSION

In the experimental measurement 1, an unfavorable chip shape was obtained, which was striped and twisted in a narrow space (figure 1). Such chip is twisting directly to the cutting edge of the tool and burdens the tool with additional surface pressures, causes the appearance of vibration during machining and prevents the cooling and lubricating agent from entering the immediate cutting zone. In order to successfully remove the chip from the cutting zone, it is necessary to construct special forms of chip breaker, which would increase the production costs. By changing one of the parameters of the cutting regime (experimental measurement 2), in this case main spindle speed n, a more favorable chip shape is obtained compared to the previous one (figure 2). The chip in this case is straight shape, partially ragged and with a much smaller length. This shape is highly desirable in machining because it is easily removed from cutting zone and does not affect on the appearance of vibrations that impair the quality of the machined surface.

Figure 1. Measurement 1:
(a_p=2 mm; v_f=80 mm/min; n=600 rpm)

Figure 2. Measurement 2:
(a_p=2 mm; v_f=80 mm/min; n=1200 rpm)

In experimental measurements under 3, a continuous chip shape was obtained that has mostly twisted around the workpiece rather than tools (figure 3). In comparison with the experimental measurement 1, this kind of chip less burdens the coupled elements of machining and does not lead to additional vibration of the tools. This kind of chip can be shortened by the previous application of a series of transversal machining, ie by more precise design of the technological machining process.
The chip shape in the experimental measurement 4 is a long and continuous chip without visible deformations and ragged edges (figure 4). This shape is very unfavorable and it was obtained using the maximum values of all three parameters of the cutting regime. In this case, the circle is twisted around the tool and around the workpiece, further burdening the entire tribological system with visible distortion of the quality of the machined surface.

Figure 3. Measurement 3:
(a_p=2 mm; v_f=300 mm/min; n=600 rpm)

Figure 4. Measurement 4:
(a_p=2 mm; v_f=300 mm/min; n=1200 rpm)

The circle in the experimental measurement 5 has similar characteristics as in the measurement 4, but in this case the obtained chip shape is achieved using the minimum values of all three parameters of the machining cutting regime (figure 5). The conclusion is that a linear reduction in the value of the parameters of the machining cutting regime can also result in an unfavorable chip shape, and that the parameters of the machining regime according to the nonlinear principle should be varied in order to achieve a more favorable shape. The experimental results of the measurement in the sixth test confirm this thesis (figure 6). In this experimental measurement, a short chip is obtained that can easily be removed from the cutting zone, with very small vibrations of the coupled system (tool-processing-clamping accessories) and similar characteristics as in experimental measurement 2.

Figure 5. Measurement 5:
(a_p=1,5 mm; v_f=80 mm/min; n=600 rpm)

Figure 6. Measurement 6:
(a_p=1,5 mm; v_f=80 mm/min; n=1200 rpm)

In the experimental measurement 7, the chip shape was similar to that in experimental measurement 1 with all the negative characteristics (figure 7). The chip shape in the experimental measurement 8 (figure 8) is somewhat more favorable in relation to measurements 4 and 5, which can be concluded that the most unfavorable shapes are obtained in the given measurements. The chip in experimental measurement 8 is striped, but not continuous. At a certain length, the chip breaks and thus more easily goes out of the cutting zone. A partial conclusion is that by reducing the machining depth, while retaining the maximum values, the remaining two parameters of the cutting regimen can be obtained more favorable chip shape.

Figure 7. Measurement 7:
(a_p=1,5 mm; v_f=300 mm/min; n=600 rpm)

Figure 8. Measurement 8:
(a_p=1,5 mm; v_f=300 mm/min; n=1200 rpm)

CONCLUSION

Chip is a good indication of the machinability of certain materials, especially materials with higher toughness and less hardness and strenght. The expected chip shape in the machining of thermoplastic materials is almost always spiral with a large length and without visible broken segments in the operation of the chips breaking. The chip brakers almost have no effect on the shape and length of the chips in these materials. Experimental data in this paper show that the production of small and shreded chips can be achieved by adequate selection of parameters of the cutting regime, primarily by the main spindle speed (n [rpm]) and step size (f [mm / 0]), i.e. feedrate (v_f [mm / min]). By increasing the speed and at the same time by reducing the step size (experimental measurements 2 and 6), the required chip shape is obtained which is most easily removed from the cutting zone. The cutting depth for these two experimental measurements is different and it is not a decisive factor for the given material.
This assumption complies with experiments of world famous tool manufacturer Sandvik-Koromant, which confirmed assumption that with variation of step size and spindle speed, independently from machining depth, can be influenced on shortening overall length of chip.

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COMPARATIVE INVESTIGATION OF ASCENDING STRUCTURE PROMOTORE AT THE STABILITY HDS CATALYST AT THE FUNCTION OF ACTIVATION TEMPERATURE

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Abstract With the stringent legislation imposed by emission adverse products (S, N etc.) from crude oil and tendency of increased participation of heavy oils, grow importance of hydrodesulphurization (HDS) process in refining industry. Activation (sulfidation) phase of Mo-catalyst the directs affect at theirs activity and stability.
In this paper is inspect ascending of temperature sulfidation at the stability NiO-MoO_3/γ-Al_2O_3 and CoO-MoO_3/γ-Al_2O_3 catalyst. Comparative investigation of stability was practice at base of the structural and textural changes of catalysts subdue deactivation aging in laboratory condition in different atmosphere (steam and hydrogen).
Details analysis of results was indicated at the different presence of Mo catalysts at the function of structure promotores and the temperature of sulfidation.
Key words: Hydrodesulphurization, Stability, Activation

INTRODUCTION

Hydrodesulfurization (HDS) is an indispensable process in the processing of petroleum and its derivatives, which is explained by the fact that by the volume of installed capacities in industry it is the most widespread process of heterogeneous catalysis in general. The main objective of this process is to remove sulfur from petroleum products by reacting sulfur compounds with hydrogen in the presence of the appropriate catalyst. The scope of installed HDS installations and the significance of this process in the overall technology of obtaining quality petroleum products is a constant incentive in research on various aspects of this process, and in particular the catalysts used in it, due to ever-sharper ecological requirements in terms of reducing the amount of sulfur in petroleum products and The oil processing is of a worse quality [1].
In industrial HDS plants, the broadest application has NiO-MoO_3/γ-$A1_2O_3$ (NiMo) and CoO-MoO_3/γ-$A1_2O_3$ type catalysts. (CoMo).
The catalysts for HDS represent a specific catalyst group that is active in the sulphide form. Since the catalyst is produced in the oxide form, as an active agent precursor, activation of the catalyst by a suitable sulfidation process is the starting and at the same time the key stage in the start of the operation of each HDS process. The choice of sulfidation and working conditions (especially temperature) is one of the most sensitive stages for achieving optimal activity, selectivity and stability of the catalyst. In addition, the activation process can also affect the stability of the catalyst, especially in oxidative regeneration, during which the active sulphide structure is temporarily converted into an oxide structure similar to the precursor of the catalyst [2].

EXPERIMENTAL PART

Testing procedure:

Activation of the catalyst was carried out with a mixture of H_2S / H_2 in the flow system at constant temperatures: 240, 260, 280, 300, 320 and 340^{0}C. The measured sample mass was heated to the working temperature in the nitrogen stream, and then sulfurized with H_2S (3-4% by weight of sulfur relative to the weight of the catalyst) introduced into the H_2 current. Dosage was performed in seven

equal portions at equal time intervals over a total duration of one hour. The sulphide catalyst was cooled under a hydrogen atmosphere of up to 100^0C and thereafter to room temperature in a nitrogen stream.
In this paper, simplified laboratory deactivation tests of the catalyst were applied, along with the monitoring of the aging process of the catalyst in the function of the thermal treatment atmosphere. The tests were based on earlier testing of a catalyst for a HDS of similar type [3], which indicated a critical impact of the type of atmosphere and temperature regime on the kinetics of structural changes and sintering of the catalyst. The working temperature was 750^0C, and the treatment time was 3 hours from the moment of reaching the operating temperature.
Aging experiments were performed in two atmospheres: water vapor and hydrogen. The choice of the water vapor atmosphere is based on the real conditions of regeneration of the HDS catalyst, which is carried out in industrial plants in an oxidizing atmosphere, in a mixture of gases with different oxygen content in steam (or nitrogen) as a gas carrier [4] and the atmosphere H_2 is chosen real process conditions would be simulated.

Method of examination:

Diffractograms were recorded on the Philips APD 1700 (40 kV, Cu K a) in the interval 2 = 5-70. The identification of the crystalline phases was performed on the basis of the reference ASTM data.
Textural changes in the catalyst are monitored by determining the specific surface area, the pore volume, and the average pore diameter. Static method of low temperature adsorption of nitrogen (LTNA, Micromeritics, ASAP 2000) is applied, recording complete adsorption and desorption isotherms (50 points).
In the study of structural changes in the catalyst is the method of IR spectroscopy. The samples were prepared by KBr discs, introducing the same sample weight into a measured amount of dry KBr as a solvent (0.5% by weight). The spectra were recorded on the Perkin Elmer 399B, in the interval of wavelengths of 400 4000 cm-1.

RESULTS AND DISCUSSION

Analysis of the diffractograms of samples of fresh catalysts prior to sulphidation confirms that both types of catalyst feature a dominant rentgeno-amorphous structure (γ-modification of Al_2O_3 of a small degree of crystallinity) with high dispersion of the active phase applied to the carrier [5]. The high degree of dispersion of the active phase and promoter phase on the surface of the carrier is confirmed by the absence of the maximum on diffractograms that could be attributed to the crystalline phases of molybdenum and Co/Ni. This structure is characteristic for most catalysts of this type [6]. The chemical composition of the catalysts confirmed that both of the tested catalysts conform to classical catalysts for HDS (about 15% MoO_3 and about 4% CoO/NiO) [7].

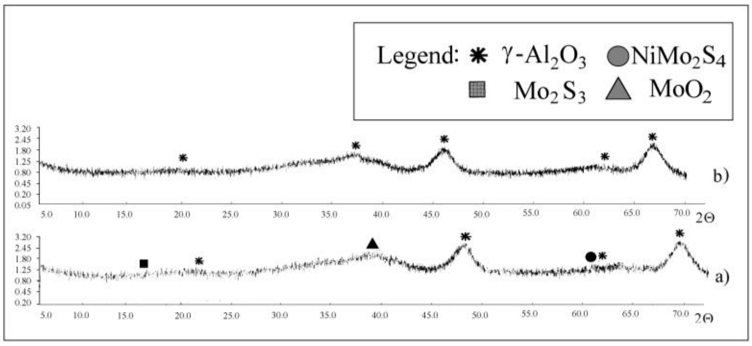

Figure 1. XRD NiMo (a) and CoMo (b) catalysts are sulfurised to 340°C

On the diffractogram of the sample of the sulphide NiMo catalyst over the entire range, the sulphuration temperature (240^0C-340^0C) is clearly expressed by the wide peaks of γ-Al_2O_3 at angles of

2θ = 20.02; 45.86; 66.580 [ASTM 10-425], indicating poor crystallinity catalysts, catalysts characteristic of samples of fresh catalyst of this type [8].

In diffractograms, there are also very weak peaks at angles of 16,360 and 60,360, corresponding to the phases Mo_2S_3 [ATM 12-692] and $NiMo_2S_4$ [ATM 21-1273]. Diffractograms of samples of sulphide CoMo samples indicate only the presence of a weak crystalline structure of γ-alumina, characteristic for fresh samples, and there is no indication of the formation of crystalline sulphide phases of molybdenum and cobalt, indicating an even more pronounced dispersion of the active phase and stability of such a structure relative to that of base nickel as a promoter. No significant differences were observed for both catalysts with the change in the sulfur temperature (Figure 1). Subsequent examination of the samples of both catalysts by IR spectroscopy by analysis confirmed the presence of sulphide molybdenum species, but also the presence of small amounts of sulphate, which were not identified by XRD analysis, representing a transitional phase between the oxide and sulphide forms during sulfidation of the fresh catalyst or oxidation (degradation) of the active sulphide phase [9].

Comparison of the diffractograms of both catalysts indicates the initial higher stability of the CoMo catalyst, due to the increased dispersion and stability of this structure, as indicated by the results of the XRD analysis of both the sulphide sample, subjected to accelerated aging in the hydrogen atmosphere over the whole temperature range of sulfidation [10], [11].

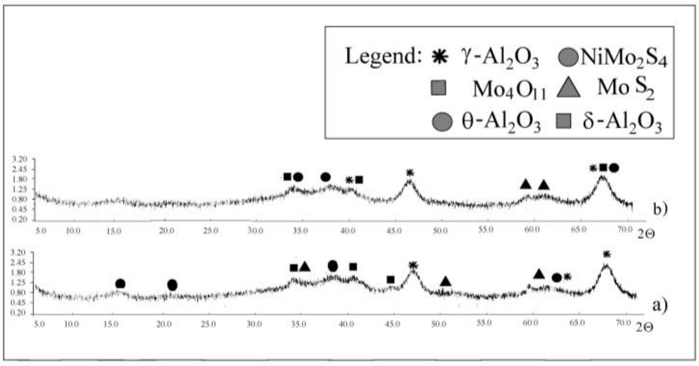

Figure 2. XRD NiMo (a) and CoMo (b) catalysts are sulfurised to 340°C, exposed to accelerated aging in hydrogen

On the diffractograms of the NiMo catalyst samples, (Fig. 2), the maximum of γ-Al_2O_3 (2θ ~ 39, 46, 670) and the weaker maximums characteristic of the sulphide phases of molybdenum and nickel ($NiMo_2S_4$, 2θ ~ 14, 33, 43, 61, and MoS_2, [ASTM 17-744], 2θ ~ 33, 52, 61), something more pronounced at a higher sulphuration temperature. This indicates a partial reduction of the molybdenum phase and the interaction of the active phase and the structural promoter. At a higher sulfidation temperature, the sulphide phase of α-Ni_7S_6 ([ASTM 25-583], 2θ ~ 19, 33, 49) appears. All this points to certain differences in the structure and thermal stability of the samples activated at different temperatures.

On diffractograms of the CoMo catalyst there are weak spots characteristic of transient more stable forms of aluminum; θ - (2θ ~ 33, 37, 67,) [ASTM 11-517] and κ-Al_2O_3 (2θ ~ 14, 37, 67) [ASTM 4-0877], indicating a partial transformation of γ-Al_2O_3. These changes are more pronounced at higher temperatures of sulfidation. In addition to these changes, the tests did not indicate any other significant changes in the structure.

Table 1. Changes of specific surface with temperature and atmosphere

Sulfidation temperature ^{0}C	Specific surface CoMo (m^2/g)		Specific surface NiMo (m^2/g)		
	Fresh catalyst	H_2	Fresh catalyst	Sulfidised	H_2
260	196,34	196,90	255,34	239,30	169,90
280	196,34	187,30	255,34	247,60	189,50
300	196,34	163,70	255,34	238,30	177,23
320	196,34	192,6	255,34	240,00	176,58

The different nature of the changes in the structure and texture of the carrier and the active phase of the catalyst was confirmed by comparing the textural characteristics of NiMo and CoMo catalysts (Table 1).
Fig. 3: XRD NiMo (a) and CoMo (b) catalysts sulfurized at 340 ° C and exposed to accelerated aging in steam it can be concluded that the hydrogen atmosphere causes much more pronounced textural changes NiMo catalyst. The decrease in the specific surface area of about 30% relative to the fresh NiMo catalyst confirms significant sintering in this atmosphere. The CoMo catalyst does not show a significant change in the specific surface, with a certain deviation depending on the applied sulphuration temperature, and in addition to identifying transitional stable alumina forms (θ - and κ-Al_2O_3) by derivatographic analysis. These results are confirmed by data on other textural characteristics (mean pore diameter and total pore volume).

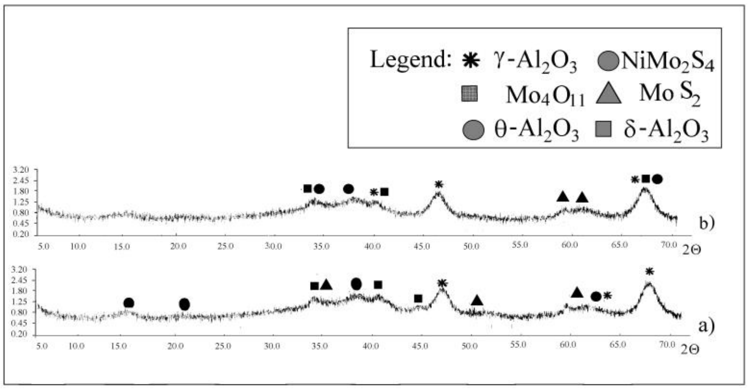

Figure 3. XRD NiMo (a) and CoMo (b) catalysts are sulfurised to 340°C, exposed to accelerated aging in steam

Further studies of the samples of both catalysts in exposed aging in the atmosphere of water vapor (Fig. 3) indicate significantly more pronounced structural changes in the active phase and carrier, with much greater crystallization of the alumina and segregation of the active molybdenum phase in the form of MoO_3 (ASTM 21-569, 2θ ~ 18, 19, 26) and MoO_2 (ASTM 5-0452, 2θ ~ 26, 32, 37, 530) for all pre-treatment temperatures.
There are noticeable differences in diffractograms of NiMo catalysts sulphide at different temperatures. The increase in the crystallization of the isolated phase of molybdenum oxide with the increase in the temperature of the previous sulphidation indicates an apparent maximum of 2% of the 2θ ~ 260.

CONCLUSION

An analysis of the structural changes of both catalysts points to a more significant impact of the accelerated aging atmosphere on the structural changes of the catalyst in relation to the applied activation temperature, as well as on the critical influence of the water vapor in relation to the reduction atmosphere.
Already in the analysis of the XRD spectra of sulphide samples, certain differences are observed: The sample diffraction patterns of the sulphated CoMo samples indicate only the presence of a weak crystalline structure of γ-alumina, while in the NiMo catalyst sample, in addition to the poor crystalline structure of γ-alumina, also characteristic for fresh samples peaks indicating the formation of crystalline sulphide phases of molybdenum and nickel (Mo_2S_3 and $NiMo_2S_4$). This indicates already the more pronounced dispersion of the active phase of the CoMo catalyst and the stability of this structure in relation to the nickel-based promoter. No significant differences were observed for both catalysts with the change in the sulphuration temperature.
Analyzes of the XRD spectra of catalysts accelerated aging in hydrogen confirmed preliminary conclusions, but the partial reduction of the molybdenum phase and the interaction of the active phase and the structural promoter in the NiMo catalyst was more pronounced at higher sulfide temperatures,

as confirmed by the presence of the sulphide phase of the α- Ni_7S_6. The analysis of the textural characteristics also indicated the significant sintering of the NiMo catalyst in this atmosphere.

Appearance of weak spots characteristic of transitional stable forms of aluminum; (θ - and κ-Al_2O_3, at the CoMo catalyst indicates a partial transformation of γ-Al_2O_3. The detected transformation of γ-Al_2O_3 was not confirmed by the testing of textural characteristics (negligible decrease of the specific surface and increase of the mean diameter and total pore volume), which confirms the higher relative thermal stability of the catalyst based on cobalt as a promoter.

For both catalysts, it can be concluded from the observation of the intensity of the change in the texture of the catalyst in the hydrogen atmosphere that even with more pronounced temperature jumps in the catalytic layer during operation in the reaction environment, no significant sintering of the catalyst should be expected.

For the atmosphere of water vapor, structural changes are observed, especially the phase separation of MoO_3 from the active phase of the catalyst, as well as the sintering of the catalyst accompanied by the change in its porous structure. In this atmosphere, the formation of $Al_2\ (MoO_4)\ _3$, as a result of the chemical interaction of the active phase and the carrier, was observed. In this way, the part of the active component is bound to the inactive structure, which further reduces the activity of the catalyst.

In the atmosphere of water vapor, changes in the crystallinity of the carrier and the active phase of the catalyst were noted, which indicate a significant disruption of the starting active catalyst structure. The sulfurization temperature affects the intensity of structural changes in aging in this atmosphere, with the lower activation temperature being somewhat more favorable in terms of increasing thermal stability for the NiMo catalyst and higher for the CoMo type catalyst.

Based on the results shown, it can be generally concluded that CoMo catalysts also have certain structural differences in the reduced samples resulting from the applied sulfurization temperature, especially with respect to the active molybdenum phase. However, these differences are less pronounced than in the case of a nickel base catalyst, and it can be concluded that the cobalt-based catalyst is a promoter and a somewhat more stable catalytic system, less sensitive to fine variations in the activation process.

Studies have shown that the sulphuration temperature applied in the activation process of the catalyst has an effect on the structural changes in the molybdenum phase during the operation of the catalyst in the process in the reducing medium, and thus on the stability of the catalyst structure. The nickel catalyst is more sensitive to the variation of the sulfurization temperature, with more pronounced structural differences in the molybdenum phase, especially after exposure of the catalyst to more rigorous reduction conditions. The cobalt-based catalyst as a promoter exhibits greater thermal stability and less sensitivity to fine variations in the catalyst activation process.

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USE OF THE REHRA MODEL TO CALCULATE THE HAZARD INDEX FOR A LANDFILL GAS DEGASSING FACILITY

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Abstract:
This paper presents applies mathematical relations of the REHRA model to calculate the hazard index and the degree of hazard for the purpose of qualitative and quantitative risk assessment. Equations used in risk assessment for the operation of a landfill degassing facility include: technical characteristics of the landfill degassing facility; characteristics of organizational structures in a facility; description and characteristics of substances that degrade the environment and/or have a toxic effect on exposed workers; and properties of a facility location in terms of the effects of natural disasters (floods, earthquakes, or landslides).
Key words: environmental risk, landfill gas, landfill

INTRODUCTION

In order to eliminate the negative impact of uncontrolled spreading of landfill gas, as a risk-inducing event, collection from the landfill must be performed. If landfill gas collection from the landfill body is not performed properly, the gas is retained in the body, thus increasing the pressure and causing the landfill surface to crack. The resulting cracks allow atmospheric precipitation to penetrate the landfill body and increase landfill filtrate and landfill gas. This results in differential devastation of the landfill surface and destabilization of the landfill flanks. Landfill depression can also be caused by vehicles passing over it. Due to potential risks, Council Directive 1999/31/EC prescribes the conditions for landfill gas control for all landfill types. Analysis of landfill gas collection technology justifies its use in preventing landfill risk due to uncontrolled emission and diffusion of landfill gas. Landfill gas collection systems can be passive and active. Passive systems are used in shallow landfills, where the pressure of the landfill gas itself allows it to move. Active systems, which are considered in this paper, contain vertical and horizontal gas wells similar to the passive system wells. Active gas wells also contain a valve for gas flow regulation and gas sampling. Components of a landfill degassing facility include: horizontal or vertical collector (well) for gas reception, a network of collection and drainage gas pipes leading to the collector, a vacuum pump or compressor for landfill gas extraction, a device for incineration of collected landfill gas, and the auxiliary electronic equipment. Malfunctioning of the landfill gas collection system may cause hazardous events in the landfill. Potential hazards may be due to: pipe and valve leakage, failure of automatic valves that shut off gas flow to the burner, the flashback effect through failure of the system for igniting landfill gas with propane or natural gas, inadequate pipe pressure, irregular control before and during system operation, failure to adhere to the operating instructions, etc.
The REHRA model is suitable for rapid risk assessment when a landfill gas collection facility is not working properly.

METHODOLOGY

Qualitative and quantitative risk assessment in landfills for landfill gas degassing is performed because of potential hazards in the degassing facility and methane emissions, which could degrade the environment. Rapid risk assessment can be achieved by use of the methodology of calculating the individual hazard index (IHI) of a facility. Based on the measured IHI value, four risk levels can be distinguished: low, moderate, high, and very high [1]. Equation (1) is used to calculate the IHI:

$$\mathrm{IHI} = \sqrt{\left[\frac{(\mathrm{IGI}+\mathrm{NHI})\cdot \mathrm{MF}}{\sum_{\max}\mathrm{IGI}+\mathrm{NHI}}\right]\cdot \mathrm{IDSI}} \qquad (1)$$

where: IGI – general index for a facility, whose values vary from 0.84 to 10; NHI – natural hazard index for a given location, whose values vary from 0 to 2; IDSI – index of dangerous substances found in a facility, whose values vary from 0 to 10; MF – modification factor, whose value is 10.

General index for a facility (IGI) is the probability of failures within a facility leading to accidents. It is calculated with equation (2):

$$\mathrm{IGI} = \sqrt{\mathrm{ITF}\cdot \mathrm{EOF}} \qquad (2)$$

where: ITF – index of the technological factor of a facility; EOF – index of the organizational factor of a facility.

ITF is calculated with equation (3):

$$\mathrm{ITF} = \mathrm{ITPF}\cdot \mathrm{ISCF} \qquad (3)$$

where: ITPF – technological and processing factor of a facility; ISCF – compensation factor determined by safety systems of a facility.

Impact of ITPF on the occurrence of hazards is calculated with equation (4):

$$\mathrm{ITPF} = \frac{\sum_i' \mathrm{E}_i}{\sum_i \max(\mathrm{E}_i)}\cdot \mathrm{MF} \qquad (4)$$

where: E_i – numerical value assigned to the technological or processing element; MF – modification factor introduced for normalization, with a value of 10. The elements used to calculate the ITPF are given in Table 1.

Values for working conditions in a facility – element E5 – are determined according to the value of E5 base element. E5 base values are calculated with equation (5). Correlation between the values of E5 and $E5_{BASE}$ is given in Table 1.

$$\mathrm{E5}_{\mathrm{BASE}} = \sum_i' \mathrm{E5}_i \qquad (5)$$

ISCF values depend on the base compensation factor $ISCF_{BASE}$. $ISCF_{BASE}$ is calculated with equation (6):

$$\mathrm{ISCF}_{\mathrm{BASE}} = \sum_i' \mathrm{S}_i \qquad (6)$$

where: S_i – assigned value to each sub-element S, which establishes compensation measures determined by the safety systems in a facility. The assigned values of each sub-element S are given in Table 2.

In order to determine the numerical values of ISCF, we considered specific elements in a facility marked as element S and given in Table 2.

To calculate the IGI using equation (2), it is also necessary to calculate the EOF index, which quantifies the degree of occupational and environmental management and safety. It is calculated with equation (7).

$$\mathrm{EOF} = \frac{\sum_i' \mathrm{O}_i}{\sum_i \max(\mathrm{O}_i)}\cdot \mathrm{MF} \qquad (7)$$

where: O_i – assigned value of element O used to determine the organizational factor and given in Table 3.

Quantifying the IHI index involves numerous factors, which pertain to the hazard caused by natural phenomena. The factors considered in the calculation of the NHI are given in Table 4 as sub-elements N. NHI is calculated with equation (8):

$$\mathrm{NHI} = \sum_{i=1}^{5} \mathrm{N}_i \qquad (8)$$

Table 1. Values of elements E under different conditions

Facility age: Element – E1 - Category	**Value of** E1
1 to 10 yrs.	1
10 to 30 yrs.	5
over 30 yrs.	10
Date of last upgrade: Element – E2 - Category	Value of **E2**
1 to 5 yrs.	1
5 to 10 yrs.	5
over 10 yrs. or none	10
Process control system – E3 - Category	Value of **E3**
High technological level	1
Medium technological level	5
Low technological level	10
Type of operation performed – E4 - Category	Value of **E4**
Continuous production cycle	1
Semi-continuous production cycle	5
Discontinued production cycle	10
Reactions – E6 - Category	Value of **E6**
No reaction	1
Exothermal reactions	5
Possibility of uncontrolled reaction	10
Loading/unloading operations – E7-- Category	Value of **E7**
Number of loading/unloading operations: <50 operations per year for transport via railroad/road; <12 operations per year for transport by ship	1
Number of loading/unloading operations: between 50 and 300 operations per year for transport by railroad/road; between 12 and 50 operations per year for transport by ship	5
Number of loading/unloading operations: >300 operations per year for transport via railroad/road; >50 operations per year for transport by ship	10

Work conditions in a facility – E5 Work conditions under high pressure – sub-element E5.1	
$0 \leq P < 20$ bar	1
$20 \leq P < 70$ bar	5
$70 \leq P < 150$ bar	10
≥ 150 bar	20
Work conditions in a facility – E5 Work conditions under low pressure – sub-element E5.2	
Operative pressure lower than atmospheric	5
Operative pressure lower than atmospheric with added substances that react with air	10
Work conditions in a facility – E5 Work conditions at high temperatures – sub-element E5.3	
$0 < T \leq 21$ °C	1
21 °C $< T \leq 230$ °C	10
230 °C $< T \leq 400$ °C	15
$T > 400$ °C	20
Work conditions in a facility – E5 Work conditions at low temperatures – sub-element E5.4	
-29 °C $\leq T \leq 0$ °C	1
-45 °C $\leq T < -29$ °C	5
$T < -45$ °C	10
$8 \leq E5_{BASE} < 20$	E5 = 1
$20 \leq E5_{BASE} < 40$	E5 = 5
$40 \leq E5_{BASE} < 60$	E5 = 10

Table 2. Assigned values of each sub-element S

Systems for detecting gas and vapour loss sub-element S1-CATEGORY	**Value of S1**
Systems for detecting gas/vapour loss that cover all rotational and critical devices[1]	1
Systems for detecting gas/vapour loss that DO NOT cover all rotational and critical devices	5
Systems for detecting gas/vapour loss have limited capabilities or are non-existent	10
Retention systems – sub-element S2 - CATEGORY	**Value of S2**
Retention systems designed to retain 100% of hazardous liquids in a facility	1
Retention systems designed to retain at least 30% of hazardous liquids in a facility	5
Retention systems for hazardous liquids are either non-existent or non-functioning	10
Insulation systems – sub-element S3 - CATEGORY	**Value of S3**
Insulation valves, automatic or remotely controlled, placed before every critical rotational device[2]; on every line of critical devices for liquid collection or before every load lever	1
Insulation valves, automatic or remotely controlled, placed before some critical rotational devices; on some lines of critical devices for liquid collection or before some load levers	5
No insulation valves	10
Collection systems for emergency drainage sub-element S4-CATEGORY	**S4**
ALL valves of critical devices are connected with reception and treatment circuits	1
Some valves of critical devices are connected with reception and treatment circuits	5
Safety valves of critical devices are not connected with reception and treatment circuits	10
Fire systems – sub-element S5 - CATEGORY	**S5**
Available fixed fire systems capable of covering all critical devices	1
Available monitors and hydrants	5
Unavailable or non-functioning fire protection systems	10

[1] Any device containing a dangerous substance in the amount equal to or higher than 5% of the substance limit amount according to Directive 96/82/CE is defined as ‘critical’.
[2] Pumps or compressors with dangerous substance hourly flow of 5% of the substance limit amount according to Directive 96/82/CE.

CORRELATION OF ISCF AND $ISCF_{BASE}$ FACTORS ISCF	
$5 \leq ISCF_{BASE} < 15$	ISCF = 0.7
$15 \leq ISCF_{BASE} < 30$	ISCF = 0.85
$30 \leq ISCF_{BASE} < 50$	ISCF = 1

Table 3. Assigned values of elements O

Training in the safety sector – Element O1- CATEGORY	O1
Periodical and regular training in the safety sector for all employees	1
Irregular training in the safety sector for all employees	5
training in the safety sector only for some employees	10
Emergency response plans for a facility – Element O2 - CATEGORY	**O2**
Available and periodically tested	1
Available, but no data on testing	5
Unavailable	10
Maintenance – Element O3 - CATEGORY	**O3**
Special structure and organization for maintenance activities	1
Maintenance without special structure and organization	5
Other cases	10
Planned control of critical devices – Element O4 - CATEGORY	**O4**
Special structure and organization for control activities	1
Control without special structure and organization	5
No control	10
Management systems for 'safety and environment' – Element O5 - CATEGORY	**O5**
There is a certified "safety and environment system" and a certified "safety management system"	1
There is a certified "safety and environment system" or a certified "safety management system"	5
There is no certified "management system"	10

Table 4. Factors used to calculate the natural hazard index (NHI)

EVENT DESCRIPTION	Hazard	VALUE	Hazard	VALUE
Area exposed to frequent floods	Yes	$N_1 = 0.5$	No	$N_1 = 0$
Area of seismic risk	Yes	$N_2 = 0.5$	No	$N_2 = 0$
Area with frequent landslides or ground instability	Yes	$N_3 = 0.5$	No	$N_3 = 0$
Area exposed to severe weather (tornados, hurricanes, etc.)	Yes	$N_4 = 0.25$	No	$N_4 = 0$
Area with potential threats of fires that can engulf at least two sides of a facility (to be considered only if the distance between the sides and a forest is less than 50 metres)	Yes	$N_5 = 0.25$	No	$N_5 = 0$

IHI quantification also includes the calculation of the IDSI index, which provides quantity ratios of substances found and/or stored in a facility. Before calculating the IDSI, it is first necessary to determine the specific dangerous substance factor IDSF (equation (9)).

$$IDSF = \sum_{i=1}^{n} \frac{q_i}{Q_i} \tag{9}$$

where: q_i – amount of dangerous substance/compound (or categories of present substances/compounds) in a facility; Q_i – predefined limit amount for the dangerous substance/compound; n – total number of dangerous substances used in a facility.

Correlation between IDSI and IDSF is given in Table 5.

Table 5. Correlation factors of IDSI and IDSF

VALUE OF IDSF	VALUE OF IDSI
$0 < IDSF \leq 1000$	$IDSI = (IDSF)^{1/3}$ I
IDSF > 1000	$IDSI = 10$

Depending on the calculated IHI value, the degree of hazard implemented in the risk assessment is qualitatively and quantitatively determined. The quantified IHI values and the degree of hazard are given in Table 6.

Table 6. Correlation between IHI and the degree of hazard of a facility

VALUE OF IHI	DEGREE OF HAZARD OF A FACILITY
$0 \leq IHI < 1.6$	LOW
$1.6 \leq IHI < 3.6$	MODERATE
$3.6 \leq IHI < 6.4$	HIGH
$6.4 \leq IHI \leq 10$	VERY HIGH

RESULTS AND DISCUSSION

We calculated the hazard index for a landfill gas degassing facility according to the conditions and characteristics of the “Bubanj” municipal waste landfill. The landfill is located to the southwest of the City of Niš, Serbia, at 43° 24' 18" latitude and 21° 57' 07" longitude, covering the area of cca. 31 ha .
The advantages of this landfill are: its god road connection with the areas it services; the possibility of connection to the infrastructure network; its distance of 150 m from the nearest local road; its elevated location stretching in the north-south direction; and its location on clay, loam, and marly clay beds, which are categorized as coherent compact soils. Soil composition makes this location suitable for a landfill. The landfill body is protected from surface water courses and atmospheric precipitation and is located in a zone of low seismic risk, with hardly any landslides, floods, and other natural disasters, and of low fire risk. This site has been used for waste disposal for over 30 years and has received over 2 million m^3 of municipal waste.
The perimeter is surrounded by a concrete canal. The central part of the disposal area contains a for landfill filtrate drainage placed at the average depth of 11 m. The drainage system comprises HDPE pipes and chutes. In order to prevent uncontrolled spread of landfill gas, an active degassing system can be installed with a vertical system of horizontally connected wells. The enclosed portion of the disposal area is degassed by ∅800 mm wells with axial distance of 30-35 m. The active surface contains drilled ∅800 mm holes (metal pipes 4000 mm x 800 mm), inside which ∅110 mm perforated HDPE pipes are placed, surrounded with granulate (32-64 mm). The pipes are pulled up to the level of deposited waste. Hypothetically, it is possible to install a degassing system with the following components in this landfill: vertical collectors (wells) for degassing, network of gas pipes for collection and drainage to the burner where the gas is burned, compressor for landfill gas extraction, a device for burning collected landfill gas (burner), and the auxiliary electronic equipment. Likewise, we considered the assumption that the system for gas loss detection for the abovementioned components has limited capabilities and that valves are installed at critical spots in the facility.
According to the landfill age and the amount of deposited waste, the expected methane concentration in landfill gas is 30%. A fire protection system has not been installed in the landfill. Likewise, there is no regular training in the landfill safety sector. There is, however, an emergency response plan but there are no data on whether the persons trained for emergency response are regularly tested. There is also a specialized sector for the control of landfill processes.
Calculation of the hazard index for the landfill gas degassing facility at the “Bubanj” landfill is schematically represented together with the qualitative representation of the degree of hazard of the facility (Figure 1).

Depending on the given characteristics of the system at the “Bubanj” landfill, equations (4), (5), (6), and (7) used the sub-elements given in Table 7. When calculating the IDSF, we took into account that the volumetric flow rate of gas in the landfill gas degassing facility was 150 m^3/h.

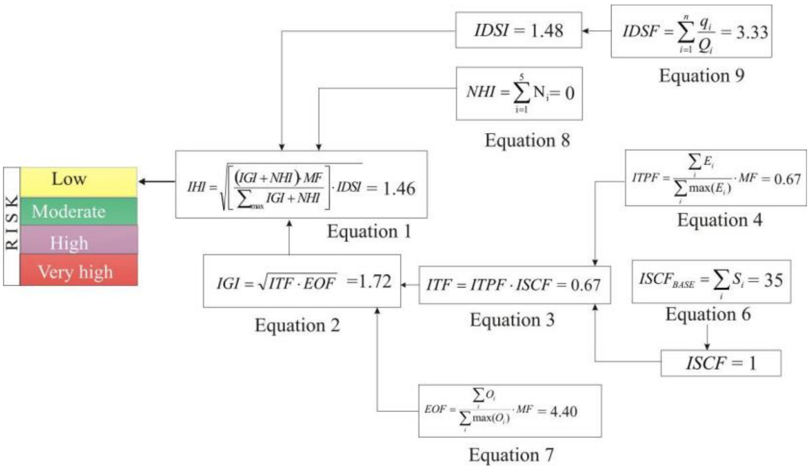

Figure 1. Schematic representation of the hazard index calculation for the landfill gas degassing facility of the "Bubanj" landfill

Table 7. Numerical values of elements E, S, and O

Assigned values to element E		Assigned values to element S		Assigned values to element O	
Facility age – 10 to 30 yrs.	**E1 = 5**	Systems for detecting gas/vapour loss have limited capabilities or are non-existent	**S1 = 10**	Irregular training in the safety sector for all employees	**O1 = 5**
Date of last upgrade – 5 to 10 yrs.	**E2 = 5**	Retention systems for hazardous liquids are either non-existent or are non-functioning	**S2 = 10**	Available emergency response plans, but no data on testing	**O2 = 5**
Process control system – Medium technological level	**E3 = 5**	Insulation valves, automatic or remotely controlled, placed before some critical rotational devices; on some lines of critical devices for liquid collection or before some load levers	**S3 = 5**	Other cases of maintenance	**O3 = 10**
Type of operation performed – Semi-continuous production cycle	**E4 = 5**	Some valves of critical devices are connected with reception and treatment circuits	**S4 = 5**	Special structure and organization for control of critical devices	**O4 = 1**
Reactions – Possibility of uncontrolled reaction	**E6 = 10**	Unavailable or non-functioning fire protection systems	**S5= 10**	There is a certified "safety and environment system" and a certified "safety management system"	**O5 = 1**
Loading/unloading operations – Number of loading/unloading operations: >300 operations per year for transport via railroad/road; >50 operations per year for transport by ship	**E7 = 10**				
Assigned values to element E5 BASE		**Σ S =35** =ISCF$_{BASE}$ ISCF =1			
Work conditions under high pressure	**E5.1 = 1**				
Work conditions under low pressure	**E5.2 = 10**				
Work conditions at high temperatures	**E5.3 = 1**				
Work conditions at low temperatures	**E5.4 = 0**				
Σ E5 $_{BASE}$ = E5 = 12					

CONCLUSION

Using the equation for calculation of the hazard index for a landfill gas degassing facility against the actual conditions of the analysed municipal waste landfill and a hypothetical degassing facility, we managed to assess the potential risk as being in the ‘low risk’ category. The results thus obtained are logical and expected considering the age of the landfill, for which the maximum methane concentration in landfill gas is estimated at 30%. When calculating the hazard index for the facility, we normalized its values from 0 to 10 by a square-type, rather than linear-type, class division. We resorted to such an adjustment in order to preserve the required compatibility with non-linear formulas used to calculate sub-indexes. The testing performed on the analysed landfill showed that the complex of adopted equations tends to direct result distribution towards the lower part of the 1-10 scale. In order to establish the best possible correlation between the hazard index and the degree of hazard of the facility, we used a square scale, according to which the calculated hazard was marked as low degree, which corresponds to IHI value of 1.46 (lower than 2, which would be the limit value in case of linear distribution).

Accordingly, we concluded that the use of the REHRA model for rapid risk assessment is justified and that the determined level of risk is relevant.

The comprehensive REHRA model allows a wider-scope risk assessment for environmental degradation caused by various unwanted occurrences in the landfill. Calculation of the hazard index for the facility is only one portion of the REHRA model, whose assessment can be implemented into the final assessment of environmental degradation due to unwanted landfill occurrences.

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TECHNOLOGIES OF RAW OIL DEHYDRATATION

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Abstract: Applied technical solutions on water separation have a direct impact on the technique and processes of collecting and preparing crude oil as well as the process of producing this fluid. Each oil field contains water in an amount up to 30%. Water can be linked to crude oil as free water and as emulsified water. The technology of separating crude oil from water provides the production of crude oil and facilitates all other processes and technologies that are treated in the preparation itself. The extraction of water from crude oil, ie Dehydration, represents a significant part of the process of oil production. Therefore, considerable attention is paid to designing technologies for the extraction of water from crude oil.
Key words: technology, oil, dehydration.

INTRODUCTION

The extraction of water from crude oil, ie Dehydration, represents a significant part of the process of oil production. The technology of separating crude oil from water provides the production of crude oil and facilitates all other processes and technologies that are treated in the preparation itself. Water separation technology with its techno-economic efficiency should respond to all environmental and transport requirements as well as the requirements presented to the refinery manufacturer. Applied technical solutions on water separation have a direct impact on the technique and processes of collecting and preparing crude oil as well as the process of producing this fluid. Therefore, considerable attention is paid to designing technologies for the separation of water from crude oil and they are still the subject of study and further improvement. The cost of the system for extracting crude oil as well as the price of their maintenance directly affects the price of crude oil. Therefore, it is very important to find an optimal solution when designing a system for extracting water from crude oil.

CRUDE OIL

Each oil field contains water in an amount up to 30%. Water can be associated with crude oil as free water and as emulsified water. All the waters that are in the deposit are genetically related to the formation of oil, i.e. These are marine waters and contain mineral salts (Na, Ca, K, Mg) in amounts of 10-14 g / l. There are also waters that fall in crude oil during its production, ie, Extraction, and they are called marginal water, or water that came into the well by artificial pressure, resulting in some wells producing more water. During the production of water and crude oil, they mix, pass through perforations, tubing and various devices, thus forming an emulsion between these two liquids.
Separation of oil from oil implies the following procedures:
- water separation by breaking emulsions,
- separation of free water on the basis of gravity separation.

Characteristics of emulsion Emulsion is referred to as a system of two liquids that do not dissolve or interact chemically, where one liquid is dispersed in the other in the form of microscopic droplets. The dispersant liquor is referred to as the dispersed phase, and the dispersing liquid is called a dispersing medium. ***Properties of emulsions*** Emulsion dispersion Emulsion dispersion is the degree of dispersion phase shrinkage. The dispersion phase droplet size ranges from 0.14 to 100μ. If there are droplets of the same diameter, we have a monodispersion system, and if there are several drops of droplets, we have a polydispersing system. Petroleum emulsions belong to polydispersion systems. Electrical properties of emulsions clean water and clean oil are good electricians. The conductivity of the oil is from $0.5 * 10^{-7}$ to $0.5 * 10^{-8}$ s / m, but with the slightest presence of salt and acid in water, an increase in electrical conductivity occurs up to 10 times. Water has up to 40 times higher conductivity than crude oil. This feature served as the basis for the procedures for the destruction of emulsion by the electric field. Stability of the emulsion Stability represents the ability of an emulsion to prevent its destruction, or separation of water and oil, during a certain period of time.

DEVICES FOR OUTPUT OF OIL WATER

Water separation devices can be divided into those that are used for the separation of free water and those used for the extraction of water from emulsions, or for breaking off oil emulsions. In devices for separating free water we include:
- precipitators (Gun Barell Tanks, Washingstanks),
- Free Water Knouckouts,
- Tanks,
- Skiming Pits,

Devices that are based on the use of one or more methods for breaking emulsions fall into emulsion breakers.
These include:
- furnaces for heating emulsions,
- filters,
- centrifugal dehydratators,
- electrical dehydratators,
- devices with a combined emulsion breaker system(triters).

PURIFYING OIL FROM SALT

Reduction is a complex process that is in principle implemented in refineries to reduce salt in oil to an economically acceptable minimum. Petroleum in deposits is in contact with a layer of water that, due to its marine origin, contains a significant percentage of chloride, sodium, calcium and magnesium. Increased salt content in oil significantly complicates the exploitation of refineries and reduces the quality of petroleum products. The presence of salt in oil above a certain limit reduces the capacity of the devices and equipment, primarily the heat exchanger, which, due to crystallization, results in their damage. High salt content also results in the intensification of the corrosion of the equipment and the progression of the pipe. Desalination on oil fields is rarely applied, and when applied it is done as part of the technological process of dehydration of crude oil. A method of desulphurisation is used for washing oil. This is done in such a way that in the process of dehydration of oil in certain places, fresh water is added which in the process of mixing with oil and pond water takes part of the salt. After that, fresh water is separated from the oil as a layer of water by dehydration procedures, which significantly reduces the concentration of residual salts in oil. Fig. 1, examples of technologies for oil desulphurisation and dehydration are given.

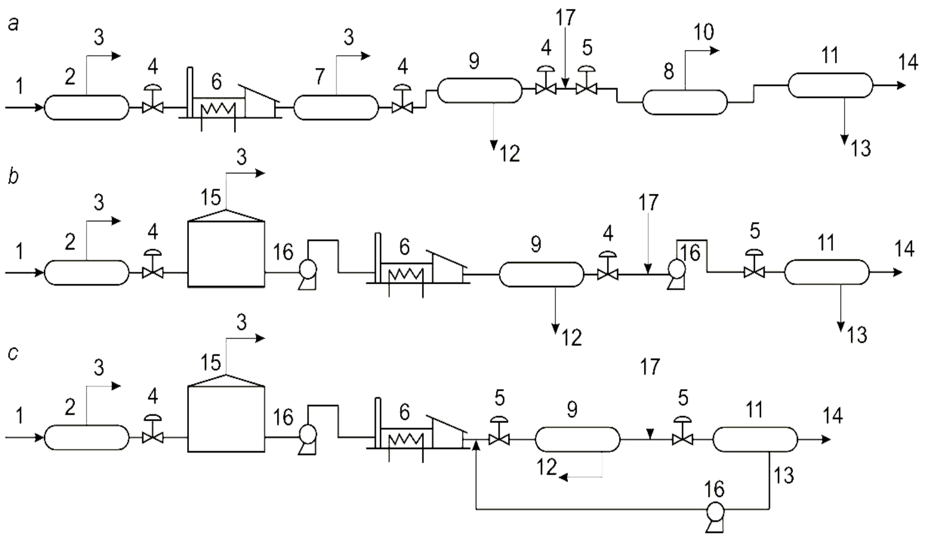

Figure 1. Examples of technologies for desulphurisation and dehydration of oil

Fig. 1a, the technological scheme of the oil preparation process is performed and the off-shore process is shown. This process is characterized by a multiple dehydration process. The well fluid (1) after separation (3) goes to heating (6) and enters the separator (7) where the separation takes place at a higher temperature, then the liquid phase and goes to the precipitator (9) from which the drained water (12) , And the oil and the emulsion go to the next degree of separation (8) from which the liquid fluid goes into the second stage precipitation (11), where the drainage water (13) is separated, and the oil (14) is dispatched. From the separator (2), (7), (8) the gas is collected and kept for further use. The extraction of the gas is carried out in front of the precipitator to accelerate the precipitation-extraction of water. Fig. 1b, a dehydration technology demonstrated with desulphurization. According to this scheme, the well fluid (1) is separated and, from the last separation (2), into the reservoir (15) which is hermetically sealed and oil degassing is performed. The characteristic of this scheme is that degassed oil refers to the dehydration process and desalination. The movement of oil and emulsion through the following process vessels is carried out using pumps located in front of the heating and deposition system. From the reservoir (15), the oil pump and the emulsion pump pass through the heating system (16), and then into the first stage precipitator (9). The precipitated water (12) is extracted from this precipitator, and the oil and the remaining emulsion are referred to the second level precipitator (11). Prior to entering this second-stage precipitator, the oil is mixed with fresh water (17) for washing oil. In the precipitator (11), water is discharged through the discharge (13), and the offal oil goes on shipping (14). Fig. 1c, a modification of the previous scheme is shown. The well fluid (1) goes to the separation (2) then into the tank where the degassing of the oil is carried out. The oil is pumped from the reservoir by a pump (16) through the heating system (6) to the precipitator of the first stage (9). Separated water is removed from the precipitator (12), and the oil is delivered to the second degree by the precipitator (11). Before entering this precipitator, fresh water (17) for washing the oil is introduced into the system. From the second stage precipitated water is returned by the pump (16) in front of the first-stage precipitator, which allows for saving in fresh water. This return of water from the precipitator (11) can be completely or partially depending on the salinity of the separated water, this closed circuit is the element of economics in adding fresh water.

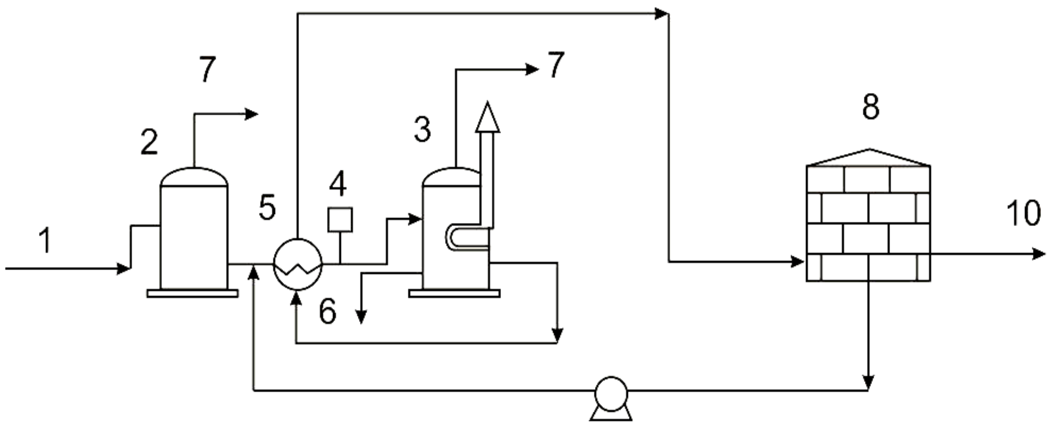

Figure 2. Technological scheme of oil dehydration

Fig. 2, a technological scheme of oil dehydration is shown. The water emulsion in the oil goes after the first stage separation (2) to heat through the heat exchanger (5), and then into the triter (3). Before entering the triter into the emulsion, the deemulgator pump (4) is pumped through the pump. A triter that functions as a second stage separation runs at a pressure of 0.12 MPa. The emulsion is heated to 60 ° C. Oil with a water content of 1% goes to the tank (8) in which it stands 12h. Water and the intermediate non-emulsified emulsion from this reservoir are returned to the triter. This treatment allows the production of salt with a salt content of up to 9 mg / l. The problem that arises during the work of this process is related to corrosion of equipment and the deposition of salt on heating pipes.

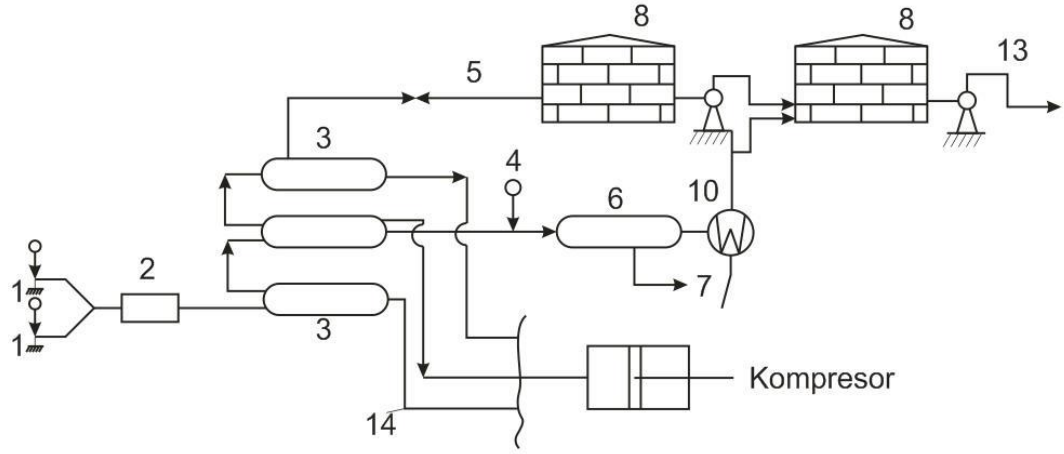

Figure 3. Technological scheme for dehydration and oil deposition

Fig. 3, a diagram of dehydration and oil deposition in the field of Hasi Mesaud, Algeria, is shown. The borehole fluid goes on a three-stage separation (3). From the separation, the liquid fluid goes to the electrohydrator (6), but before this device, fresh water (4) is added for washing the oil. In the electrohydrate, mineralized water (7) is separated, and the oil goes on heating through the heat exchanger (10) into the reservoir (9). Out of the tank (9), the oil is pumped (13). The schematic shows a reservoir (8) that represents a reservoir that accepts the fluid from the separator under overload conditions. The separated gas from the separator goes through the lines (14) to compress the compressor.

CONCLUSION

The length of oil pipelines for the transport of crude oil may be several thousand kilometers, so the task of separating water from crude oil and the cost-effectiveness of a technical-technological solution for carrying out the task is imposed. The cost of the system for extracting crude oil as well as the price of their maintenance directly affects the price of crude oil. Therefore, it is very important to find an optimal solution when designing a system for extracting water from crude oil. However, finding this optimal solution complicates the imperfection of equipment and procedures that are being applied today. This is due to the fact that besides the water in the well, there are also impurities such as sand, clay, etc., which damage the filters, and these must be cleaned frequently and changed, which hinders the continuity of the process. If the bulk fluid contains a higher percentage of paraffin, its coking will occur on the heat exchanger tubes in the triters and separators, as well as in the emulsion heating furnaces. Problems arise also due to the corrosion of equipment and the deposition of salt in pipes and devices when the wellbore fluid is saturated with salts, and the processes of desulphurisation do not yield good results. When designing a system for extracting water from crude oil, all these factors should be taken into account. They can avoid the proper selection of equipment. The procedure for selecting equipment from the system for extracting water from crude oil must respect some basic principles and experiences, such as:

- Determine of water in oil,
- monitor the quality and composition of water at the exit of the system,
- choose the appropriate operating temperature of the triter,
- determine the viscosity of oil at operating temperatures,
- determine emulsifying compound in emulsions,
- choose the appropriate demulsifier,
- determine the required quantity of demulsifier,
- determine the time of emulsion retention in the devices (separators and triters).

The extraction of water from crude oil, ie Dehydration, represents a significant part of the process of oil production. The technology of separating crude oil from water provides the production of crude oil and facilitates all other processes and technologies that are treated in the preparation itself.

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STUDY OF THE FUNCTIONALITY OF A 4-STROKE MONOCYLINDER ENGINE FUELED WITH LPG

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Abstract: The need to breathe a cleaner air, as well as the increase in the price of fuel, has led to the finding of new solutions for fuelling the engines of vehicles. The use of natural gas in the transportation sector is a step forward in tackling the acute pollution problem caused by the road traffic. This type of fuel, kept in a liquid state, is known as *liquefied petroleum gas* (LPG) and became the most widely used oil replacement solution; the number of vehicles that use it as fuel has already reached millions. The low LPG price and the low level of pollutant emissions make this fuel very attractive for study, either experimentally or by simulation. The development of engines in recent times requires a special interest in what is happening inside the cylinder, and especially in the most complex phenomenon – the combustion.
The scope of this paper is to design and build an experimental stand that enables the visualisation and measurement of the signals coming from the sensors of the management system of a heat engine used for the propulsion of a KYMCO AGILITY scooter of 50 cm^3, adopting the LPG fuelling solution.
Key words: heat engine, sensors, fuel, LPG, pollution

INTRODUCTION

The internal combustion engine is a thermal machine which partially transforms the heat obtained from the combustion of a fuel into mechanical work. The conversion of the fuel chemical energy into mechanical work is carried out inside the engine through a succession of processes that are periodically repeated, making up the engine cycle. The four-stroke engine is a type of internal combustion engine whose piston makes four simple strokes in an engine cycle. The 4 operating times are assigned to the four distinct strokes performed by the piston during a 4-stroke cycle. During these times, there are five processes occurring inside the cylinder: intake, compression, ignition, expansion and exhaust. The piston moves inside a cylinder, which is closed at one end by the cylinder head. The piston movement is provided by a crankshaft-connecting rod mechanism and takes place between two extreme positions: the inner dead point and the outer dead point. In the inner dead point (IDP), the piston is placed inside the cylinder and its volume is minimal. At the outer dead point (ODP), the piston is placed at the other end relative to the IDP, and its volume is maximal.
The liquefied petroleum gas (LPG) has stood out over the past decade as an important alternative fuel for the internal combustion engines. It is estimated that the fleet of vehicles fuelled by LPG worldwide has exceeded 6 million in 2000 and it continues to grow.
The LPG installation is the name commonly used for an alternative fuelling system using liquefied petroleum gas (LPG) for a vehicle. As can be seen from this designation, it is a system by which the engine of a vehicle originally designed to operate being fuelled with gasoline is adapted to operate being fuelled with LPG, at the discretion of the user (gasoline or LPG – alternatively, not simultaneously).
The LPG fuelling system of the engine is of particular importance for the performance of the vehicle engine. The simplest solution consists in LPG passing through a vaporizer and introduction of vapours into the intake system through a mixer, which dispenses the fuel in its mixture with air, into an open loop control system. Currently, it is also used the injection of LPG (in liquid phase) into the inlet air column, as well as closed loop control system.
LPG is a fuel whose use is safe, because it does not need any additives, which are omnipresent in gasoline, i.e. benzene or lead. LPG is a mixture of hydrocarbons, especially C_3 (propane – C_3H_8) and C_4, (isobutane and normal butane - C_4H_{10}, butane - C_4H_8, etc.), small amounts of C_5 hydrocarbons (pentane) and very small traces of C2 hydrocarbons (ethane, propylene, etc.). These hydrocarbons are obtained from the processing of crude oil and its derivatives, but they can also be obtained from natural gas.

The vehicle autonomy when using LPG is slightly lower than when using gasoline, because the LPG tank has a maximum permissible capacity of less than 80% of its total volume, but this is enough, as LPG filling stations are quite widespread at present. For example, at a consumption of 8 litres / 100 km, a LPG tank with a useful capacity of 48 litres (total volume: 60 litres) will provide an autonomy of 600 km when using LPG, plus the initial autonomy provided by the gasoline.

It follows that, at a vehicle fitted with such a tank, whose gasoline tank has a capacity of 60 litres and would provide 750 km of autonomy, we will reach a total autonomy of 1350 km, distance that the vehicle could cover without any refuelling.

The vehicle operation with LPG prolongs the life of the engine by keeping the oil lubricating properties throughout its life; practically, the oil is no longer degrading by mixing it with the partially burned fuel.

About the aggregation state of a fuel after entering into the inlet of an engine, we can say that the fuel is in a vapour state regardless of its initial state, and the role of the fuelling system is just to vaporize the fuel as much as possible to obtain a homogeneous air-fuel vapour mixture.

EXPERIMENTAL DETAILS

Overview of Kymco Agility scooter engine of 50 cm^3

In this paper we intended to create an experimental stand for the study of four-stroke engines with injection system.

The requirements imposed on this stand were that the final solution to be suitable for the study of electronic management systems used for the operation of spark-ignition heat engines. In order to do this, we started from the structure of a heat motor usually used for a normal scooter. To be operated in the laboratory, it was necessary to modify the fuelling solution. For this, we adopted a radical solution to fuel the system: the use of liquefied petroleum gas (LPG). This solution, which is not described in the literature, is a new direction of research.

The conversion of this relatively simple system (from carburettor to injection) required the elimination of the carburettor and its replacement with a single-point injection system. Although it may seem to be simple, this conversion has a certain degree of difficulty. The main difficulty lies in the fact that there are only ECU units for high-power four-cylinder traction control systems on the market.

To manage the operation of this heat engine, it was necessary to include an injection computer. For that, we used an ECU unit and the sensor system from a normal car equipped with monorail injection system. Because the injection system uses a normal injector, the engine operation is not optimal. This is because the amount of fuel combined with air is not correctly calculated by the injection control unit.

The solenoid valve consists of a body with two orifices (inlet and outlet) and a filter for retaining the impurities, an electromagnetic coil is fitted at the top, its position is normally-closed and allows the gas to pass only when the coil is energized and attracts the magnetic core which forms an integrant part with the obturator.

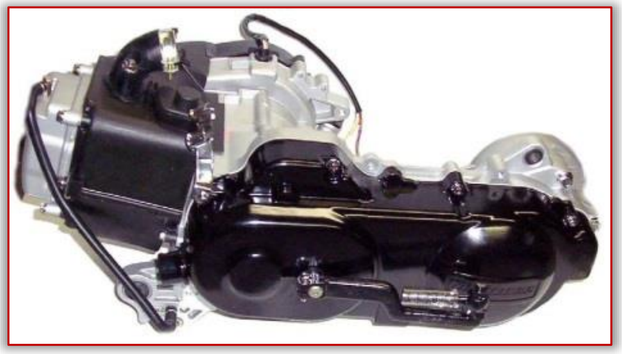


Figure 1. Kymco Agility engine

For an engine to be able to work with LPG, it is necessary to install a mixer (mixing valves) which has the role of producing the air-gas fuel mixture. This mixer is a specially designed mechanical device that ensures a proper air-gas mixture either under dynamic or static conditions.

A low pressure regulator is attached to the gas cylinder, the gas pressure at the regulator inlet is 0.3-7.5 bar, and the gas pressure at the regulator outlet is 20-60 mbar.

Composition of experimental stand

After the acquisition of the propulsion system (power unit) taken from the 50 cm^3 KYMCO AGILITY scooter, we built, in compliance with the gauge size, a physical support able to sustain it and the stand-related items: the LPG bottle, the battery, and the auxiliary systems required for the operation of the experimental equipment.

Figure 2. Support of the stand

Since the stand is designed to enable the visualisation of the signals emitted by the installed sensors and transducers, it is necessary to design an electrical connection diagram (Figure 3) that enables the visualization of sensors and actuators connection to the electronic control unit.

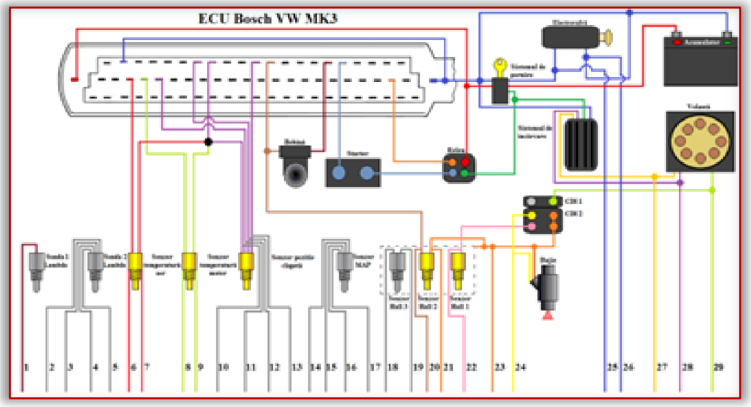


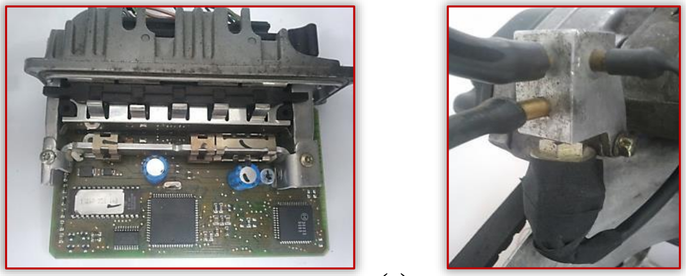
Figure 3. Electrical diagram

The application is designed to enable the measurement and visualization of the signals received from sensors and transducers, which is why a series of connectors have been installed on the electrical circuit. The signals were retrieved and viewed using the multimeter shown in Figure 4.

Figure 4. Multimeter used to retrieve the signals

Additionally, this multimeter shows the ease to communicate with a PC via a USB cable and using specialised software. The signals captured by the multimeter are transferred to a specialized interface, which enables to view the respective signals on the PC screen and to modify their characteristic parameters.

The signals generated by sensors and transducers are input signals for the Electronic Control Unit (ECU) of the engine, shown in Figure 5.



(a) (b)

Figure 5. (a) Electronic Control Unit (ECU); (b) Gas solenoid valve

The ECU processes these input signals and generates a series of output signals that control various actuators, including the solenoid valve that dispenses the gas flow to the engine cylinder.

The input signals come from a Hall sensor placed on the engine flywheel. Additionally, another two Hall sensors are fitted to compare the transmitted signals: these sensors are not connected to the ECU (Figure 6). Also, the ECU receives a signal from the MAP sensor (Figure 7), as well as from two temperature sensors (inlet air and engine). The sensor measures the absolute air pressure in the intake manifold. The use of an air pressure sensor instead of a flowmeter is determined by the much lower cost of this sensor.

Figure 6. Hall sensors and flywheel

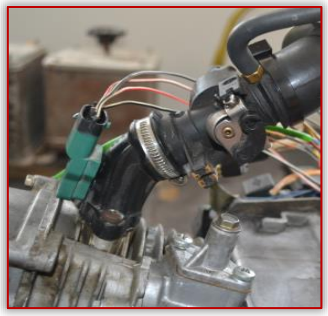


Figure 7. MAP sensor

Figure 8. Throttle position transducer

Figure 9. Lambda probe

Figure 10. Air filter

Figure 11. Overview of the experimental stand

The intake air pressure sensor is positioned after the throttle. If the engine is turbocharged, there is another air pressure sensor placed upstream of the throttle (downstream of the compressor) that reads the compressed air pressure.
There are also signals received from the throttle position transducer (Figure 8) placed downstream of the air inlet, which is equipped with an air filter specially designed for this type of engine (Figure 10).
In addition, the acquisition of signals can be also made from two lambda probes placed upstream or downstream of the silencer (Figure 9).
Here are the types of signals acquired from sensors via the oscilloscope and displayed on the PC screen when using the software.

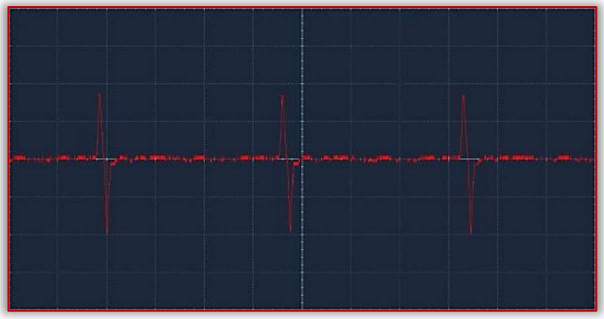


Figure 12. Hall 1 sensor signal

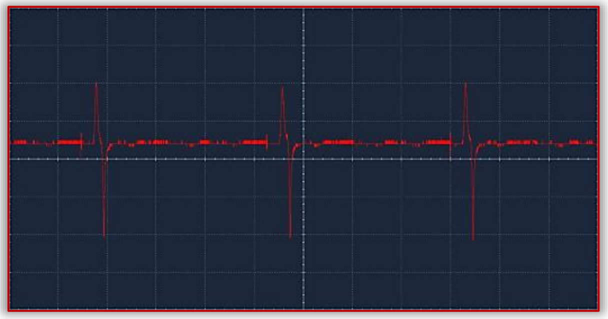


Figure 13. Hall 2 sensor signal

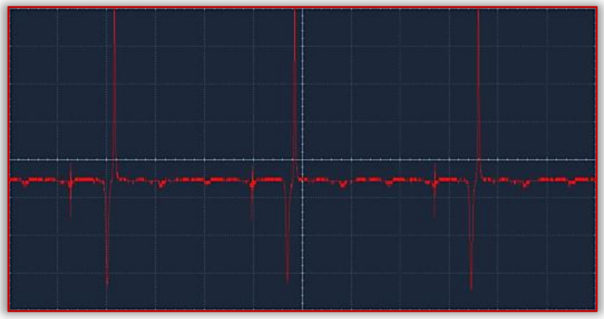


Figure 14. Hall 3 sensor signal

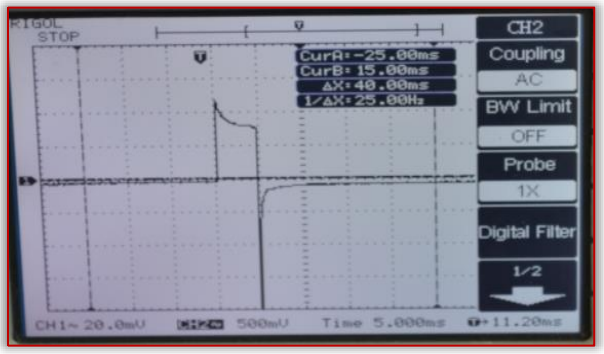


Figure 15. Solenoid valve control signal

CONCLUSIONS

In this paper we aimed to create a laboratory stand for the study of four-stroke engines with injection system.
The requirements imposed on this stand were that the final solution to be suitable for the study of electronic management systems used for the operation of spark-ignition heat engines. In order to do this, we started from the structure of a heat motor usually used for a normal scooter. To be operated in the laboratory, it was necessary to modify the fuelling solution. For this, we adopted a radical solution to fuel the system, i.e. the use of liquefied petroleum gas, due to the fact that the extremely large number of scooter vehicles and small machines equipped with this type of engines *(single-cylinder engine)* contributes with a significant percentage to the current level of pollution.
Their conversion to another type of fuel would lead to a significant reduction in the pollution caused by them. In order to manage the operation of this heat engine, it was necessary to include an injection computer. For this, we used an ECU unit and the sensor system from a normal car, equipped with single-point injection system. Because the injection system uses a normal injector, the engine operation is not optimal. This is because the amount of fuel combined with air is not correctly calculated by the injection control unit.
The conversion of this relatively simple system (from carburettor to injection) required the elimination of the carburettor and its replacement with a single-point injection system. Although it may seem to be simple, this conversion has a certain degree of difficulty. The main difficulty lies in the fact that there are only ECU units for high-power four-cylinder traction control systems on the market.

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BINARY MIXTURE OF N,N-DIMETHYLANILINE AND POLYETHYLENE GLYCOL 400 AS POTENTIAL SOLVENT FOR REGENERATIVE FLUE GAS DESULFURIZATION PROCESSES

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Abstract: Desulphurization processes (FGD) of flue gases from the thermal power and industrial plants, based on organic liquid solvents with mechanism of chemical absorption (N,N-dimethylaniline) physical absorption (polyethylene glycol 400) or combination of physical and chemical absorption recently gained its significance. The research results presented in this paper include density and dynamic viscosity measurements of binary mixture consisting of N,N-dimethylaniline and polyethylene glycol 400 in temperature range from 288.15 to 323.15 K and at atmospheric pressure. Density values were correlated by the second order polynomial equation. Viscosity modeling has been performed using correlative models (McAlister, Eyring - UNIQUAC and Eyring - NRTL). For simultaneous modeling of densities and viscosities, model based on the equation of state was used.
Key words: *Flue gas desulphurization, Density, Viscosity, Modelling*

INTRODUCTION

The most common method for flue gas desulfurization (FGD) is the lime/limestone process, which was patented in 1909 [1], and since then has gained wide practical application. Even today, the lime/limestone process, with some improvements/modifications, is the major FGD method. Recently, wet regenerative processes with gas absorption in liquid organic solvent and thermal regeneration have found practical application. The basic concept of wet regenerative process is that it consists of two stages: first is the absorption of sulfur-dioxide (SO_2) which takes place in the absorption tower, after which, in the second stage, the solvent goes through thermal regeneration in the desorption tower and can be reused in the process.
Processes based on N,N-dimethylaniline (DMA) and tetraethylene glycol dimethyl ether (TEGDME) have already been patented and industrially applied [2,3]. Proper selection of the organic solvent is of the utmost importance. In addition to the selectivity and binding capacity towards SO_2, in order to avoid its major losses from the process, solvent must possess a high boiling point and low vapor pressure. In some cases a mixture of solvents shows much better properties due to the synergetic effect. The main disadvantage of DMA is its high toxicity which imposes the need for more environmentally friendly replacements. Recent investigations suggested liquid polyethylene glycols of different chain lengths as one of the possible solutions [4]. Following the principle “green meets toxic” we have focused our attention on the solutions of the toxic compound N,N-dimethylaniline (DMA) with ambient friendly polyethylene glycol with molar mass 400 (PEG 400). The results presented here are a continuation of our previous work on alternative solvents for flue gas desulfurization processes [5-7]. Besides reducing DMA negative environmental impact additional reason for combining it with PEG 400 is the above mentioned synergetic effect. N,N-Dimethylaniline, as tertiary amine, has high selectivity towards SO_2 in comparison to the other components of flue gas like CO_2, and excellent binding capability by the mechanisms of chemical absorption. In polyethylene glycol 400 the binding of sulfur-dioxide (SO_2) occurs by means of physical absorption. Investigations [8,9] have shown that mixtures of physical and chemical solvents often show better characteristics regarding binding capacity and selectivity than aqueous solutions of amines, traditionally used in gas purification processes.
This article presents novel data on density and viscosity of DMA and PEG 400 binary mixture in the entire composition range, at temperatures between 288.15 K and 323.15 K with 5 K temperature step, and at pressure 0.1 MPa. In addition, viscosities of the mixture were correlated using several models:

McAlister [10], Eyring-UNQUAC [11], Eyring-NRTL [12], models. Simultaneous modelling of density and viscosity was performed using a model based on the Eyring approach in combination with Peng-Robinson equation of state (PR EOS) and van der Waals mixing rule (vdW1-3) [13].

MATERIAL AND METHODS

During the experimental work, following chemicals with guaranteed purity by manufacturer were used: polyethylene glycol 400 (Acros, 99.0%) and N,N-dimethyl aniline (Merck, 99.0%).
Prior to use, chemicals were kept in a dry, dark place in delivery bottles. All chemicals were used for the experiments, immediately after opening, without prior purification. Comparison of experimental values for density and dynamic viscosity of pure chemicals, with available data published in literature [14-20], at the atmospheric pressure and temperature of 298.15 K, is given in Table 2. Differences between measured density values and literature data do not exceed 0.9 kg·m^{-3}, while for dynamic viscosity the difference is up to 1.7 mPa·s for viscous PEG 400 and around $3\cdot10^{-2}$ mPa·s for DMA.

Table 1. Densities *(ρ)* and dynamic viscosities *(η)* of pure components at 298.15 K or 303.15 K and *p* = 0.1 MPa.[a]

Component	T/(K)	$10^{-3}\rho$ /(kg·m^{-3})		η /(mPa·s)	
		Exp.	Lit.	Exp.	Lit.
Dimethyl aniline	303.15	0.947778	0.9484 [14] 0.948 [15] 0.94833 [16]	1.2035	1.174 [15] 1.170 [16]
Polyethylene glycol 400	298.15	1.122534	1.12249 [17] 1.1218 [18] 1.12230 [19] 1.12162 [20]	91.062	92.797 [17]

[a]Standard uncertainties *u* for each variables are $u(T) = \pm$ 0.01 K and $u(p) = \pm$ 5 %, and the combined expanded uncertainties U_c are $U_c(\rho) = \pm$ 0.8 kg·m^{-3} and $U_c(\eta) = \pm$ 0.9 %, with 0.95 level of confidence (k ≈ 2).

For the investigated binary system, density (ρ) and dynamic viscosity (η) were measured at atmospheric pressure at eight temperatures ranging from 288.15 K to 323.15 K. Temperature step was 5 K. Densities of pure chemicals and binary mixtures were determined on the Anton Paar DMA 5000 apparatus, while dynamic viscosity was measured on Stabinger viscometer SVM 3000. Experimental procedure and apparatus are described in detail in our previous papers [5,6]. Binary mixtures have been prepared on the analytical balance Mettler AG 204 with accuracy of $1\cdot10^{-7}$ kg, while the standard mole fraction measurement uncertainty is within order of magnitude $\pm\,1\cdot10^{-4}$. The repeatability of density measurements is $\pm\,8\cdot10^{-2}$ kg·m^{-3} while the combined expanded uncertainty in density, mainly due to the influence of chemical purity, is within ± 0.8 kg·m^{-3} with a 0.95 level of confidence (k≈2). The uncertainties in viscosity data are estimated as ± 0.9 %. The uncertainties of investigated properties were determined using the Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results [21].

RESULTS AND DISCUSSION

The experimental values of density (ρ) and viscosity (η) for the investigated pure substances DMA and PEG 400 and their binary mixtures, at temperatures ranging from 288.15 K to 323.15 K and at atmospheric pressure are given in Table 2 and graphically presented in Figure 1.

Table 2. Densities ρ, and viscosities η of DMA and PEG 400 binary mixtures at T = (288.15-323.15/333.15) K and p = 0.1 MPa.[a]

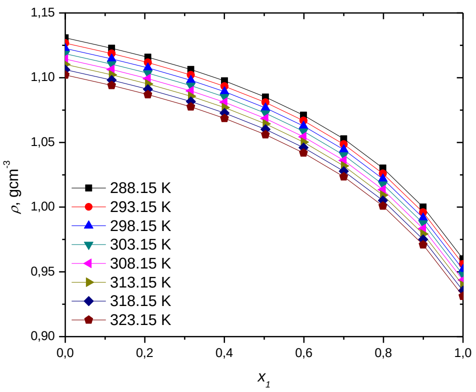
x_1	$10^{-3}\cdot\rho$/kgm^{-3}	η /mPas	x_1	$10^{-3}\cdot\rho$/kgm^{-3}	η /mPas
	288.15 K			293.15	
0.0000	1.130721	162.74	0.0000	1.126632	120.20
0.1167	1.122700	133.79	0.1167	1.118599	99.476
0.2076	1.115780	111.36	0.2076	1.111665	83.361

0.3156	1.106280	85.904	0.3156	1.102155	64.991
0.4006	1.097529	67.767	0.4006	1.093399	51.770
0.5036	1.085005	47.798	0.5036	1.080868	37.091
0.5992	1.070948	32.159	0.5992	1.066801	25.428
0.7000	1.052705	19.475	0.7000	1.048542	15.745
0.7986	1.030160	10.288	0.7986	1.025974	8.5852
0.8998	1.000070	4.3832	0.8998	0.995893	3.8096
1.0000	0.960062	1.5247	1.0000	0.955975	1.4030
	298.15			303.15	
0.0000	1.122534	91.062	0.0000	1.118432	70.224
0.1167	1.114488	75.778	0.1167	1.110382	58.926
0.2076	1.107550	63.892	0.2076	1.103438	50.013
0.3156	1.098031	50.309	0.3156	1.093909	39.745
0.4006	1.089266	40.449	0.4006	1.085135	32.223
0.5036	1.076722	29.384	0.5036	1.072581	23.745
0.5992	1.062647	20.611	0.5992	1.058497	16.891
0.7000	1.044382	12.975	0.7000	1.040220	10.844
0.7986	1.021800	7.2730	0.7986	1.017627	6.2339
0.8998	0.991719	3.3485	0.8998	0.987554	2.9667
1.0000	0.951878	1.2965	1.0000	0.947778	1.2035
	308.15			313.15	
0.0000	1.114337	55.617	0.0000	1.110244	44.568
0.1167	1.106280	46.774	0.1167	1.102179	37.727
0.2076	1.099327	39.892	0.2076	1.095224	32.354
0.3156	1.089789	31.962	0.3156	1.085677	26.121
0.4006	1.081009	26.120	0.4006	1.076886	21.500
0.5036	1.068447	19.487	0.5036	1.064310	16.210
0.5992	1.054351	14.046	0.5992	1.050200	11.828
0.7000	1.036058	9.1880	0.7000	1.031895	7.8607
0.7986	1.013458	5.3991	0.7986	1.009292	4.7224
0.8998	0.983393	2.6502	0.8998	0.979232	2.3843
1.0000	0.943669	1.1205	1.0000	0.939552	1.0462
	318.15			323.15	
0.0000	1.106158	36.348	0.0000	1.102079	30.248
0.1167	1.098087	30.906	0.1167	1.093999	25.768
0.2076	1.091123	26.631	0.2076	1.087030	22.224
0.3156	1.081564	21.653	0.3156	1.077461	18.288
0.4006	1.072762	17.940	0.4006	1.068647	15.250
0.5036	1.060173	13.662	0.5036	1.056043	11.729
0.5992	1.046049	10.083	0.5992	1.041902	8.7553
0.7000	1.027729	6.7986	0.7000	1.023566	5.9883
0.7986	1.005125	4.1636	0.7986	1.000962	3.7276
0.8998	0.975074	2.1577	0.8998	0.970916	1.9773
1.0000	0.935426	0.9796	1.0000	0.931291	0.9197

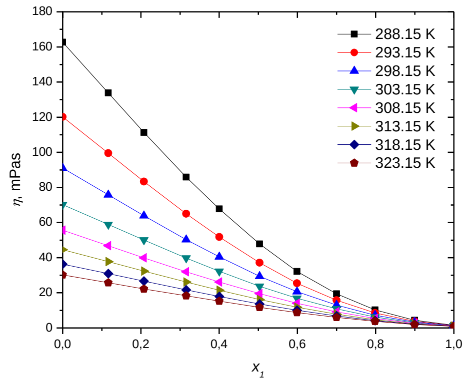
[a]Standard uncertainties u for each variables are $u(T) = \pm$ 0.01 K; $u(p) = \pm$ 5 %; $u(x_1) = \pm$ 0.0001, and the combined expanded uncertainties U_c are $U_c(\rho) = \pm$ 0.8 kg·m^{-3}; $U_c(V^E) = \pm 6\cdot10^{-8}$ m^3·mol^{-1}; $U_c(\eta) = \pm$ 0.9 %; $U_c(\Delta\eta) = \pm$ 0.5 %, with 0.95 level of confidence (k ≈ 2).

It can be noticed from Figure 1 that density lines at each temperature are following the same trend and are parallel to each other. On the other hand, viscosity of mixtures changes significantly with composition, due to the great difference between the viscosities of pure components. This change is more pronounced at lower temperatures. For correlating density a simple second order polynomial equation was sufficient:

$$\rho = A_1 + A_2 \cdot x_1 + A_3 \cdot x_1^3 \quad (1)$$



(a)



(b)

Figure 1. Experimental values of : (a) density *(ρ)* and (b) dynamic viscosities *(η)* as a function of DMA molar fraction x_1 at temperatures from 288.15 K to 323.15 K. Lines are fitted to data points from this paper.

Correlating viscosity of the mixture is a more complicated task for which several literature methods were used: two parameters McAlister [10], Eyring-UNQUAC [11], Eyring-NRTL [12] models and three parameters McAlister model [10]. In addition simultaneous correlation of density and viscosity was performed using the Eyring approach in combination with Peng-Robinson equation of state (PR EOS) and van der Waals mixing rule (vdW1-3) [13]. More details about the used models and calculation procedure can be found in our previous publications [7,22].
Interaction parameters for all models were obtained using Marquard technique [23] for the minimization of the objective function given by the equation:

$$OF = \frac{1}{m}\sum_{i=1}^{m}\left(\frac{Y_{\exp} - Y_{cal}}{Y_{\exp}}\right)^2 \rightarrow \min \tag{2}$$

and the quality of models were evaluated by the percentage deviations (*PD*):

$$PD(Y) = \frac{100}{m}\sum_{i=1}^{m}\left|\frac{Y_{\exp} - Y_{cal}}{Y_{\exp}}\right|_i \tag{3}$$

where Y_{exp} and Y_{cal} denotes experimental and calculated values of investigated property – density *(ρ)* or dynamic viscosity *(η)*. Values of *PD* for density correlation can be found in Table 3. Although much better results were obtained with PR EOS in combination with vdW1-3 mixing rule, satisfactory density correlation was also performed with simple polynomial equation (1). Another advantage of the approach based on the application of EOS is the fact that model parameters have unique values in the investigated temperature range which is significant for its practical application.
In the case of viscosity the values of *PD* for every mixture at each temperature can be also found in Table 3. The modeling was performed and the interaction parameters determined in the whole temperature range for Eyring-UNIQUAC, Eyring-NRTL and EOS-based models, while for the McAllister models it was done for every temperature individually, since modeling in the temperature interval gave unsatisfactory results.

Table 4. Results of density and viscosity correlation for the binary mixture DMA and PEG 400

T/(K)	*PD (ρ)*/(%)		*PD*(*η*) /(%)				
	Equation (1)[a]	Eyring-PR EOS + vdW1-3[b]	Eyring-UNIQUAC [b]	Eyring-NRTL[b]	McAllister-3[a]	McAllister-4[a]	Eyring-PR EOS + vdW1-3[b]
288.15	0.331	0.004	14,50	21,25	2,36	0,38	7,51
293.15	0.331	0.003	10,40	18,00	2,18	0,36	4,24
298.15	0.332	0.003	6,61	15,35	2.00	0,31	3,20

303.15	0.332	0.004	3,23	13,10	1,87	0,29	2,59
308.15	0.332	0.004	0,77	10,92	1,73	0,30	2,41
313.15	0.332	0.004	3,53	9,55	1,65	0,29	2,78
318.15	0.333	0.003	6,55	8,25	1,55	0,28	4,91
323.15	0.333	0.003	9,05	7,97	1,46	0,30	4,94

[a] parameters are determined for each temperature
[b] unique set of parameters for the whole temperature range

From the Table 3 it can be concluded that McAlister-3 and McAlister-4 models gave excellent results for all temperatures. Satisfactory correlation were also achieved with model based on Eyring approach in combination with Peng-Robinson EOS and vdW1-3 mixing rule, which is especially significant for practical application since the same values of parameters were used in the entire temperature range. Eyring-UNIQUAC showed acceptable values at certain temperature while the results obtained with Eyring-NRTL model were, in general, unsatisfactory. The improvment of the results obtained by these two models could be achieved if the modelling parameters were treated as temperure dependent instead of constant in the investigated temperature range.

CONCLUSION

In this paper, selected binary mixture consisting of N,N-dimethylaniline (DMA) and polyethylene glycol 400 (PEG 400) was investigated as potential solvents for flue gas desulfurization processes. One of these solvents, has already found industrial application, while the addition of the other, polyethylene glycol 400, could have favourable effect on process efficiency as well as postitive environmental impact. Study of suggested mixture involved mesurement of density (ρ) and viscosity (η) for DMA and PEG 400 mixtures at atmospheric pressure and in the temperature range from 288.15 K to 323.15 K.
Density correlation was performed by simple polinomial equation as well as with the model based on application of PR EOS in combination with vdW1-3 mixing rule. Satisfactory results were obtained in both cases, with the difference that the approach based on application of EOS uses the same set of parameters in the entire temeprature range.
For viscosity modelling McAlister-3 and McAlister-4 models gave excellent results at all temperatures, but satisfactory correlation was also achieved with model based on Eyring approach in combination with Peng-Robinson EOS and vdW1-3 mixing rule. Poorer results were obtained with Eyring-UNIQUAC and Eyring-NRTL models. All the applied models, except McAlister, treat the parameters as constant in the investigated temperature range order to facilitate their practical application. The improvment of the results obtained by some models could be achieved if the modelling parameters were treated as temperure dependent instead of constant.

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Session 4.

Energetics

INVESTIGATION OF ENERGY EFFICIENCY IN TURKEY

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Abstract: The fact that the reserves of fossil energy resources are limited, the scientific studies on renewable and alternative energy sources are intensified and the share of the total installed capacity in the world is still small while the investments are increasing at a serious rate, the efforts of using energy more efficiently have been increased. When the geographical location is examined, it is observed that Turkey is located on the intersection of energy corridors; What is the level of energy efficiency studies? In this study, with the increasing population and energy consumption amounts, Turkey's analysis of the energy efficiency situation has been analyzed and some evaluations have been made for the future.It has also been shown that it may be possible to contribute to the protection of the country's economy and the environment without restricting civilian needs by using energy more efficiently on a sectoral basis from the example of Turkey.

INTRODUCTION

For economic and social development and human life; reliable, cheap and clean energy supply today has become the most important problem. It is known that 1.3 billion people in the world still do not have the right to use energy. This is one of the problems expressed in the future that could lead to wars in world scale. The data show that the rate of increase in energy consumption in Turkey is more than twice that of the EU and OECD countries. The change in electricity consumption is four times higher than the average of other countries[1]. The world's energy consumption has increased by 45% since 1980. It is predicted that by 2030 it will have increased by more than 70%. The emerging Asia-Pacific markets include 75% of the new demand and put new pressure on the resources of the world.
However, there is a growing demand and limited resource problem in developed markets such as North America, Europe and Japan. These developed markets will continue to make the necessary adjustments to reduce consumption, use alternative energy sources and increase energy security.

GENERAL OVERVIEW OF WORLD ENERGY APPEARANCE

The oil crises of the early 1970s and subsequent embargoes on the producer countries led to western countries taking urgent measures for their energy needs. Since these countries have urgently deployed nuclear power plants, they have made serious investments in alternative energy sources and energy efficiency issues. The variation of primary energy consumption on the basis of resources is shown in Figure 1 [2].

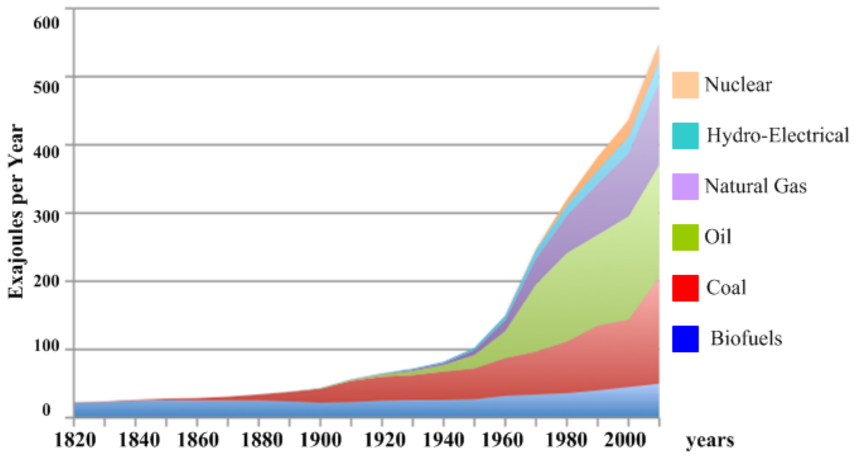

Figure 1. Change of world primary energy consumption on the basis of sources (1820 - 2010)

Today, fossil fuels have a dominant share in energy consumption. In 2010, 34% of 12 billion tons of equivalent petroleum (TEP) energy consumed by petroleum, 30% by coal and 24% by natural gas.
In 2010, 54% of the world's energy is consumed by five countries. These are China, the United States, Russia, Japan, and India, where consumption is increasing in Figure 2. China's annual energy consumption has grown 2.4 times over the past 10 years, leaving behind the US annual consumption at the end of 2010 [3].

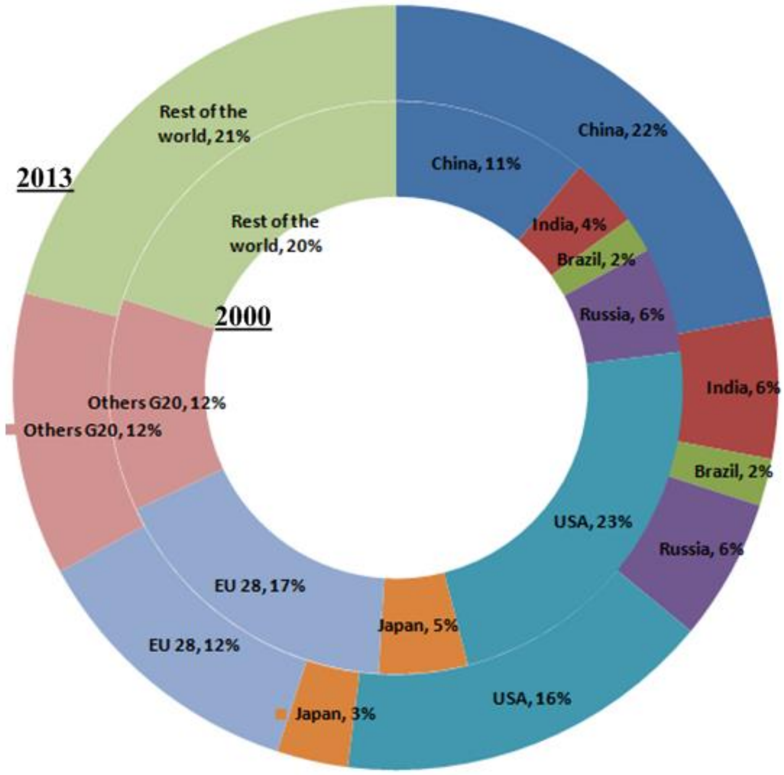

Figure 2. Change in primary energy consumption of some countries (2000 - 2013)

TURKEY AND ENERGY

The development of primary energy consumption in Turkey in recent years based on resources can be seen in Figure 3. Petroleum, whose share of primary energy demand in the 1970s has reached 50%, now has a significant share of 26.7%. The demand for natural gas, which is 3.1 million TEP in 1990, has increased 11 times in the last two decades and reached 34.9 million TEP in 2010 [4].

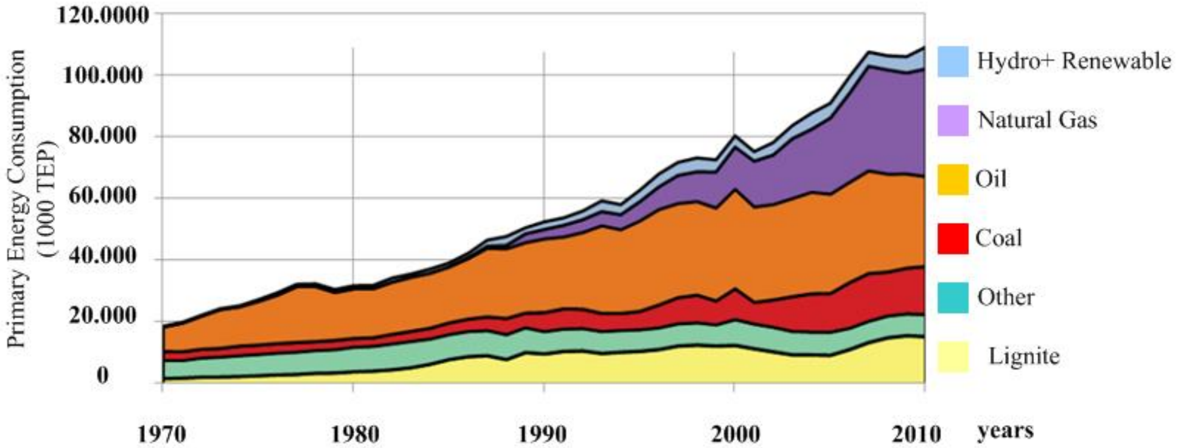

Figure 3. Development of Turkey's primary energy consumption on the basis of resources.

Turkey's primary energy consumption reached 109.3 million TEPs in 2010, despite a slight decline due to the 2009 economic crisis. A trend of 5% increase has been observed since 2010. On the other hand, the rate of meeting the energy demand with domestic production is decreasing [5].

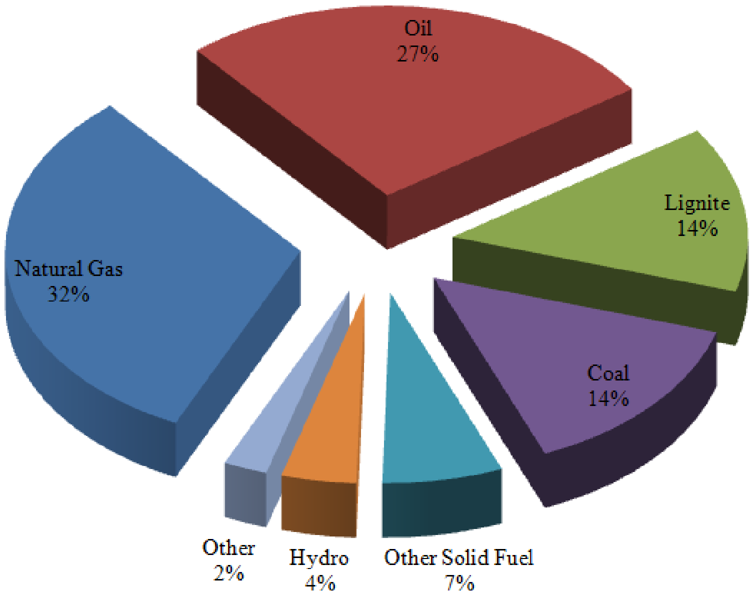

Figure 4. Distribution of primary energy consumption in Turkey (2010)

Turkey's Population Projection

According to data from the Turkish Statistical Institute, it is expected that the population of Turkey will reach 94.6 million by 2050. This is to ensure that the energy needs of the population can be met from domestic sources and that external dependency on energy can be reduced; it is also important to use energy efficiently as well as to increase energy production. Figure 5 shows Turkey's present and future population projection. By 2050 then the population will decrease in scenario 1 [6].

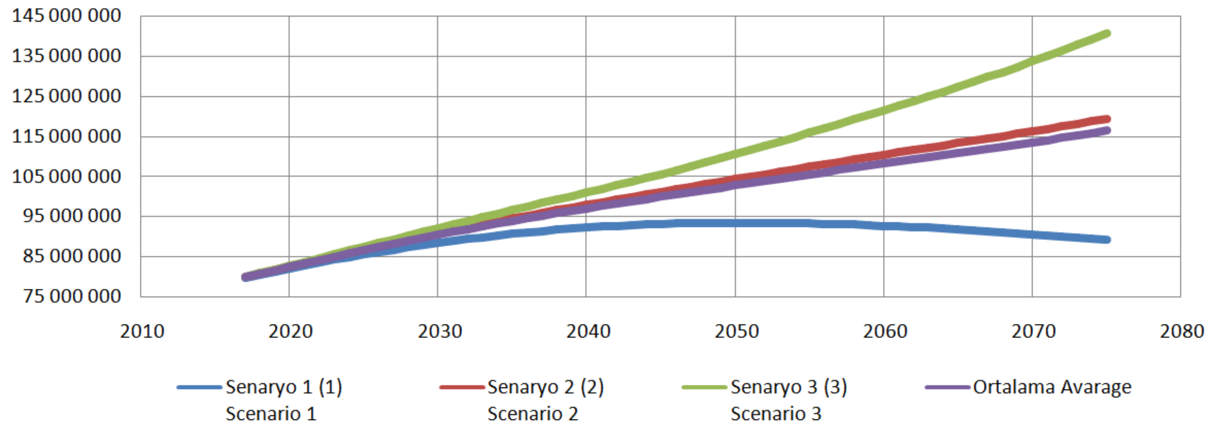

Figure 5. Turkey population projection based on various scenarios of Turkish Statistical Institute

Turkey’s Electricity Consumption

The consumption of electricity in Turkey between 2003 and 2013 is given in Figure 6 and the annual energy consumption is showing an increasing trend. When it is thought that the increase in consumption will continue in this trend; energy efficiency gains more importance [7].

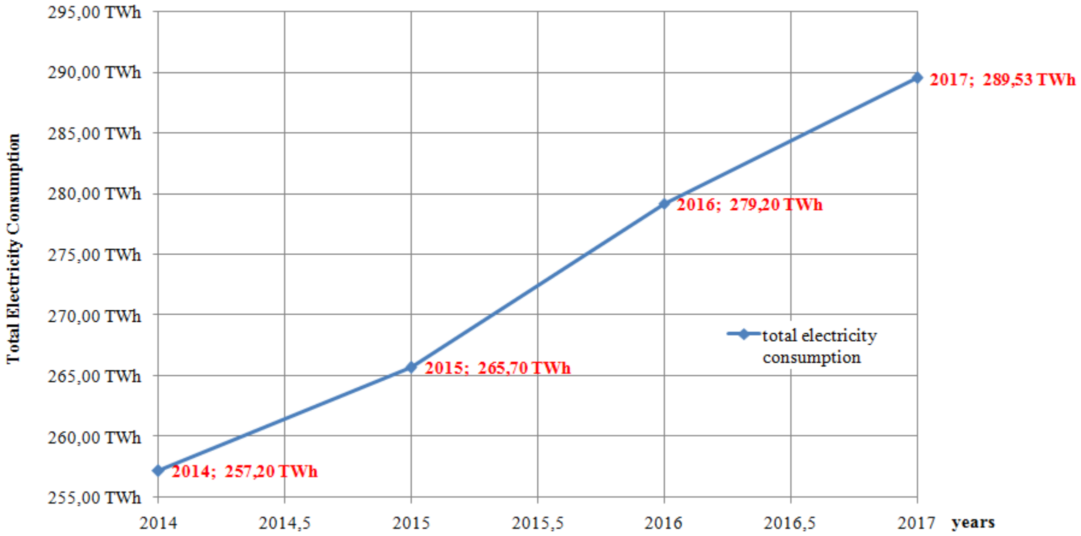

Figure 6. Electricity consumption in Turkey

Energy-intensive industrial sub-sectors are important in the industry. Energy costs are between 20% and 50% of total production costs. The iron and steel sector has the largest share of industrial energy consumption with a share of 22% and cement, glass, ceramics and brick have a consumption share of 19%. These sectors have a large share in energy consumption and have high energy efficiency potentials [8]. The energy saving potential in the industrial sector in Turkey is at least 20%, of which about 50% can be paid with small investments and less than two years back. According to the work of the General Directorate of Renewable Energy, Turkey has a potential to save 15% in the primary energy demand of 222 million TEP by 2020 [9]. According to the current legislation, industrial facilities consuming 1000 TEP energy and Organized Industrial Zones (OSB), which has more than 50 enterprises in it, have to implement energy management. Well-organized energy management it is possible to save 10% energy with no investment at all.
The electricity consumption ratios in the houses are given in Figure 7, and when these ratios are examined, it is observed that household appliances consuming the most electric energy are refrigerated with a share of 30% followed by enlightening by 28%. In order to reduce the high energy consumption due to refrigerator usage, energy saving models have been started to be used in refrigerator production and washing and dishwashing machines have been produced using saving models in the same way [10].

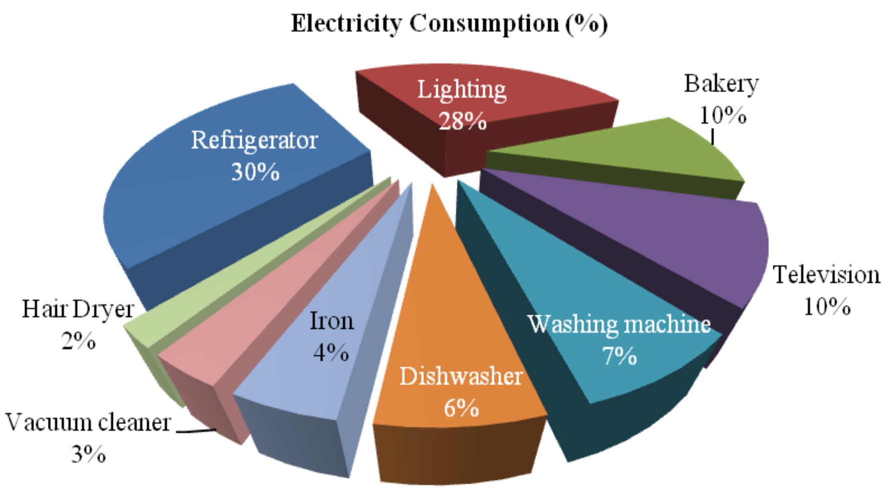

Figure 7. Electricity Consumption Rates in Buildings (%)

The share of enlightenment in energy consumption is great. The lighting industry is showing a trend towards Light Emitting Diode (LED) technology, which consumes less energy each passing day. It is expected that in 2020, 75% of the lighting industry will be formed by LEDs [11].

Energy Density

Energy Density, an important indicator of energy efficiency; It represents the amount of TEP energy consumed for the product of $ 1000. In other words, the lower the density, the more energy is used efficiently. Turkey's energy intensity and the Tenth Development Plan are expected to take place as in Figure 5 for years [12].

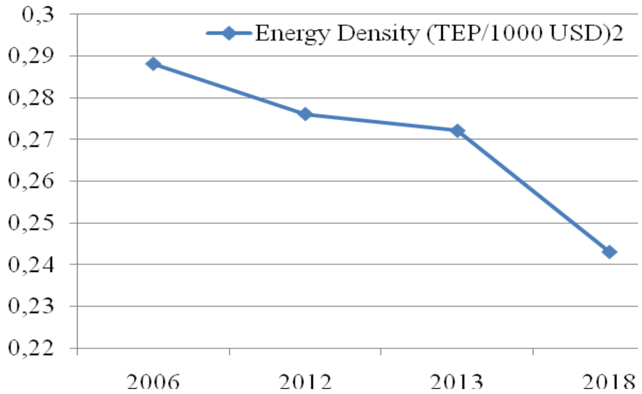

Figure 8. Energy Density Plan (between 2006 – 2018 years)

ENERGY EFFICIENCY

It is a concept that deals with a wide area such as energy efficiency, protection of the environment, contribution to world and country economy, some solution to unemployment, contribution to family budget. From another point of view, energy efficiency, energy generation, transmission and distribution, heating, cooling, lighting, home appliances, and office equipment, in the home and the service sector. As population growth and the development of technology increase the energy demand, when the current production is not enough to meet this need, new investments are made this need needs to be met. On the other hand it is possible to meet the energy deficit with primarily energy efficiency investments and energy efficiency, which can be called free energy. Energy efficiency is defined as negawatt, negajoule in the sense of negative energy in some sources. As a result of studies on energy efficiency in Turkey, it has been determined that there is an energy saving potential of approximately 2.5 billion USD, 30% in the building sector, 20% in the industrial sector and 15% in the transportation sector [13]. According to the projections made for 2020, the primary 222-MTEP it has been seen that there is potential to reduce energy demand by at least 15%.

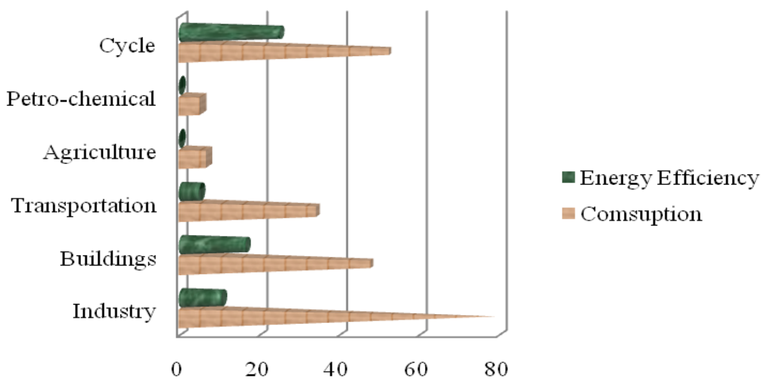

Figure 9. Turkey's energy saving potential of 2020

The coal-fired power plants in Turkey are 92% owned by the state and the average age of these power plants is over 30%. It is known that the conversion efficiencies of these plants are around 30% and that these efficiencies can be increased to 90% [14]. Technically, 94% of hydraulic power generation can be achieved. In our country, hydraulic plant efficiencies other than those built in recent years can be reduced to 80%. Continued for the rehabilitation of public-owned hydraulic power plants According to a preliminary survey conducted within the scope of the studies, 615 million kWh can be obtained annually by the rehabilitation of hydroelectric power plants over a certain age in Turkey [15].
In Turkey, the ratio of total transmission and distribution losses to consumed electricity is around 14.5% in 2009 [16]. This rate is in Germany and Japan about five percent, four percent in South Korea, and seven percent in the United States [17].

CONCLUSION

- Evaluating the saving potential in the sectors where there is a lot of energy consumption and decreasing the loss rates in transmission they will reduce their energy expenditure. Effective management of energy management in parallel with current legislation and future plans in the energy sector will make a significant contribution to energy saving [18].
- Reduction of energy intensity in the industrial sector, energy improvement in productivity and structural changes. Savings in the iron and steel, cement, glass, petrochemical and petroleum sectors should be increased in this sector where energy saving potential is high and energy consumption is high. If the energy intensity needs to be reduced regularly and necessary precautions are not taken; In Turkey As energy consumption increases, the economy is likely to be more energy intensive.
- In the transportation sector, increasing the use of rail systems and public transportation will significantly reduce energy consumption.
- Large-scale enterprises, such as factories, hospitals, shopping malls, public life centers and similar places where there is a lot of energy consumption, such as cogeneration systems the preference of efficient systems will greatly contribute to energy efficiency.
- Saving the energy of citizens it is seen that it will be beneficial to raise awareness about usage, to develop public transportation culture and to make electrical household appliances used in houses more energy efficient ones.
- In the industrial sector, it is necessary to replace energy consuming instruments and systems, such as diesel engines, with those that are conservative, make market transformations, and attach importance to heat insulation in the houses.
- In order to reduce energy demands and carbon emissions of buildings sustainable eco-friendly buildings using renewable energy sources seem to be necessary.
- While planning for the future is planned in Turkey, the needs of the society can be analyzed in a proper and sustainable manner in terms of economic and social development. the approach must be exhibited and energy policy must be created.

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ENERGY CONSUMPTION ANALYSIS OF THE MAPPED PUBLIC BUILDING IN THE CITY OF NOVI SAD

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Abstract: Since the Building Sector is responsible for 40% of global energy consumption and 30% of GHG emissions, the aim of the work is to analyze the trend of reducing energy consumption in a public building in the City of Novi Sad. The energy consumption analysis was carried out at the building of the Elementary School "Nikola Tesla". Energy consumption analysis refers to costs of heating, electricity and water in the period from 2013 to 2015.
Key words: public building, energy consumption, heating, electricity, water

INTRODUCTION

According to the United Nations' expert team and the World Meteorological Organization's forecasts, the average surface temperature is projected to rise from 1.4 to 5.8 degrees Celsius by the end of the 21st century and, in spite of our supposedly controlled CO_2 emissions, will continue to rise in the next 100 to 300 years, because the gases are kept in the atmosphere for a long time. However, if the Kyoto Protocol principles were strictly applied and if there was a quick transition from fossil fuels to renewable energy sources (solar energy, wind energy, biomass, etc.), which are quite sufficient, the rise in temperature by the end of the century would not exceed 2 degrees Celsius [1].
In order to keep the world temperature rise below 2 degrees Celsius, GHG emissions in 2025 should be reduced to 48 Gt CO_2e, and in 2030 to 42 Gt CO_2e. In 2014, GHG emissions were 52.7 Gt CO_2e in the countries under the Kyoto Protocol. Fossil fuels and industry emitted 35.5 Gt CO2e in that year. If the countries under the Kyoto Protocol met the objectives for reducing GHG emissions, which were delivered before the climate conference in Paris, emissions in 2025 would be 54 Gt CO_2e per year, and in 2030, 56 Gt CO_2e per year [2].

ENERGY EFFICIENCY IN BUILDINGS

Energy consumption, i.e. CO_2e emissions for buildings of different purposes, or different facilities, ranges from 300 to 1,650 kg CO_2e/m^2 [3]. Energy consumption in residential and commercial buildings ranges from 3.6 to 19 GJ/m^2 [4].
The world's rapidly growing energy consumption rates, coupled with the associated environmental impacts of such energy consumption, have raised concerns in different communities and among researchers, engineers, and even politicians [5,6]. As buildings are responsible for more than 40% of primary energy usage and 70% of overall electricity usage in the U.S., policy-makers must quickly take action to reduce the energy demand of buildings [6,7]. The energy consumption of buildings is responsible for 38% of CO_2 emissions to the atmosphere, 52% of SO_2 emissions, and 20% of NOx emissions [8]. At the same time, the quantity of energy consumed by buildings will rise in the future, bearing in mind the increasing number of population and their needs [1]. Transition to sustainable energy buildings requires the reduction of energy consumption to a minimum, while keeping comfort at the same level. In order to make appropriate energy-efficient building projects, one should take care of the isolation, the way of lighting, the orientation of the building itself, and other factors that can affect the energy consumption. Nowadays, there are various studies dealing with the use of different sensors in order to reduce energy consumption.

ENERGY EFFICIENCY IN THE BUILDINGS OF THE REPUBLIC OF SERBIA

Houses of our ancestors were energy sustainable, as being made from natural materials, such as wood, mud, cane, soil and similar materials. But, after the Second World War, in the former Republic of Yugoslavia, the quantity, and not the quality and comfort of the buildings, was taken into account, which soon led to the large influx of rural population to the cities.
Today, the largest number of residential buildings in the Republic of Serbia is in energy class ”G”, which means that they consume more than 175 kWh/m^2 per year for heating [9-11]. Here we should also add that maintenance costs rise over the years due to the age of buildings and their installations. The average energy required to heat buildings in Serbia is about 2.5 times higher than in EU countries. In Serbia, 70% of the buildings have no insulation, which is the reason why they spend about 40% of energy. To invest in high-quality insulation, one needs 18 €/m^2 at this moment.
One of the main reasons for implementing energy efficiency in buildings is the protection of the environment, or reduction of CO_2 and other harmful gases' emissions into the atmosphere [11-14]. For example, by the application of measures of economic efficiency, emissions of CO_2 and other harmful gases in Germany have been reduced by 27%, and today the Federal Republic of Germany gets 1/3 of its energy from renewable energy sources.
The European Commission has proposed a five-point action plan for European energy security and solidarity through [15] construction of infrastructure and the diversification of energy supplies, international energy relations, creation of oil and gas reserves and the mechanisms of response to emergencies, energy efficiency, and the best use of domestic resources within the EU.

MATERIALS AND METHODS

On the territory of the City of Novi Sad, on November 15, 2016, there were 328 buildings for public purposes, which were under the jurisdiction of different subjects and different levels of government [16]. 39 of them were under the jurisdiction of public utility companies, whose costs were not paid by the City of Novi Sad, which means that there were 289 facilities whose costs of maintenance were borne by the City. One of these buildings is the Elementary School "Nikola Tesla".
As an example of an analysis of energy consumption in public buildings in the City of Novi Sad, the energy consumption in the building of the Elementary School "Nikola Tesla" was analyzed. Energy consumption analysis refers to heating, electricity and water costs in the period from 2013 to 2015. Energy consumption analysis was done in accordance with the Manual and Guidelines for energy balance creation in municipalities.
However, the school building has been repaired since 2015, and has therefore become more energy efficient (new joinery, replacement of energy-inefficient lighting with energy efficient, insulation, etc.), and the aim of this work is to determine the exact amount of the energy saved and to make further projections of savings for the period from 2017 to 2019.
In order to display the expenditures for the mapped building, the following data are analyzed:
- basic information and energy data on the facility, Table 1,
- energy indicators, depending on the purpose of the facility, Table 2,
- economic indicators related to the energy consumed, depending on the purpose of the facility, Table 3,
- indicators related to the water consumed, Table 4,
- energy indicators in the observed facility, Table 5.

In order to analyze the annual results of energy consumption, the following data are graphically displayed:
- energy and water consumption, Fig.1. and
- the ratio of electricity and heating consumption, Fig.2.

RESULTS AND DISCUSSION

The total floor area of the building of the Elementary School "Nikola Tesla" is 4,056 m^2, and the number of permanent users ranges from 891 to 951 users, **Table 1**.
Energy indicators, depending on the purpose of the facility, are shown in **Table 2**. The conclusion is that the annual electricity consumption per m^2 of the facility was 28.88 kWh/m2 in 2013, 28.73 kWh/m^2 in 2014, and 28.18 kWh/m^2 in 2015; the annual electricity consumption per user was 118.92 kWh/user in 2013, 111.77 kWh/user in 2014, and 109.63 kWh/user in 2015, Table 2.
Economic indicators related to the energy consumed, depending on the purpose of the facility, are shown in **Table 3**. The conclusion is that the annual electricity costs per m^2 of the facility were 2.07 EUR/m^2 in 2013, 2.05 EUR/m^2 in 2014, and 2.10 EUR/m^2 in 2015; the annual electricity costs per user were 8.54 EUR/user in 2013, 7.97 EUR/user in 2014, and 8.18 EUR/user in 2015, Table 3 [16].
Indicators related to the water consumed in the observed facility are shown in **Table 4**. The conclusion is that the annual water consumption per user was 9,05 m^3/user in 2013, 5,62 m^3/user in 2014, and 5,00 m^3/user in 2015; the annual water costs per user were 16.23 EUR/user in 2013, 9.72 EUR/user in 2014, and 8.60 EUR/user in 2015, Table 4.
The analysis of energy indicators in the observed facility is displayed in **Table 5**. The specific annual electricity consumption per m^2 of the building's area was 28.18 kWh/m^2, while the specific annual electricity consumption per user was 109.63 kWh/user, Table 5. The specific annual heating consumption per m^2 of the building's heated area was 203.32 kWh/m^2, while the specific annual heating consumption per user was 790.92 kWh/user, Table.5. The specific annual water consumption per m^2 of the building's area was 1.28 m^3/m^2, while the specific water consumption per user was 5.00 m^3/user, Table 5.

Table 1. Basic information and energy data on the facility

The name and the address of the facility	**Elementary school "Nikola Tesla", 25a Futoski put, 21000 Novi Sad**		
Category	Educational institution		
Subcategory	Elementary school		
Construction year	1956		
Last significant reconstruction year	2013		
The projected number of users (capacity)	-		
The number of permanent users (preferably in the last few years)	**2013**	**2014**	**2015**
	891	951	951
The number of temporary users (preferably in the last few years)	100		
Total floor area of the building	4.056 m^2		
Heated floor area of the building	4.056 m^2		
Total building volume	-		
Heated building volume	-		
Heating mode (energy, fuel, technical system with a construction year)	Natural gas		
Annual consumption and costs (preferably in the last few years) of			
Electricity [kWh, EUR]	**2013**	**2014**	**2015**
	117,140.00 kWh 8,407.97 €	116.800,00 kWh 8,326.15 €	114.560,00 kWh 8,551.85 €
Heating (for district heating systems – heat quantities [kWh, EUR], and for the other fuels: gas, oil, coal, firewood etc. are displayed in the appropriate quantity units [m^3, t, EUR] and calculated values expressed in energy [kWh]	**2013**	**2014**	**2015**
	167,508.00 m^3 1,551,124.08 kWh 67,198.17 €	86,405.00 m^3 800,110.30 kWh 34,840.00 €	89,256.00 m^3 826,510.56 kWh 34,760.76 €

CO_2 emissions due to the consumption of			
Electricity [t/year]	**2013**	**2014**	**2015**
	93,7	93,4	91,6
Other fuels [t/year]	**2013**	**2014**	**2015**
	310,2	160,0	165,6
Total emissions [t/year]	**2013**	**2014**	**2015**
	403,9	253,4	146,6

Table 2. Energy indicators, depending on the purpose of the facility

Indicator	2013	2014	2015
The annual electricity consumption per m^2 of the facility [kWh/m^2]	28.88	28.73	28.18
The annual electricity consumption per one user [kWh/user]	118.92	111.77	109.63
The annual heating/cooling consumption per m^3 of the heated/cooled floor area of the facility [kWh/m^3]	-	-	-
The annual heating/cooling consumption per m^2 of the heated/cooled floor area of the facility [kWh/m^2]	382.43	196.83	203.32
The annual heating/cooling consumption per one user [kWh/user]	1,574.75	765.66	790.92

Table 3. Economic indicators related to the energy consumed, depending on the purpose of the facility

Indicator	2013	2014	2015
The annual electricity costs per m^2 of the facility [EUR/m^2]	2.07	2.05	2.10
The annual electricity costs per one user [EUR/user]	8.54	7.97	8.18
The annual heating/cooling costs per m^3 of the heated/cooled floor area of the facility [kWh/m^3]	-	-	-
The annual heating/cooling costs per m^2 of the heated/cooled floor area of the facility [kWh/m^2]	16.57	8.57	8.55
The annual heating/cooling costs per one user [kWh/user]	68.22	33.34	33.26

Table 4. Indicators related to the water consumed in the observed facility

Indicator	2013	2014	2015
The annual water consumption and costs [m^3, EUR]	8,911 m^3 15,984.62 €	5,869 m^3 10,162.60 €	5,221 m^3 8,990.74 €
Technical indicators of water consumption - the annual water consumption per one user [m^3/user]	9.05	5.62	5.00
Economic indicators of water consumed - the annual water costs per one user [EUR/user]	16.23	9.72	8.60

Table 5. The analysis of energy indicators in the observed facility

The name of the facility: Elementary school "Nikola Tesla"		
Floor area	(m^2)	4,056
Heated floor area	(m^2)	4,056
The actual number of permanent users		951
Total electricity consumption	(kWh)	114,560
Total electricity costs	(€)	8,551.85
Total heating consumption	(kWh)	826,510
Total heating costs	(€)	34,760.76
Total water consumption	(m^3)	5,221
Total water costs	(€)	8,990.74
The way of using the facility		
Total floor area per user	(m^2/user)	4.26
Heated floor area per user	(m^2 h./user)	4.26

Energy indicators of the facility			
Specific annual electricity consumption			
JZE1	per m^2	(kWh/m^2 a year)	28.18
JZE2**	per user (the actual number of permanent users)	(kWh/u. a year)	109.63
Specific annual heating consumption *			
JZG1	per heated m^2	(kWh/m^2 a year)	203.32
JZG2**	per user (the actual number of permanent users)	(kWh/u. a year)	790.92
Specific annual water consumption			
JZV1	per m^2	(m^3/m^2 a year)	1.28
JZV2**	per user (the actual number of permanent users)	(m^3/ u. a year)	5.00
Specific annual energy costs			
Specific annual gross electricity costs			
JZTE1	per m^2	(€/m^2 a year)	2.10
JZTE2**	per user (the actual number of permanent users)	(€/u. a year)	8.18
Specific annual gross heating costs *			
JZTG1	per heated m^2	(€/m^2 a year)	8.55
JZTG2**	per user (the actual number of permanent users)	(€/u. a year)	33.26
Specific annual gross water costs			
JZTV1	per m^2	(€/m^2 a year)	2.21
JZTV2**	per user (the actual number of permanent users)	(€/u. a year)	8.6

The indicators of energy and water consumption in the observed facility (Elementary school "Nikola Tesla") for the period from 2013 to 2015 are graphically displayed in **Fig.1**. The indicators of the ratio of electricity and heating consumption for the period from 2013 to 2015 are graphically displayed in **Fig.2**.

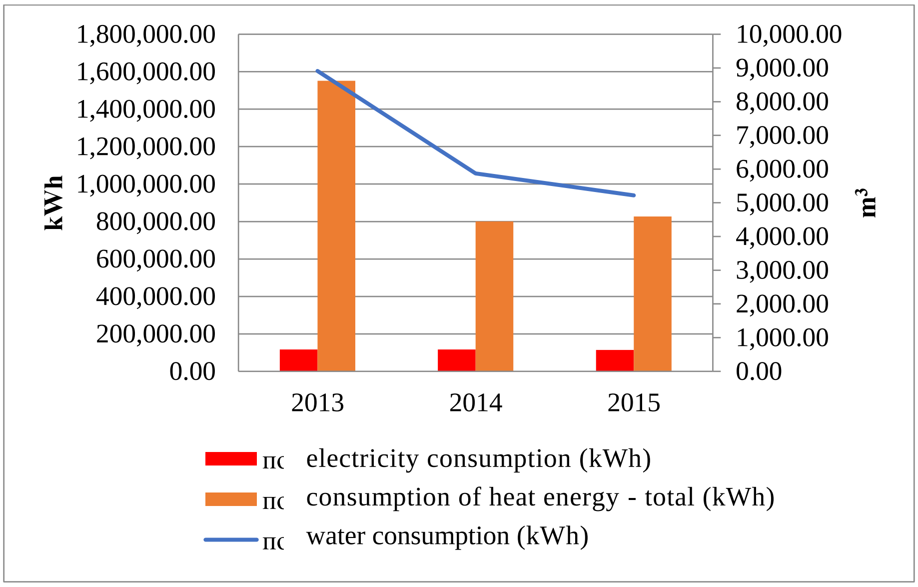

Figure 1. Energy and water consumption in the observed facility

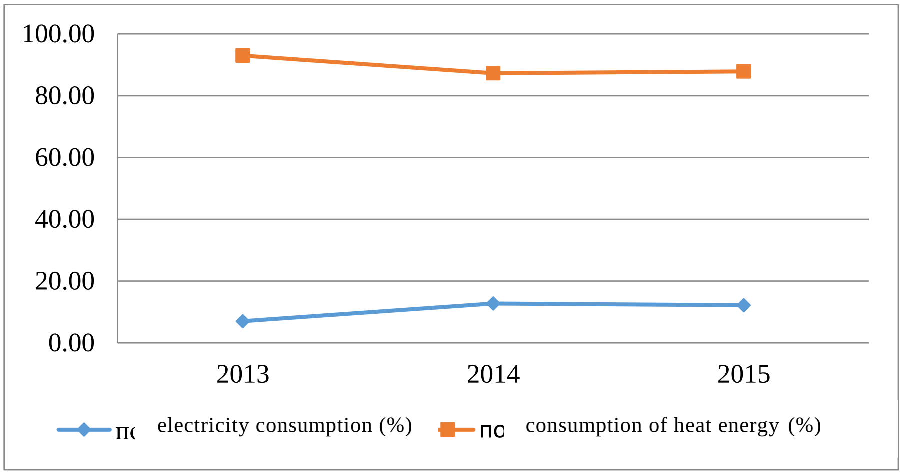

Figure 2. The ratio of electricity and heating consumption in the observed facility

CONCLUSION

Generally speaking, it can be concluded that the measures of energetic efficiency in the facility have given results and that the trend of reducing energy consumption has been noticed. The analysis of the energy consumption presented in this work presents a good basis for future three-year planning of the primary energy savings in the observed facility as well as in other facilities. The plan is to reach the cumulative savings of 473.4 toe, in the 200 public buildings analyzed in the City of Novi Sad, ie. 1% annually, and 6% in total, in the following period from 2017 to 2019.

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RATIONAL SUSTAINABLE USE OF WASTE BIOMASS AS A RENEWABLE ENERGY SOURCE IN THE DEVELOPMENT OF THE LOCAL COMMUNITY

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Abstract: The use of available agricultural waste wood and plant biomass for energy or other purposes is significant due to poor energy potentials in general, as well as due to the reduction of import dependence, ensuring energy supply, reducing environmental pollution, satisfying international commitments to reduce CO2 emissions ,. Also, the rational use of available agricultural waste wood and plant biomass for energy and other purposes would significantly influence the raising of the technological level of energy, mechanical engineering, food industry, etc., faster development of poorly developed regions rich in waste from agricultural wood and plant biomass is realized through: realization of investments, engagement of local workforce, opening of new jobs, improvement of local infrastructure, and realization of income through various types of production.
Key words: waste wood and bimine biomass, use, community development

1.0 INTRODUCTORY REVIEWS

1.1 Overview of the current situation

Significant quantities of waste wood for energy are obtained on sawmills and other wood processing plants - timber of trunks with bugs or logs that are attacked by mushrooms, scabs, sawdust, and the like. Also, all wood residues that occur in forests and plantations around roads and averages, branches, hives etc are usually left around the roads where natural decomposition of this wood mass is carried out. Natural degradation - the humification of these wood residues occurs spontaneously and lasts for many years. Unfortunately, this wood mass is often burned in the forest, which brings risks of fire and damage to forest land.
When it comes to biomass in agriculture, then, first of all, it refers to plant residues from plant, fruit and vine production. There are great potentials for the use of biomass in agriculture: for the production of humus (forage), manure (spinning), fodder (without treatment, treatment with chemicals, mixing with protein foods, etc.), heat energy (heating), building materials various plates and cubes), furniture parts (chipboards), alcohol (fermentation), biogas (anaerobic fermentation), paper and packaging production, cleaning agents for metal surfaces (polishing), powders and other cosmetic products, decorative items (tapiser straw hats, etc.) and for other purposes.
Between farmers, livestock farmers, technologists, engineers, economists and other potential biomass users, there are contradictory opinions for which purposes biomass could be most useful. Raters believe that most of the biomass should be crushed and thus increase the fertility of the soil, cattle farmers believe that biomass should be used for rug and animal feed production, and with manure to increase the fertility of the soil, technologists believe that biomass should produce alcohol, thermals consider biomass to be used for the production of thermal energy, etc.
Therefore, in the production of agricultural products, there are various residues that can be used as energy or for other purposes. According to the available information, the valorization of cuttings from raspberries, blackberries, vineyards, orchards and some other agricultural products is very rare, that is, this valorisation is most often done by incineration at the original locations.
For the rational use of firewood, as well as wood and vegetable residues, they should define the energy potentials for the defined territory, which arise from:
- firewood intended for heating,
- wood residues that arise, in the first place, by shrinkage of woody plants: unused wood, remains of logs, horns, branches, etc.,
- agricultural residues: straw, leaves, parts of fruit trees, waste in the production of raspberries and blackberries, vines, maize stems, etc.

- waste wood and vegetable biomass from: fragments of forests, boundaries, bays, landslides, maintenance: electric lines, roads, etc.,
- municipal wood and vegetable waste from households and industry, etc.

1.2 Sustainability of the rational use of available energy and wood biomass fuels

A defined concept for the rational use of available wood and plant biomass will enable sustainable development, since conceptual embedded current energy, industry and environmental strategies are yet to be incorporated into central policies of economic and social development. The concept of sustainable development of this project has generally three-dimensional aspects: (1) economic (or perhaps techno-economic) sustainability, (2) ecological sustainability and (3) social sustainability. Sustainable development systems depend on the practical application of matching technologies, providing the best "interconnection" between the feasibility, social acceptability and environmentally sustainable use of available resources.
Some of the aspects of environmental protection are aggregate environmental impacts from agricultural production residues in emissions into: air, watercourses and land, and on the change or degradation of habitats (humans, flora and fauna). To date, knowledge of such influences is mainly based on observation and oral statements.

2.0 STRATEGIC GOALS FOR THE USE OF WOOD AND PLANT BIOMASS AS ENERGY

Renewable energy sources of wood and plant biomass can significantly contribute to the less use of fossil fuels and to the achievement of defined goals for the share of renewable sources in final energy consumption, as well as environmental improvements. The goals of the energy policy of the Republic of Serbia, which refer to the increased use of RES (renewable energy sources) from biomass, can be achieved through the realization of the following activities:
- by building new facilities that meet the requirements to inspect the energy efficiency of biomass utilization as an energy source,
- energy rehabilitation of buildings, heating of energy sources from biomass using utilities (mainly public sector),
- replacement of oil for heating, coal and natural gas used for heating with biomass,
- introduction of district heating systems based on the use of biomass and combined production of electricity and heat,
- using and production of equipment technology that will enable more efficient use of energy from biomass.

The key activities to be undertaken to achieve the stated objectives include:
- ensuring the leading role of the public sector in implementing an efficient use of energy from biomass,
- Setting up efficient use of energy from biomass in order to stimulate the economic development of the country (production of green energy technology equipment),
- the development of sustainable biomass production and the provision of financial support for development,
- formation of the energy market from biomass.

In order to achieve the stated goals in the field of energy use from biomass, it is necessary to apply the following support measures:
- adoption and improvement of the legal framework that will stimulate more energy efficient energy use and greater use of biomass as an energy source,
- Measures of economic incentives (through the establishment of an already established support scheme for the production of electricity from renewable sources and cogeneration of heat and electricity with high efficiency of the process, as well as the preparation of measures to support the production of thermal energy from biomass at the local level):
- direct financial incentives for appropriate tax policies,
- measures that will encourage a sustainable biomass market,
- systematic promotion of best practices applied in EU countries (efficient use of energy from biomass),

- systematic planning of projects for energy use of biomass, etc.

3.0 TECHNOLOGIES FOR ENERGY USE OF AVAILABLE ENERGY POTENTIAL OF WOOD AND PLANT BIOMASS

Depending on the place of production, the degree of humidity and the amount of waste wood and vegetable biomass, appropriate preparation should be made for the rational use of these energy sources. Preparatory technologies for the rational use of wood and vegetable biomass should include appropriate preparation at the source of production with the appropriate machinery. So, this mechanization is necessary to be mobile.
There are two main types of biofuels from wood biomass. One type of biofuel from wood biomass includes firewood, chips, sawdust and other wood residues without any preparation. Another type of biofuel from wood biomass includes pellets and briquettes. Biofuels that are specifically produced by increasing their bulk density.
Wood waste in the forest is collected to a certain extent, but not all the rest in the harvest is collected, and what is collected remains in the woods. Usually the remains that remain in the forest make the branches thinner than 7cm. All this waste should be collected manually.
Typical cutting-edge technologies are shown in Figure 1. These are machines with different capacities and different possibilities. Some of them are for cutting thin branches and for use for one household (Figure 1a) with a capacity of 6-10 m^3/h, while others are intended for cutting thinner logs (Figure 1b) with a capacity of 100 m^3/h. According to the available information, these technologies for the production of choppers have not yet been applied in Serbia [4].
Despite the availability of forest residue, the existence of boilers on biomass and the relatively low price of machines for the production of wooden cutters, this technology has not yet found wider application in Serbia. Lack of information and the promotion of the use of fuels from biomass, especially forest residues, is probably the main reason why this technology is not used.

a)

b)

Figure 1. Cutting machinese (www.linddana.dk) [5]

3.1 Energy production by burning wood and wood waste

The most common way of utilizing waste wood and vegetable biomass for energy production is combustion in boilers or furnaces. To burn wood biomass, boilers and boilers for burning biomass are used (Figure 2. [1]) in a hot water or steam version, with a power of 25 kW to 20 MW. The benefits of this technology are: ecological work, reduction of greenhouse gas emissions, operation of boiler rooms with occasional supervision. Boilers and boilers for burning biomass are designed on a non-service system with occasional supervision, fully automated, including automatic fuel dispensing and retirement systems. For combustion of wood biomass in medium-sized boilers commonly used technology in Serbia is burning on grids. This means that biomass burns in a fixed layer or on a moving grid. A typical construction of a boiler for combustion of sawdust with a heat insulated furnace that allows full combustion of biomass is shown in Figure 3.


a)


b)

Figure 2. Automated boiler room with industrial computer and standalone a) control system, b) appearance of internal pellet firebox [1]

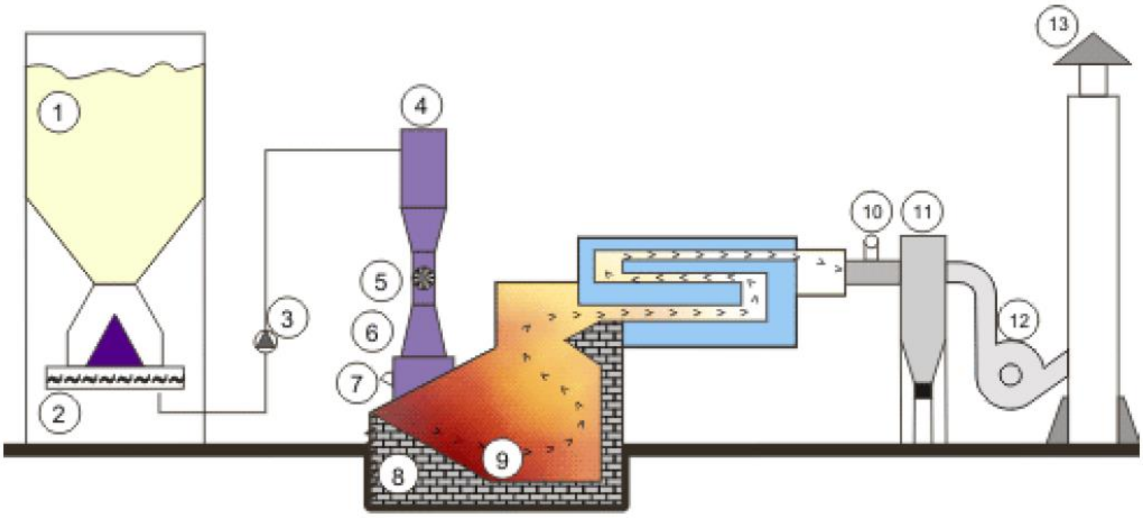

Figure 3. Scheme of the boiler with combustion equipment (www.kirka-suri.com) [1]
1-silo for sawdust; 2-worm dispenser; 3-fan; 4-cyclone; 5,6,7-dosing system; 8-wall furnace; 9-zone combustion; 10-regulator; 11-cyclone; 12-fan; 13-chimney

Biogas is a fuel gas that mostly consists of methane (CH4) and carbon dioxide (CO2). From waste wood and plant biomass, biogas can be produced as an energy source.

Wood biomass as a fuel must not be used only for the production of heat but also for the production of electricity. For now, in Serbia all boilers burning biomass produce warm air, hot water or steam for some process. Today, projects in Serbia are in the lead to install plants for electricity generation using biomass. Wood processing companies, almost all except plain sawmills, usually have drying chambers. Since these companies use electricity for the operation of machines, this means that wood processing companies have needs for heat and electricity. For this reason, if viewed from a technical point of view, wood processing companies are an ideal place for installing plants with combined heat and power production - cogeneration plants - (CHP). In cogeneration plants we have (MWe -

represents the equivalent for produced electricity, while MWt- represents the equivalent for generated heat energy).
Also, biogas can be produced from the appropriate waste wood and plant biomass. Biogas arises in a biochemical process called anaerobic digestion, in which complex organic matter (organic substrates) dissolve in the absence of oxygen. Biogas can be used for the production of heat energy, combined production of electricity and bulk energy (in a cogeneration plant) or combined production, electrical, bulk and cooling energy (trigeneration).
The advantage of the CHP plant is their high total utility (80%) compared to the usefulness levels of separate heat production plants (85%) and electricity production (35%). A higher degree of usefulness means less fuel consumption, and less fuel consumption for a given amount of wood waste means greater production of heat and electricity. Electricity produced in enterprises can be used to meet their own needs or may be surrendered to the network and sold. For this reason, these companies are, in principle, interested in maximizing the production of electricity after satisfying their needs for thermal energy.
It can be expected that the rational use of the energy potential of waste wood and plant biomass will have a very important role in the production of energy in Serbia in the coming years, bearing in mind that it is also necessary to reduce the amount of carbon dioxide emitted into the atmosphere. In all of this, a state should also be involved to help develop the market for renewable energy by means of certain incentives.
In addition to possible use for energy purposes, available wood and plant biomass can also be used to obtain appropriate technologies and products from them that can be applied in: food, cosmetic, pharmaceutic, etc. industry.

3.2 Composition

3.2.1 What is composting?

As a compost product, useful material is obtained, similar to humus, which has no unpleasant smell, which can be used as a soil conditioning agent or as a fertilizer.
Compost is a product produced by the composting of plant and animal remains in somewhat controlled, usually aerobic conditions. Almost all plant residues (grass, leaves, branches, fruits and vegetables, etc.) can be composted, as well as some remains of animal origin (manure, trash, remains of meat ...).
In the process of maintaining green areas in the city, a large amount of biodegradable waste that can be composted is collected.
Justification of composting from the aspect of environmental protection is reflected in:

- reducing the total amount of waste for landfilling,
- improving sanitary status in areas of intense human activity,
- improving the sanitary status of the landfill,
- obtaining organic fertilizers and improving soil quality,
- A more rational approach to biomass,
- reduced air pollution volume.

The economic justification of composting involves:

- More rational use of waste as a resource,
- reduction of transportation and waste costs,
- Extensive exploitation life of the landfill, and therefore the investment coefficient of investment in the landfill.

The legal aspects of justification of composting are:

- KJOTO protocol,
- RIO Declaration - Local Agenda 21,
- Sustainable Development Strategy,
- Council Directive 75/442 / EEC on waste,
- Directive 78/319 / EEC on toxic and hazardous waste,
- Council Directive 99/31 / EC on waste dumps.

4.0 CONCLUSIONS

For the rational use of available waste wood and plant biomass for energy purposes, the available potentials can be used to generate heat and / or electricity. Cogeneration (often referred to as combined heat and power generation) is at the same time generating useful heat and electricity in one process. With combined heat and power production, fuel consumption can be reduced by approximately 25-35% compared to the production of electricity and heat in separate processes. In this way, the emission of CO2 per heat produced and electricity is reduced and the overall efficiency is higher. In the case of cogeneration plants in the production of a current of one MWh, carbon dioxide emissions are reduced by about one ton. A similar situation exists in the case of trigeneration plants where thermal energy, electricity and cooling energy can be produced.

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MANANGING THE PROJECT FOR REMEDIATION OF CONSEQUENCES OF COAL THERMAL POWER PLANT OPERATION

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Abstract: The consequences of thermal power plants' operation in terms of environmental quality are numerous, especially in the developing countries, because some of them are over 40 years old. The analysis of the life cycle of thermal power plant contributes to the determination of the impact of emissions of pollutants on the quality of air, water, and soil. A significant contribution to mitigating the negative impact comes from energy savings and reduced coal consumption. The analysis of the thermal power plant life cycle should be based on consideration of concentrations of carbon dioxide, sulfur dioxide, nitrogen oxides, as well as the impact of tailings, ash, and wastewater. The management of the project for remediation of consequences of thermal power plant operation is based on the application of MS Project; forming the basis for future comparative and prolonged research.
Key words: power plant, analysis of the life cycle, environmental, management project, remediation of consequences

INTRODUCTION

Transformation of the primary coal energy into electricity affects the quality of human life and the environment. Emissions of gases and solid particles can be monitored within the estimation of the life cycle of coal, from the moment of determining the coal reserves on the surface mine to the moment of ash disposal. The goal of monitoring the entire process is to determine possible losses, irrational coal consumption and exceeding of the limit values of pollutants. The expected outcome of the implementation of the management project is the definition of effective corrective measures for environmental protection and mitigation of the negative effects of the thermal power plant operation on the quality of the environment

Developing countries that are using obsolete thermal power plants have a global impact because cross-border pollution also questions the quality of life in neighboring countries. Thermal power plants are sources of carbon dioxide, sulfur dioxide and nitrogen oxides whose cross-border emission values can be found in a region that does not belong to the country with obsolete equipment.

METHODS

Analysis of the life cycle of a thermal power plant

Life Cycle Analysis (LCA) is a method that analyzes the product throughout the life cycle. The procedures and methods were agreed upon at the Conference of the Society of Environmental Toxicology and Chemistry (SETAC), 1992. It has application in all engineering areas.

The application of the LCA systematic method in energetics aims to create a basis for determining sources of pollution and assessing harmful consequences, as well as finding the possibility that the observed failures in thermal power system operation will be eliminated. Application of energy balance data (on regional and national level) points to energy reserves, the exploitation of primary energy and energy efficiency. It is necessary to determine the level of pollutants by the amount of exploited and burnt coal, in order to define energy indicators and assess the impact on the quality of the environment.

The application of the International Standards (ISO) life cycle assessment (Table 1) is the basis of the thermal power plant operation analysis.

Table 1. ISO standards of life cycle assessment [2, 3, 4, 5, 6 , 7 i 8]

International Standards and life cycle assessment	
ISO 14040	Life cycle principle of framework
ISO 14041	Environmental management - Life cycle assessment - Goal and scope definition and inventory analysis
ISO 14042	Environmental management – Life cycle assessment – Life cycle impact assessment
ISO 14043	Environmental management - Life cycle assessment - Life cycle interpretation
ISO 14048	Environmental management - Life cycle assessment - Life cycle assessment data documentation format
ISO 14049	Environmental management - Life cycle assessment-Examples for the application of ISO14001

An analysis of the exploitation and combustion of coal is proposed using the LCA method, which sets the system boundaries. The analysis of existing reports leads to realistic estimations of the impact of mining, waste repositories and the functioning of the thermal power system. The aim is to point out the sources of pollutants in the analyzed plant and recognize problems in operation of the environmental protection system.

Environmental Management Project

Managing the environmental protection system is a solution to the identified problems of the LCA method. Setting the system boundaries in the framework of the previous analysis represents the framework for creating the MS Project model.
All processes that impair the quality of air, water, and land in any way are included from the moment of preparatory works for excavation of coal to the leaching of the process waters from the ash dump. System boundaries that round up the process of emission of pollutants, from the exploitation and transport of coal to the distribution of electricity are predetermined in Figure 1.

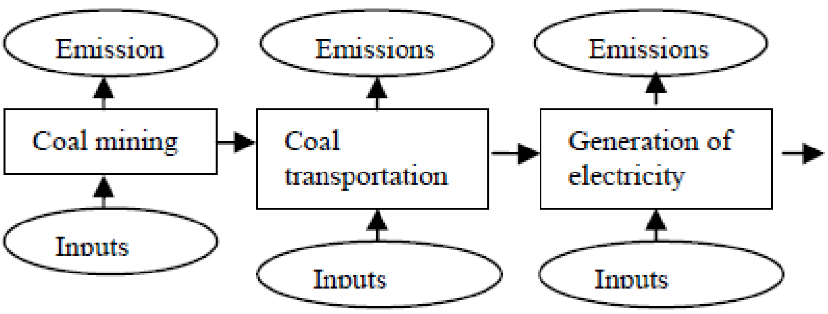


Figure 1. System boundary of the study [9]

The system boundaries (Figure 1) imply that the analysis of the thermal power plant impact on the environmental quality is based on the analysis of the consequences of oil, waste and ash transportation, the exploitation of coal on the surface mine and the transformation of appropriate coal energy into secondary energy. The analysis has determined that the pollutants of solid, gaseous and liquid aggregate state are emitted in significant quantities and are not sufficiently purified. The management project is characterized by information on their presence, in order to plan corrective protection measures and identify problems in operation of the thermal power plant's environmental protection system.

RESULTS AND DISCUSSION

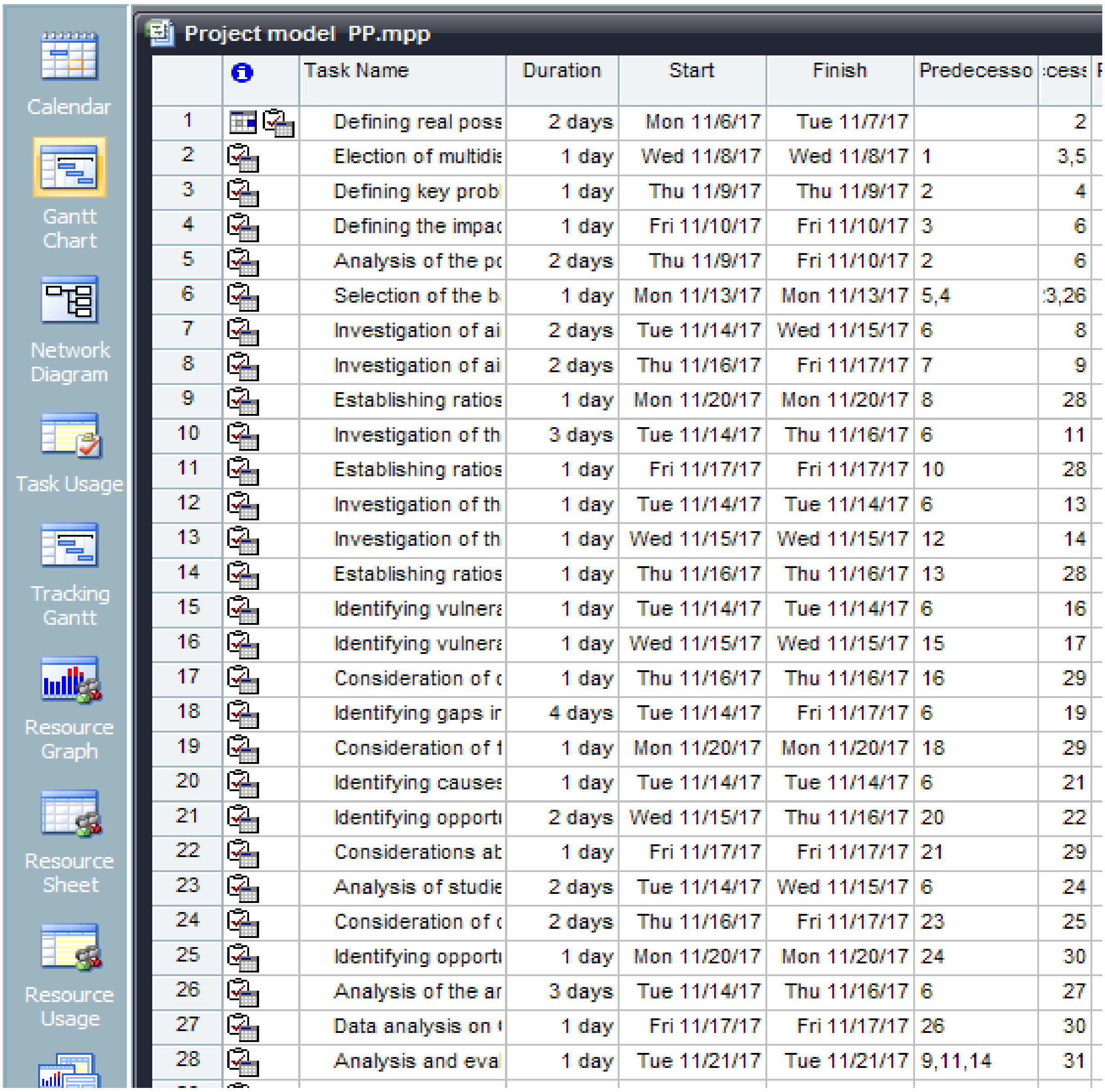
A network planning technique is a starting point for project management. Application of the critical path method (CPM) and precisely defined activity durations allows [10] forming of a model of System for managing environmental protection of thermal power plant – EPSPP. Defined activities form the basis for the realization of management program [11], by applying the software package MS Project (Table 2.)

Table 2. A list of project management activities

No.	Project management activities
1	Defining possibilities for improving the EPSPP
2	Selecting multidisciplinary team members
3	Defining key problems in the functioning EPSPP
4	Defining the impact of energy complex
5	Analysing of applying the principles of sustainable development
6	Selecting the basic principles
7	Investigating air quality
8	Investigating air quality effects of emitted ash and gaseous products
9	Establishing ratios for concentrations
10	Investigating the effects of wastewater
11	Establishing ratios for concentrations of heavy metals
12	Investigating the effects of surface exploitation
13	Investigating the effects of ash disposal
14	Establishing ratios for concentrations of heavy metals
15	Identifying vulnerabilities in the application of the applicable laws
16	Identifying vulnerabilities in the application of EU directives
17	Considering opportunities for active environmental protection
18	Identifying gaps in the preventive safety measures
19	Considering causes of threats to the environment
20	Identifying causes of the adverse effects caused by operations
21	Identifying opportunities for eliminating causes
22	Considering the need for environmental education
23	Analysing studies on the country’s energy potential
24	Considering coal reserves
25	Identifying opportunities for rational consumption of coal
26	Analysing the annual level of coal exploitation
27	Data analysing on GDP per unit of consumption
28	Analysing and evaluating harmful consequences
29	Creating amendment proposals
30	Identifying opportunities for rationalization of coal

31	Predicting risks to human health and state of the environment
32	Creating amendment proposals on the adopted environmental policy
33	Analysing energy consumption
34	Establishing procedures to stop neglecting the importance
35	Establishing procedures and compliance with EU standards
36	Preparing the documentation for the timely risk identification
37	Proposing the implementation of sustainable development principles

The duration of the activities is presented in Figure 2.



	Task Name	Duration	Start	Finish	Predecesso	:cess
1	Defining real poss	2 days	Mon 11/6/17	Tue 11/7/17		2
2	Election of multidis	1 day	Wed 11/8/17	Wed 11/8/17	1	3,5
3	Defining key probl	1 day	Thu 11/9/17	Thu 11/9/17	2	4
4	Defining the impac	1 day	Fri 11/10/17	Fri 11/10/17	3	6
5	Analysis of the pc	2 days	Thu 11/9/17	Fri 11/10/17	2	6
6	Selection of the b	1 day	Mon 11/13/17	Mon 11/13/17	5,4	:3,26
7	Investigation of ai	2 days	Tue 11/14/17	Wed 11/15/17	6	8
8	Investigation of ai	2 days	Thu 11/16/17	Fri 11/17/17	7	9
9	Establishing ratios	1 day	Mon 11/20/17	Mon 11/20/17	8	28
10	Investigation of th	3 days	Tue 11/14/17	Thu 11/16/17	6	11
11	Establishing ratios	1 day	Fri 11/17/17	Fri 11/17/17	10	28
12	Investigation of th	1 day	Tue 11/14/17	Tue 11/14/17	6	13
13	Investigation of th	1 day	Wed 11/15/17	Wed 11/15/17	12	14
14	Establishing ratios	1 day	Thu 11/16/17	Thu 11/16/17	13	28
15	Identifying vulner	1 day	Tue 11/14/17	Tue 11/14/17	6	16
16	Identifying vulner	1 day	Wed 11/15/17	Wed 11/15/17	15	17
17	Consideration of	1 day	Thu 11/16/17	Thu 11/16/17	16	29
18	Identifying gaps ir	4 days	Tue 11/14/17	Fri 11/17/17	6	19
19	Consideration of	1 day	Mon 11/20/17	Mon 11/20/17	18	29
20	Identifying causes	1 day	Tue 11/14/17	Tue 11/14/17	6	21
21	Identifying opport	2 days	Wed 11/15/17	Thu 11/16/17	20	22
22	Considerations ab	1 day	Fri 11/17/17	Fri 11/17/17	21	29
23	Analysis of studie	2 days	Tue 11/14/17	Wed 11/15/17	6	24
24	Consideration of	2 days	Thu 11/16/17	Fri 11/17/17	23	25
25	Identifying opport	1 day	Mon 11/20/17	Mon 11/20/17	24	30
26	Analysis of the ar	3 days	Tue 11/14/17	Thu 11/16/17	6	27
27	Data analysis on	1 day	Fri 11/17/17	Fri 11/17/17	26	30
28	Analysis and eva	1 day	Tue 11/21/17	Tue 11/21/17	9,11,14	31

Figure 2. The duration of the EPSPP management project

In Figure 2, in addition to the duration of the activity, the order of execution of the activity is presented, based on which it is concluded that this is a branched structure of the management project. Figure 3 shows the start of the management project with the display of activities on the critical path.

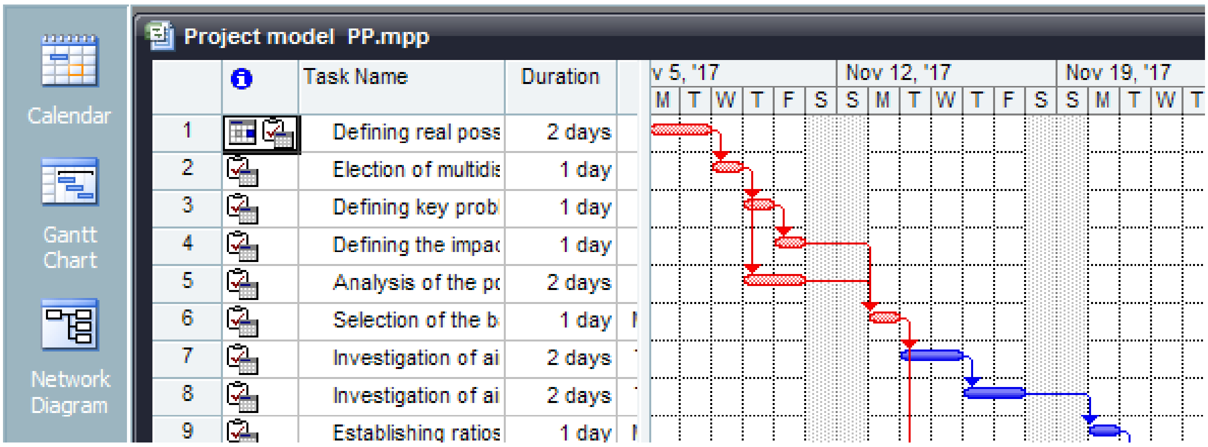


Figure 3. Initial activities of the management project

Figure 3 defines the position of activities such as defining the environmental protection management system (1), selecting team members (2), defining key protection issues (3) and the impact of the operation of the thermal power plant (4), as well as analyzing the opportunities for sustainable development (5) and the application of basic principles. The view of the activity tabs is shown in Figure 4.

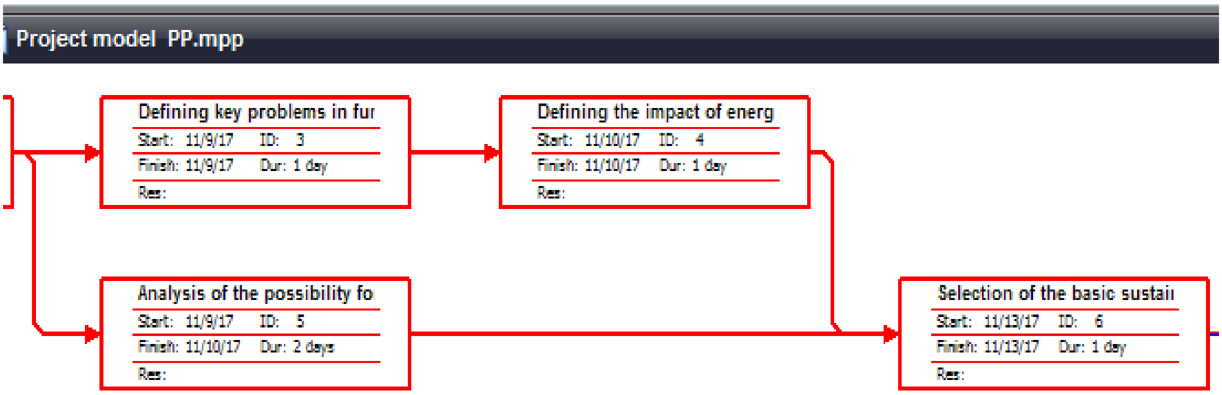


Figure 4. View of the process management activity tabs

Figure 4 shows that the management project is planning for parallel execution of the process of defining key problems (3) and the impact of thermal power plants on the environmental quality (4), by analyzing the application of basic principles of sustainable development in the field of energetics (5). The following graphic representation (Figure 5) presents the final activities of the project.

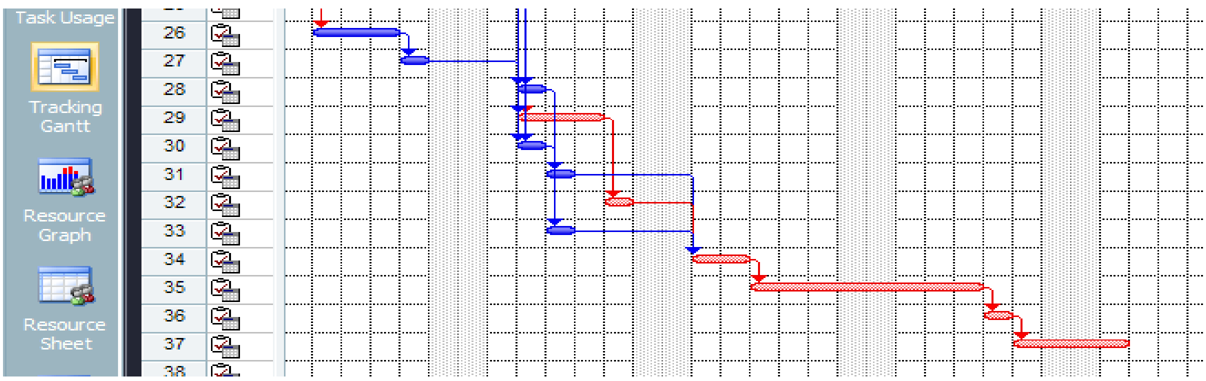


Figure 5. Display of final activities of the management project

Figure 5 presents activities for the analysis of the annual coal exploitation level (26) and the formulation of proposals for preventive and corrective protective measures (27), after which it is possible to formulate a proposal for amending the adopted short-term and long-term goals of environmental protection (29).

CONCLUSION

The management of the remediation project for the consequences of the thermal power plant operation forms the basis for finding solutions that would reduce the level of emissions of pollutants. Determining the possibilities for rationalizing coal consumption and predicting the risks to human health, as well as forming proposals for a change in environmental policy are main objectives of the management project. Determining the procedures for performing work-related exploitation activities and coal combustion would lead to compliance with the prescribed emission levels of pollutants and compliance with national and European norms. The main objective of the project is to create the basis for preparation of documents that would enable the implementation of procedures for regular analysis of the impact of work-related activities and timely risk assessment. The presented project represents a solution for remediation of consequences of thermal power plants operations with the respect of basic principles of sustainable development.

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COMPUTER PROGRAM FOR CALCULATING DISTRIBUTION OF WATER-FLOW IN CYLINDRICAL HEAT EXCHANGERS

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Abstract: This paper represents, an analysis of the influence of the input elements on the distribution of water flow in cylindrical heat exchangers. Based on a mathematical model a computer program has been developed, that determinates the degree of uneven distribution of water flow in the pipes of the pipe bundle at cylindrical evaporators (heat exchangers). A numerical example of such propellants is made and an overview and recommendations for changing certain structural elements that contribute to optimal operation of evaporators or meeting the criteria for uneven distribution of water flow in the pipe bundle.
Keywords: water-flow, evaporator, heat exchanger.

INTRODUCTION

Using the mathematical model, [1], a computer program is developed to determine the extent of the uneven distribution of water flow in pipes in the pipe bundle in cylindrical ammonia evaporators.
The degree of uneven distribution of the flow is determined by the ratio of the total pressure drop and the dynamic pressure in the intake pipe, respectively, [1],

$$K_{am} = \frac{v_{\max}}{v_{sr}} = \sqrt{\frac{\Sigma\Delta p + \Delta p_d}{\Sigma\Delta p}} \tag{1}$$

Where is:

$v_{\max}$ - maximum flow rate in the pipes,
v_{sr} - average speed of flow in pipes.

The criteria for the uneven distribution of water flow in pipes in the pipe bundle is the requirement, [1],

$$(K_{am} - 1) \cdot 100 > 5\% \tag{2}$$

A correction of the hydraulic-fluid flow sizes ammonia vaporizers is required and as a result, we get the following:

a) increase of the total pressure drop so that it will be much larger than the dynamic pressure, is, [1],

$$\Sigma\Delta p >> \left(\frac{1}{2} \cdot \rho \cdot v^2\right)_{VL} \tag{3}$$

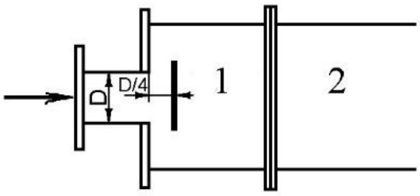
b) decrease of the dynamic pressure at the entrance of the collector or increase of the size of the collector.

In certain cases, after the inlet pipe it is necessary to set up a safety barrier, which is tasked to protect the pipes in the pipe bundle from the abrasive action of the liquid. This protective barrier is used when the product $\rho \cdot v^2$ is:

Tabele 1. Value product $\rho \cdot v^2$

Waterflow	Value product $\rho \cdot v^2$
For single-phase flow of non-aggressive liquids:	$\rho \cdot v^2 > 2235$ Pa
For other fluids, including liquids near the boiling point,	$\rho \cdot v^2 > 745$ Pa

In practice, the safety barrier is placed at a distance $D_{VL}/4$ of the lower end of the inlet pipe,



1 - entry chamber, 2 - pipe bundle
Figure 1. A safety barrier at the entrance to the water chamber, [3]

This certain placement of the barrier does not change the cross-section of flow. The fall in static pressure is calculated as the rectangular knee or equation,

$$\Delta p = \rho \cdot \left[\left(\frac{A_{VL}}{A_{KV}} \right)^2 + 0{,}3 \right] \cdot \frac{v_{VL}^2}{2} \qquad \text{Pa} \tag{4}$$

The safety barrier carried dissipation of kinetic energy flow and provides uniform distribution of pressure in the chamber.

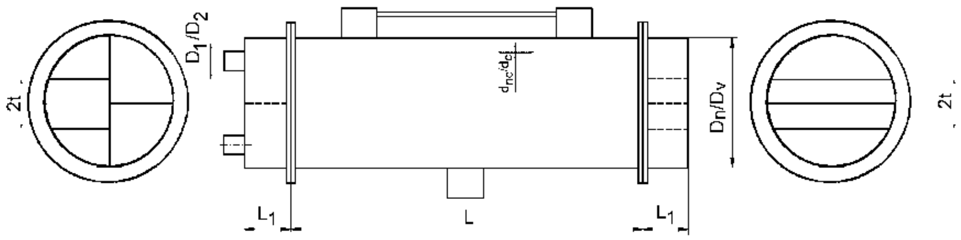


Figure 2. Structural characteristics of evaporators cylindrical, [3]

COMPUTER SOFTWARE

According to the mathematical model and the computer program, the criteria for uneven distribution of water flow pipe bundle for ammonia evaporators is determined which is a product of AD "Frinko" - Bitola, where it can be stated as follows:

a) Cylindrical ammonia evaporators Di-80 (720/700) and Di-200 with its structural and linear features are composed in a good way. The criterion of imbalances of flow with and without a protective barrier is within the permitted limits, [3].

b) Cylindrical ammonia evaporators Di-34 with the proposed design features listed in Table 2 and water flow of 7,65 m^3/h does not meet the criteria for uneven distribution of flow through the pipe bundle (18,89 / 16,94). By increasing the size of the entry and exit slots D1 / D2 = 89/82 mm for the same flow rate of 7,65 m^3/h got size criterion 7.056 / 6.735, which is also not satisfactory. By increasing the size of the entry and exit openings of following standard sizes D1 / D2 = 108/100 mm, the criteria for the uneven distribution of flow through the pipe bundle is satisfied (3.87 / 3.77), [3].

c) For the entire production program of the cylindrical evaporators AD "Frinko" - Bitola (Table 1) gives an overview and recommendations for changing certain structural elements (Table 3) that contribute to the optimal performance of the vaporizers, thus meeting the criteria for uneven distribution of water flow in the pipe bundle.

Table 2. Characteristics of cylindrical evaporators, part I

Type	D_n/D_v mm	L mm	L_1 mm	D_1/D_2 mm	d_{nc}/d_c mm
Di-22	632/614	2012	100	57/51	30/24,8
Di-34	632/614	2462	100	57/51	30/24,8
Di-60	632/614	4400	100	57/51	38/33
Di-80	720/700	4612	100	108/100	26,9/22,3
Di-80	800/776	3852	100	133/125	38/33
Di-100	1000/976	3600	100	133/125	38/33
Di-200	1120/1092	4150	100	216/200	30/24,8

Table 2. Characteristics of cylindrical evaporators, part II

Type	S mm	No. of knags	t mm	Number of tubes in the knag	Flow m^3/h
Di-22	40	8	112	13,13,17,17 17,17,15,15	3,0 4,37
Di-34	40	8	112	16,16,20,20 20,20,21,21	7,65 11,25
Di-60	50	8	112	16,16,20,20 20,20,21,21	9,3 13,7
Di-80	40	8	146	13,13,32,32 32,32,26,26	12,0 17,7
Di-80	50	8	136	22,22,22,22 22,22,22,22	12,0 17,7
Di-100	50	8	178	32,32,37,37 37,37,32,32	14,83 21,85
Di-200	40	8	180	69,69,65,65 62,62,66,66	29,67 43,65

Table 3. Review and recommendations for changes to certain structural elements, part I

Type	L mm	D_1/D_2 mm	d_{nc}/d_c mm	Flow **m^3/h**
Di-22 632/614	2012	57/51 89/82 89/82 108/100	30/24,8	3,0 3,0 4,37 4,37
Di-34 632/614	2462	57/51 89/82 108/100 108/100	30/24,8	7,65 7,65 7,65 11,25
Di-60 632/614	4400	57/51 89/82 133/125 133/125	38/33	9,3 9,3 9,3 9,3 13,7
Di-80 720/700	4612	108/100 108/100	26,9/22,3	12 17,7
Di-80 800/776	3852	133/125 159/150 159/150	38/33	12 12 17,7

Di-100	3600	133/125	38/33	14,83
1000/976		159/150		14,83
		193,7/175		14,83
		193,7/175		21,85
Di-200	4150	216/200	30/24,8	21,67
1120/1092		216/200		43,65

- unsatisfactory
+ satisfies

Table 3. Review and recommendations for changes to certain structural elements, part II

Type	K_{am1}/K_{am2} % / %	Δp Pa	Remark
Di-22	16,176/14,727	285	-
632/614	5/4,2	143	+
	5,2/5,034	297	-
	4,451/4,321	256	+
Di-34	18,89/16,94	1570	-
632/614	7,036/6,735	667	-
	3,87/3,77	556	+
	4,451/4,321	1044	+
Di-60	23,901/20,855	1793	-
632/614	13,56/12,48	496	-
	8,63/8,153	361	-
	4,62/4,456	281	+
	4,785/4,612	589	+
Di-80	2,444/2,406	2184	+
720/700	2,55/2,507	4554	+
Di-80	5,8/5,58	371	-
800/776	3,32/3,24	316	+
	3,43/3,35	665	+
Di-100	10,56/9,9	304	-
1000/976	6,55/6,28	241	-
	4,138/4,02	208	+
	4,227/4,144	438	+
Di-200	2,447/2,405	834	+
1120/1092	2,639/2,591		+

- unsatisfactory
+ satisfies

CONCLUSIONS

The degree of uneven distribution of water flow in pipes in the pipe bundle at cylindrical evaporators is an important feature at cylindrical evaporators. Therefore, in certain cases, after the inlet pipe it is important to set up a safety barrier, which is tasked to protect the pipes in the pipe bundle from the abrasive effect of the liquid. The safety barrier performs dissipation of kinetic energy of the flow and provides even distribution of pressure in the chamber. Therefore, at some cylindrical evaporators with small design features the criteria for uneven distribution of the flow through the pipe bundle will be met.

NOMENKLATURE

d	mm	- diameter,
v	m/s	- flow in the pipes,
Δp	Pa	- pressure drop.

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CURRENT FIELDS OF APPLICATION OF IRON AND STEEL SLAG PRODUCTS FROM THE INDUSTRIAL WASTE LANDFILLS

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Abstract: Iron and steel slags have a long history of being utilized as industrial by–products. Nowadays, slag is still used to build roads and for roadworks, but, based on the intensive research over more than 100 years, the current fields of applications are various: aggregates in bound and unbound mixtures, additions for the production of cement and concrete, fertilizer etc. These aspects are described in the current paper. This paper introduces into the general overview upon the main applications of iron and steelmaking slag products. The ferrous slag types can be recycled into valuable, versatile construction materials for green use, although these co–products are sometimes erroneously classified as industrial wastes. The slag can be utilize, a by–product of iron and steelmaking industry, in versatile construction material for environmentally beneficial use. Applications include road construction, asphalt, ready–mix concrete, cement, railways ballast, mining, filtration and agriculture.
Key words: industrial wastes, slags, aggregates, bound and unbound mixtures, applications

INTRODUCTION

Solid wastes in steel plants are essential by–products generated during various processing steps involved in the production of iron and steel. Solid wastes generated by integrated iron and steel works cause environmental pollution and therefore must be discarded. Until the last decade, the slag, dust and sludge generated by integrated steel plants was called “waste”, but now this term has been replaced with “by–product” due to intensive re–utilization of these wastes. The products resulting from slag processing are slag aggregates used in road, railway, civil and hydro-technical constructions, as an alternative to the traditional aggregates of natural stone, extracted from quarries. Bringing this alternative on the construction market, the stone exploitation from quarries will be substantially reduced.
The waste generated by steel industry not only causes health problems but also causes lot of environmental degradation. Therefore it becomes very important for the industries who are involved in the manufacture of steel to look for the methods that ensures safe disposal and recycling of waste.
For over 25 years, despite the general use of slag products in construction, there has been an ongoing argument about whether slag is a waste or a by–product. Still today, the situation concerning the classification of slag is not uniform, in various countries some of the slag types being considered as by–products, and however in others they have a waste status. Slag is sometimes erroneously classified as industrial waste. In fact, this co–product can be recycled into valuable, versatile construction materials for green use. The slag can be utilize, a by–product of steelmaking, in versatile construction material for environmentally beneficial use. Applications include road construction, asphalt, ready–mix concrete, cement, railways ballast, mining, filtration and agriculture.
Ferrous slag placed on the market meets the requirements of national as well as European harmonized requirements and specifications related to both technical and environmental aspects with regard to the intended use. For this reason the European steel and slag industry considers slag to be a by–product.
The use of slag is ecologically sound and economically smart. Through careful selection of raw materials, maintaining a suitable process route, tightly controlled manufacturing procedures, appropriate cooling treatments a range of high quality construction, agricultural and other slag products are formed for use in large number of important applications. Examples of traditional applications of ferrous slag are the use as aggregates and cement component in the building sector or as fertilizer, but the main uses of the iron and steel–making slag products, can be: road base and sub–base, road drainage, yard paving, asphalted cover, soil corrective element for agricultural use, landfills, river beds, railway ballast or cement manufacturing.
The awareness of environmental considerations and more recently the concept of sustainable development as well as the need for recycling of by–products for economic and environmental reasons

has led to rapid development of slag utilization. The steel industry has investigated its slag continuously, taken care of suitable processing and if necessary modified the iron and steel making processes to get slag products, which fulfill the requirements of the specific standards and regulations.

IRON AND STEELMAKING SLAG FAMILIES

Iron and steelmaking slags (ferrous slags) are co–products of the iron and steel making industry. They are non–metallic rock–like materials which are produced together with the metallic products of these processes. The iron and steel slag that is generated as a byproduct of iron and steel manufacturing processes can be broadly categorized into blast furnace slag and steelmaking slag. Therefore, iron and steel slag can be broadly classified into blast furnace slag that is generated when iron ore is melted and reduced in a blast furnace, and steelmaking slag that is generated during the steelmaking processes used to modify the components of iron. Depending on the iron and steel production process different slag types can be manufactured. In *Table 1* a short classification of the slag families can be identified in the iron and steel production processes is presented.

Table 1. Slag types

No.	Common name	Notation
1a	Granulated Blast furnace Slag	GBS
1b	Air–cooled Blast furnace Slag	ABS
2	Basic Oxygen furnace Slag (converter slag)	BOS
3a	Electric Arc Furnace slag (from Carbon steel production)	EAF C
3b	Electric Arc Furnace slag (from Stainless/ high alloy steel production)	EAF S
4	Steelmaking slag (Additional slag types)	SMS

Blast furnace slag is made during the melting and reduction of iron ore in a blast furnace. Blast furnace slag is a combination of silica and other non–ferrous components of iron ore, ash from coke used as a reducing material, and limestone auxiliary material. Because its specific gravity is less than that of pig iron, during the heating process the molten slag rises above the pig iron allowing it to be easily separated and recovered.

Steelmaking slag is generated by the process that turns pig iron produced by a blast furnace into tough and highly workable steel. Steel making slag is produced during the conversion of hot metal to crude steel in a basic oxygen furnace or during the melting of scrap in an electric arc furnace.

Converter slag is the oxidized material that is generated when lime and other auxiliary materials are added and oxygen is blown onto the pig iron in order to remove carbon, phosphorous, sulfur, and other components from the pig iron and refine it to produce strong steel. The other type of steelmaking slag, electric arc furnace slag, is generated when iron scrap is melted and refined.

If the crude steel undergoes further secondary steelmaking processes, different kinds of secondary metallurgical slags are formed. Additional slag types (e.g., de–sulphurisation slag) are formed during diverse supplementary metallurgical processes like de–sulphurisation of hot metal.

Therefore, according to the slag families presented in *Table 1*, the ferrous slags are best described by their production process, as follows:

- *Blast furnace Slag (granulated – GBS or air cooled – ABS)* – is manufactured during the production of iron by thermo–chemical reduction in a blast furnace. It is formed in a continuous process by the fusion of limestone (and/or dolomite) and other fluxes with the residues from the carbon source and the non–metallic components of the iron bearing materials (e.g. iron ore, iron sinter). Blast furnace slag is generated at temperatures above 1500°C. Dependent on the way of cooling of the liquid slag it can be distinguished between crystalline air–cooled blast furnace slag (ABS) and glassy granulated blast furnace slag (GBS).
- *Basic Oxygen furnace Slag (converter slag – BOS)* – is formed during the conversion of liquid iron (hot metal) into steel during a batch process in a basic oxygen furnace. The slag is generated by the addition of fluxes, such as limestone and/or dolomite, during blowing oxygen into the melt. Due to the oxidizing conditions some elements (like Fe and Mn) are partly oxidized and contribute to the formation of the slag. Furthermore some components are either oxidized to gas (like carbon) or are chemically bound in the slag (like silicon or phosphorus). The liquid slag which has tapping

temperatures of around 1600°C is air–cooled under controlled conditions in pits forming crystalline slag.

- *Electric arc furnace slag from carbon steel production – (carbon steel production slag EAF C)* – is formed during melting steel scrap in an electric arc furnace. The slag is generated by the addition of fluxes, such as limestone and/or dolomite. Furthermore some elements of the melt are oxidized and contribute to the formation of the slag. The liquid slag which has tapping temperatures of around 1600°C is air cooled (possibly applying small amounts of water) under controlled conditions in pots or pits forming crystalline slag.
- *Electric arc furnace slag from stainless steel production – (stainless/high alloy steel production EAF S)* – is formed during the manufacture of stainless or high alloy steel in different metallurgical vessels, e. g. electric arc furnace, converter and ladles. In this process, scrap (in some cases direct reduced iron) together with alloys is melted to stainless or special steel by means of electrical and chemical energy. The slag is generated by the addition of fluxes and reducing agents, e.g. lime and/or dolomite, silicon compounds or aluminum. The liquid slag which has tapping temperatures of around 1600°C is controlled and treated if necessary to improve the properties of the slag. Then, the slag is cooled under controlled conditions in pots or pits forming crystalline slag.
- *Steelmaking slags (SMS)* – are generated during the steel production process. They arise e.g., from the conversion of hot metal to steel, from melting scrap in an electric arc furnace or from the subsequent treatment of crude steel. The composition of the slags varies depending on the process step in which they are produced. The molten slag which has tapping temperatures of around 1600°C is discharged into pots or pits where it cools and solidifies to provide an artificial aggregate having a crystalline structure.

Figure 1. Air–cooled blast furnace slag (ABS), coarse aggregate

Figure 2. Granulated blast furnace slag (GBS), fine aggregate

Figure 3. Basic oxygen furnace slag (BOS), coarse aggregate

Figure 4. Electric arc furnace slag (EAF C), coarse aggregate

Chemical properties of different types of ferrous slag vary depending on the specific production process. A common characteristic of these slags is that they result from lime and silica based melts, therefore calcium oxide (CaO) and silica (SiO_2) are their primary components. Other components include alumina (Al_2O_3) and magnesium oxide (MgO). The content of iron (Fe) in blast furnace slag is usually lower than 0.5% since it results from a reduction process. In contrast to blast furnace slag, basic oxygen furnace slag and electric arc furnace slag are generated in an oxidizing process and therefore have iron contents that are significantly higher.

Table 2. Typical chemical constituents: Blast furnace slag vs. Steel slag

Constituent	**Blast furnace slag, %**	**Steel Slag, %**
CaO	35 – 42	35 – 45
SiO_2	33 – 38	11 – 17
Al_2O_3	10 – 15	1 – 6
MgO	7 – 12	2 – 9
FeO	≤ 1.0	16 – 26
MnO	≤ 1.0	2 – 6
Cr_2O_3	≤ 0,1	0,5 – 2
P_2O_5	–	1 – 2
S_{total}	1 – 1.5	≤ 0.2

The granulated blast furnace slag can be used in its raw/unprocessed form as a slow setting binder in hydraulically bound road construction materials. It generally requires an activator such as hydrated lime or steel slag to be added to the product for this purpose.
Steel slag can be used in both bound and unbound road construction products, which generally comprise asphalt and surface dressing and sub–base, capping and fill materials.

Figure 5. Different grain sizes of slag aggregates as used in various applications

The slag comes from the steel shop, is cooled in the slag yard and is later crushed and screened without any expansion reduction treatment. After being crushed, screened and having the metallic portion removed the slag is classified according to its granulometry.

APPLICATIONS OF IRON AND STEELMAKING SLAG PRODUCTS

To build a recycling–based society, the first priority is to reduce the generation of waste to the maximum extent. For waste whose generation cannot be prevented, it is important to recycle the waste to whatever degree possible. Manufacture and quality management of iron and steel slag products are carried out according to their application.
Iron and steel slags have a long history of being utilized as industrial by–products. Based on the intensive research over more than 100 years, the current fields of applications are: aggregates in bound and unbound mixtures, additions for the production of cement and concrete, fertilizer etc.
Nowadays, slag is still used to build roads (as for example, road landfills, ripraps and contention walls, primary coating of streets) and for roadworks (as for example, paving, road sub–base and base or even, as asphalt concrete and asphaltic road cover, road landfills). The slags has uses as primary for unpaved streets and yards and as landfill, as long as it is not confined, and when it is used in confined areas, the use of a clay bed is recommend to absorb its expansion (in roadworks). Also, the slag is recommended for the rail works (as railway ballast).
However, slag use is not limited to roads anymore, but slag aggregates are widely used in all kinds of civil works. An aggregate is a granular material used in construction. Properly applied aggregates contribute to the strength and mechanical stability of the construction. The inherent properties of iron and steel slag make it an ideal aggregate for base and surfacing asphalt products (bitumen bound application of slag aggregates). Slag is particularly useful as an aggregate, due to the high mechanical resistance of the slag grains which exceeds many natural aggregates. In addition to the environmental benefits of reducing the avoidance of unnecessary landfill (disposal), the use of slag aggregates can produce asphalt materials exhibiting superior properties to those manufactured with natural aggregate. For the production of aggregates, processing crude slag mainly consists of crushing and/or screening.

Slag aggregate can be used as a construction material in unbound applications (where the aggregate is not bound) as well as in bound applications (mixtures which contain binding agents like cements, bitumen or a substance that has binding properties in contact with water). Besides construction, slag aggregates have some specific uses like waste water treatment due to their absorbing properties for pollutants.

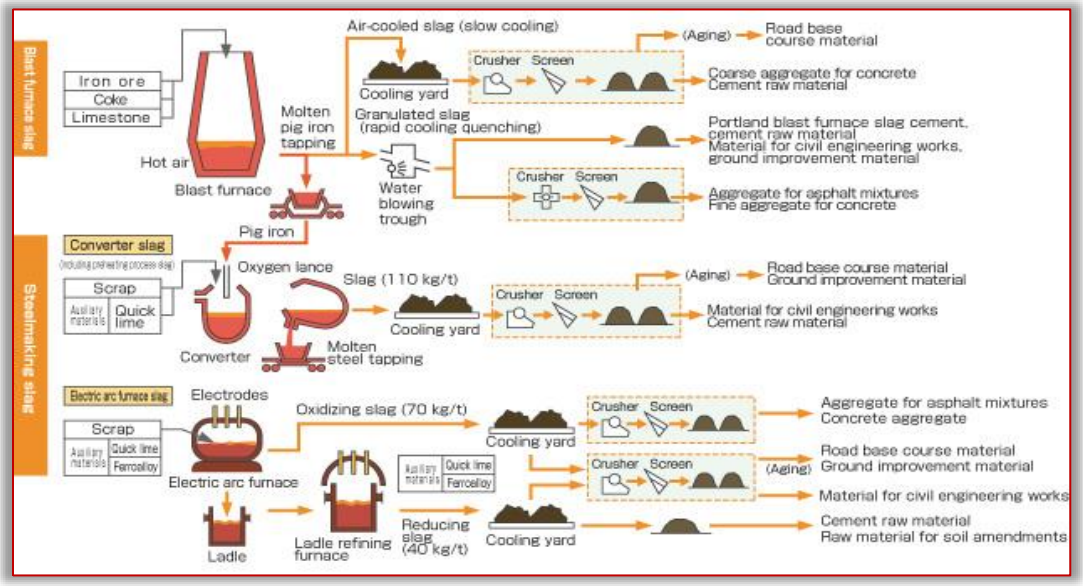

Figure 6. The main use of ferrous slags as industrial by–products

Besides correcting acid waters, the slag can also be used as a soil corrective. As a result of acid rain, many fields require pH adjustment to enable healthy and productive growth from the crops. The slag is used as a basic soil conditioner with the added benefit of the release of several trace elements essential to life. The use of slag in this application has a great advantage over the conventional fertilizers. The environmental aspect should also be highlighted, since the agronomical use of this product brings positive factors such as the non–utilization of natural resources. The utilization of steelworks slags as an agricultural consumable product has been studied for some time in many parts of the world, producing satisfactory results.

In addition to utilization on agriculture, a relatively new application has been developed – Environmental Land Remediation – to help remediate brown field sites incapable of plant growth. The slag fines release calcium oxide and other trace elements, slowly into the soil enabling the growth of grasses and trees in soft landscaping.

CONCLUSIONS

The steel industry produces not only metal, but also by–products which have been successfully used in many construction or agriculture applications. From roads to fields, slag is safely used in a wide range of activities with high quality expectations. Nowadays, the main percent of ferrous slag produced in Europe is used for building purposes. Using slag instead of natural materials is a sustainable alternative with high durability in several applications. The main advantages are:

- low implementation and maintenance cost,
- high draining quality,
- excellent appearance and
- preservation of natural resources.

The slag aggregate products, combined with advanced asphalt design and bitumen technology, offer application solutions for all industrial locations. The slag presents a higher properties than stone aggregates, thus being an excellent choice of load support material, which favors the choice of the product for road base and sub–base; it can be mixed with other materials (for example, clay) offering cost savings without compromising the paving structure. Also, the high density of the slag makes it

highly effective for example, in ripraps and contention walls because it is 70% heavier than commonly used stone aggregates.
Steel slag asphalt can be used for surfacing domestic driveways as well as heavy industrial areas and the heaviest trafficked roads. Steel slag has proved to be an excellent material for porous asphalt surfaces. Porous asphalt is a bituminous bound mixture with carefully selected, homogenous aggregate grains with a fixed grain size distribution. Roads built with porous asphalt using steel slag are quiet, safe and long–lasting.
Because of the rough surface and angular shape of the grains and high resistance to mechanical forces, iron and steel slag aggregates are very suitable for unbound applications, especially when a mechanically stable construction is needed. Because this slag slowly hardens in time due to its hydraulic properties, the stiffness of layer increases in time. This increases the life of a road surface and decreases the need for structural maintenance.
The ballast is an extremely important piece for the construction of a railway, and it is the base that equally supports and transfers the stresses of the railway to the platform. Among other characteristics, it is responsible for distributing the loads over the platform, therefore, it must be a very resistant material. The stability and durability of the railway network depends on it, since the ballast is also responsible for suppressing the irregularities of the platform and improving the permeability and ventilation. Traditionally, stony materials have been utilized for railway ballast. As a result of researches, the slag was made available in the market for applications in railway ballasts, since the slag has some characteristics that make it attractive for this type of use.
Through careful selection of raw materials, maintaining a suitable process route, tightly controlled manufacturing procedures, appropriate cooling treatments a range of high quality construction, agricultural and other slag products are formed for use in large number of important applications. Metallurgical slags have a very wide range of potential uses, based on their varying physical and chemical properties. Increasingly, the impact of environmental legislation and energy costs on the cost of producing cement clinker and on the cost of quarrying aggregates have made cement the most economically viable use for slag, wherever the cementitious qualities of the slag and the local technical regulations on cement and concrete allow it. Where they do not, the slag is used in high–value aggregate applications, particularly where the friction and polished stone value (PSV– a measure of resistance of road surface stone to skidding) of slag add value. Environmental issues also boost slag demand in high–quality aggregate applications.

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PRODUCTION OF BORON CARBIDE NANOPARTICLES BY ARC-DISCHARGE IN DEIONIZED WATER

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Abstract: In this paper, production of boron carbide nanoparticles (B_4C) provide an opportunity easy to handle and economical by using arc discharge method in deionized water. Experiments were carried out using similar type of electrode material. Graphite is used as anode and cathode materials on production of B_4C nanoparticles. The B_4C nanoparticles were characterized by X-ray diffraction (XRD), Scanning electron microscopy (SEM) and RAMAN spectroscopy. Dimensions of synthesized B_4C nanoparticles were measured approximately 63~129 nm. Consequently, it has been observed that production of boron carbide (B_4C) is favorable by arc discharge method for varied application.
Key words: Arc-discharge, Boron Nitride Nanoplate (BNNP), Nanoparticles, characterization

INTRODUCTION

Boron carbide has attractive properties for many applications, such as armoring (for its high hardness and low density), refractory applications (for its high melting point) and tribological applications (for its excellent abrasion resistance), and neutron radiation in nuclear application (for its good neutron absorption capability) [1-4]. Boron carbide shows good mechanical properties and its strength, toughness, and Young's modulus range from 300 to 500 MPa, 2.9–3.7 MPa m1/2, and 360–460 GPa respectively [5].
In this letter, production of boron carbide (B_4C) nanoparticles has been performed via arc discharge method. Graphite electrodes were used as both anode and cathode. The cathode were drilled and filled with micro sized boron carbide. The produced nanostructures were characterized by means of scanning electron microscopy (SEM), Fourier Transform Infrared Spectroscopy (FT-IR) and X-ray diffraction (XRD) tests.

MATERIAL AND METHODS

Transiently high temperatures are achieved during production of nanoparticles by using arc discharge method. These high temperatures cause ionization of macro size boron carbide particles.
During the arc discharge, isolation of produced nanoparticles and environment from each other is important for ensure the purity. So, arc discharge experiments were performed in deionized water.

Materials

The arc discharge unit was produced made of stainless steel and it consists of two parts as anode and cathode electrodes [1]. Anode electrode was designated controllable to ensure the suitable gap among the electrodes and ensure the maintain arc stability. The cathode electrode was fixed. All the materials were analytical grade. Tungsten and cupper rod (99.99%) was purchased from Alfa Aesar. The macro sized boron carbide particles were purchased from Bortek.

Synthesis of Boron Carbide Nanoparticles

Arc discharge unit was placed in a 5 litter isolated glass beaker and it was filled with 3 litters deionized water. Pure graphite bar 12 mm in diameter and 30 mm in height is used as anode. In the same purity, 10 mm diameter and 55 mm length graphite bars also are used as cathodes. The graphite in the anode bar is drilled at a depth of 40 mm and at a diameter of 6 mm then macro sized boron carbide particles are placed in it.

This study was performed using graphite electrodes. The arc discharge production was initiated by touching anode electrode to cathode electrode. The gap between the electrodes was manually adjusted as about 1 mm to maintain stable arc. The arc currents were supplied as 50 A via a direct current (DC) welding power. Meanwhile, it is estimated that the temperature increase to very high values (approximately 5000 °K) during arc-discharge. Blue brilliant light was clearly observed for 3 minutes around the arc zone. The powders which were ionized by high temperature transform to nanoparticles and dispersed in the deionized water. After deionized water was removed, these products were collected carefully by using a pipette. Several drops in the solution were dropped on silicon wafers. Finally, the synthesis particles were dehumidification by using vacuum oven at 60ºC and 0.5 bar [8].

RESULTS AND DISCUSSION

Figure 1 is shown SEM images of synthesized product by using graphite cathode. These images show that products consist of different morphological structure such as spheres and aspheric which size of approximately 63~129 nm.

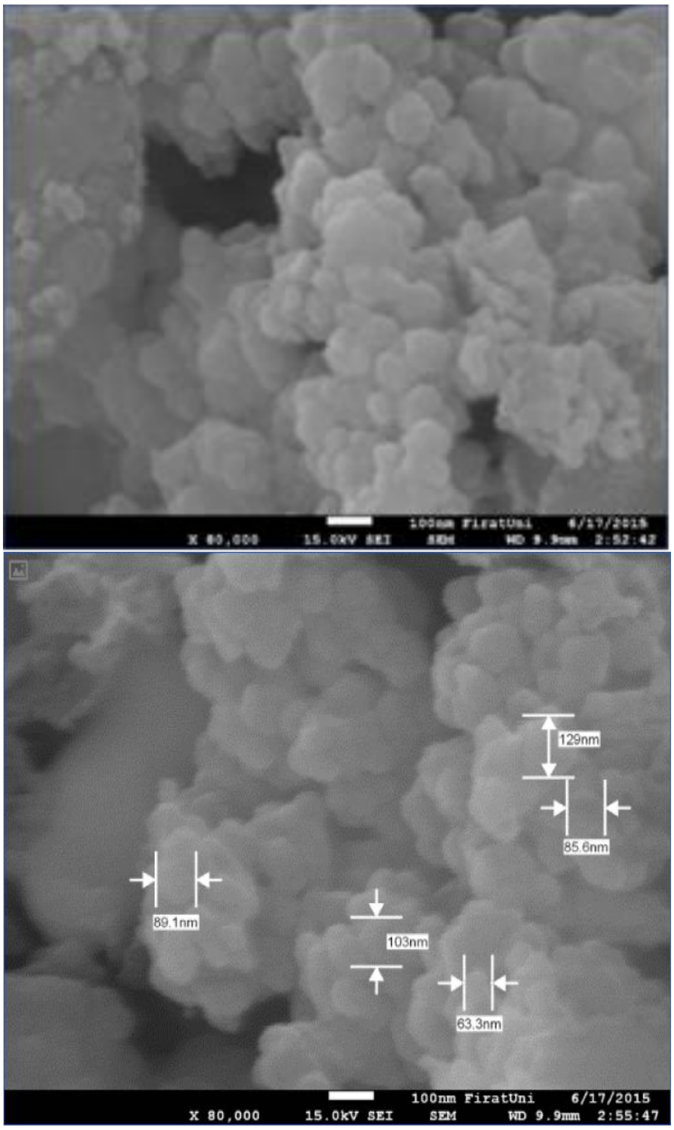

Figure 1. SEM images of synthesized structure by using graphite electrode in 80.00 KX magnification

The XRD pattern of B_4C nanoparticles which produced by using graphite electrodes is seen in Figure 2. The acute peaks are mainly attributed to B_4C and these diffraction peaks are consistent with the literature (JCPDS Card No. 06–0555).

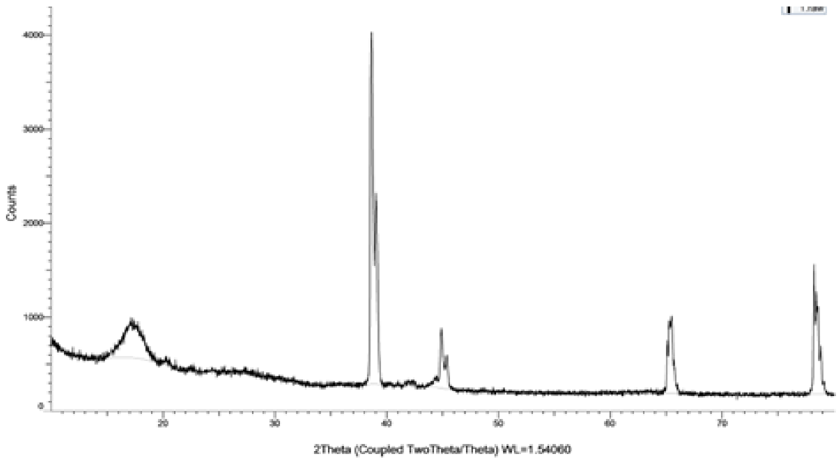

Figure 2. XRD pattern of synthesized B_4C nanoparticle by using graphite cathode

Produced by arc discharge method B_4C nanoparticles are analyzed via Raman spectroscope shown in Figure 3 and Figure 4 illustrated that the Raman Spectra of B_4C nanoparticles in the literature. Raman spectra taken from several points using 532 nm laser excitation illustrated major peaks at approximately 260, 320, 480, 532, 720, and 1088 cm^{-1}, with smaller peaks at about 800, 824, 874, 967, and 998 cm^{-1} Raman peaks of produced B_4C, taken from 632 nm laser excitation, are compatible with the observed major peaks.

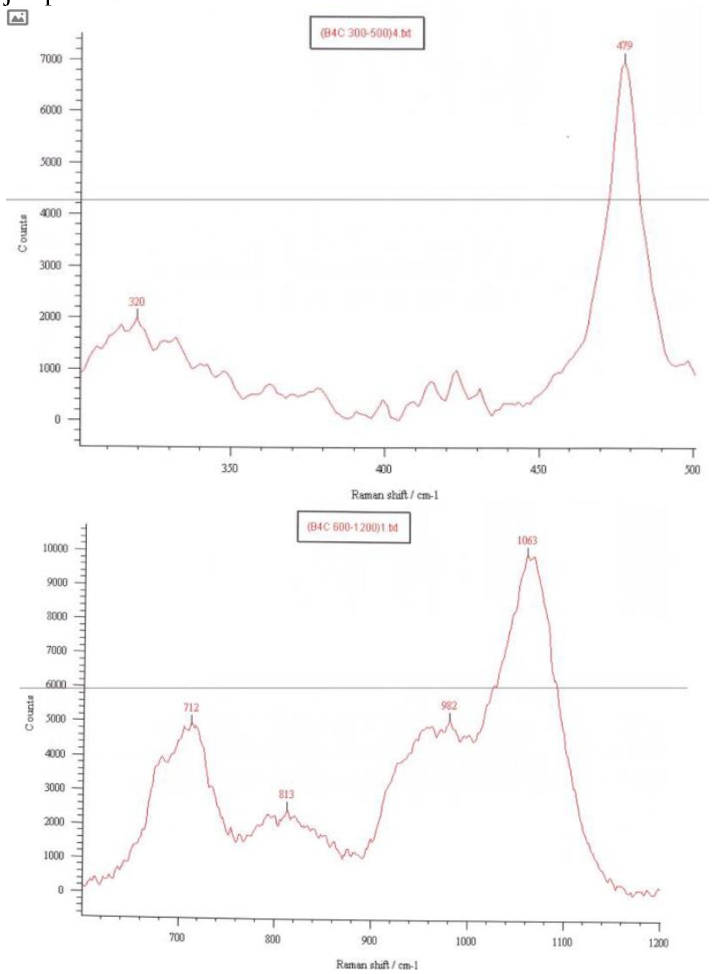

Figure 3. Raman Analysis of B_4C a) 0-500 cm^{-1} wavelengths b) 500-1200 cm^{-1} wavelengths

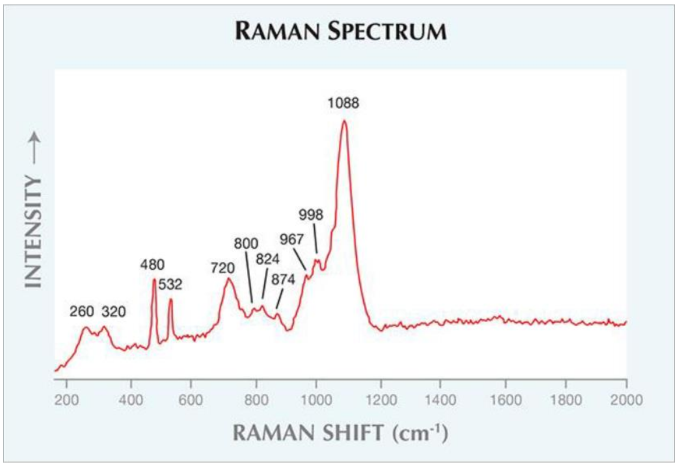

Figure 4. Raman spectrum of B_4C [6]

CONCLUSION

- Boron carbide nanoparticles have been synthesized successfully via arc discharge method in deionized water.
- SEM, XRD and RAMAN analysis showed successful synthesis of high B_4C nanoparticles has been achieved.
- Boron carbide particles have been produced with size of 63~129 nm by arc discharge method.
- According to result of XRD and Raman spectrum, boron carbide (B_4C) peaks are similar to the literature.

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APPLICATION OF SOUND INTENSITY TECHNIQUE IN NOISE REDUCTION OF A HYDROSTATIC STEERING SYSTEM

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Abstract: With the increasingly widespread use of hydrostatic steering units, the problem of the noise that they emit becomes more significant. Having satisfied only the basic functional characteristics, the development teams are confronted with new demands, the dominant of which is, of course, the reduction of the total sound power of the steering unit.
In this paper, there are presented the results of the research of noise emitted by the steering unit, in the course of which the dominant noise sources were allocated, and their attenuation achieved by redesign of the certain parts. The method of sound intensity was used for the ranking of the sound sources and determination of the total sound power.

INTRODUCTION

In the analysis of noise detected in the cab of construction machinery, agricultural tractors and vehicles, as well as machines of similar concept, there should be distinguished the influence of the systems installed inside the cab from those systems installed outside it. Those systems that are located outside the cab, such as, engine, transmission, hydraulic pumps, valves, etc. influence the structure, thereby emitting structural noise. The above mentioned systems emit sound energy simultaneously, which, after attenuation on the walls of the cab, penetrates the cab and contributes to the general level of noise next to the ear of the driver. On the other hand, those systems that are installed inside the cab directly influence the sound pressure level next to the ear of the driver. A typical example of such systems is the hydrostatic steering unit.
The fitting of the steering unit is usually done in such a way that the body of the steering unit remains on the outside of the cab or within the instrument panel. From the aspect of noise, this means that emission from the body of the steering unit is always significantly reduced before reaching the cab. For example, if the body of the steering unit is fitted below the instrument panel's plat made of Al thick 1.27mm the level of noise reduction will be approximately 25 dB @ 1 kHz. In that way, emission from the steering unit body is less significant in comparison with the steering column emission, which sustain clos to no attenuation on it's the way to the ear of the driver.

PROBLEM DEFINITION

The manufacturers of steering units are primarily interested in, quickly and rationally, achieving solution through which would be reduced the noise of their product. In that context, it is of exceptional significance to take into account the following aspects of the noted problem.
The steering unit is a source that is at the approximate distance of 0.5m from the ear of the driver. A part of the steering unit (the steering column) is always fitted in the cab in such a way that the attenuation of its emission can be disregarded on its way to the ear of the driver. On the other hand, the total emission of the source outside the cab is reduced by various panels and glass surfaces that form the structure of the cab.
The steering unit, like most other mechanical systems, is a complex source, the emission of which, viewed in respect of the total radiating surface, is very unevenly distributed. In the direct vicinity of the steering unit there can be detected zones of high but also low sound intensity, so that the determination of total sound power presents a very complex problem.

Consequently, noise source identification, identification of sound intensity level radiated from the particular sources and their ranking is of the particular importance for the noise reduction and all of these aspects are analysed in the paper.

INITIAL STATUS OF RADIATED NOISE

In order to reduce the noise of the steering unit, for which the noise has to be reduced this steering unit was firstly subjected to the measurement of the total sound power. For the reference, there were selected the conditions prevailing in the actual working cycle, which correspond to the maximum levels of sound emission. These conditions are characterized by:

- the flow through pipeline P of 10 to 20 l/min.
- a distributor leading from a neutral position, and
- pressure at the cylinder connections (R or L), notably, the connection of 70 bar.

In the above stated conditions, measurements of the sound power of the hydrostatic steering unit were made in the anechoic chamber, by applying the method of sound intensity measurement (Figure 1.).

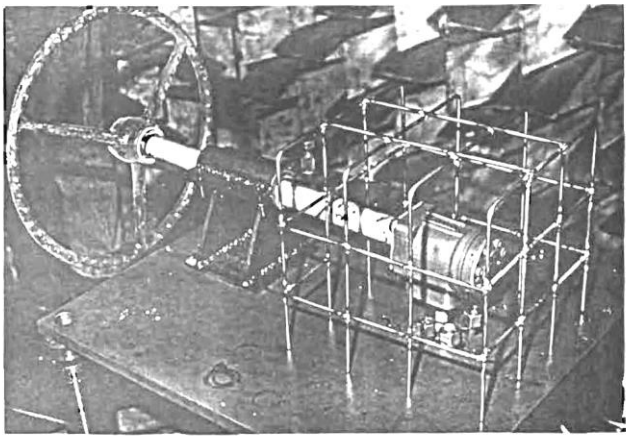

Figure 1. The appearance of the measured installation in the anechoic chamber.

The obtained results point to the fact that the emission level from the steering unit, when the distributor is in the neutral position, is so low that it does not significantly contribute to the total sound pressure level in the cab, so that this condition has not been further analysed in depth. In turning to the left or right, the total sound power level of the steering unit rises. The rotating direction is not significant for the total sound emission level, being the consequence of the mechanism of noise emission. Namely, when the distributor is disrupted from its neutral position, the entire flow is directed to the openings on the distributor where a zone of turbulent flow path is formed.
The noise sources are located along the turbulence zone, while the emitted sound energy is proportionate to the square of flow velocity. Since the distributor is symmetrical, the processes of flow are the same, regardless of the rotating direction, so that the emitted noise level is also the same.
According to the results obtained by the measurements it appears that the emitted sound energy level, when changing from the neutral to the operational position of the steering unit, rises for 21 dB(A) at flow rate of 10 l/min.

THE DESIRABLE NOISE EMISSION LEVEL

The sound power of the non-modified steering unit is at the level of 51 dB(A), and it is distributed in the frequency range as shown in Figure 2. In order to determine the required level of sound power reduction, it is necessary to introduce a certain criterion. Since the type of cab, engine, transmission, etc., all depend on the manufacturer and type of tractor, it is impossible to predict the sound pressure level in the cab, which is emitted under the influence of other sources, and further, determine the permitted emission level of the steering unit in the function of satisfying the criteria of the total SPL level in the cab. This is the reason for the adoption, as the only one rational criterion, of the sound power level of the competitive steering unit (hereunder called the steering unit "Ref.").

The sound power of the "Ref." steering unit was determined in the same operating conditions as the sound power of the not redesigned steering unit, both having the same column. The total sound power of the "Ref." steering unit, in the operating position, is 43 dB(A). In order to achieve this emission level, it is necessary to reduce the sound power of the non-redesigned steering unit for about 8 dB(A). By using the software tools, work was started on the simulation of the influence of possible changes in construction on the effects of sound emission reduction. These analyses then showed that significant sound emission reduction in the area of the steering unit head produced worse results in the respect of total noise reduction than the emission reduction in the area of the steering column. The reason for this should be sought not only in the dynamic characteristics of the individual parts of the steering unit, but also in the relations of the surfaces performing the emission (Figure 3.).

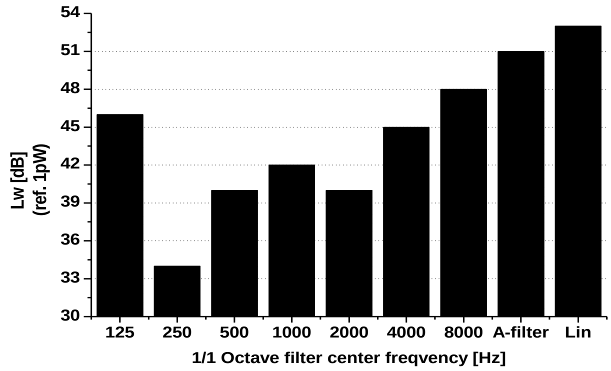

Figure 2. The total sound power of the non-redesigned steering unit in the operational position (1/1 octave filter, average period 2s, oil SAE 30, oil temperature 50°C, flow 10 1/min.).

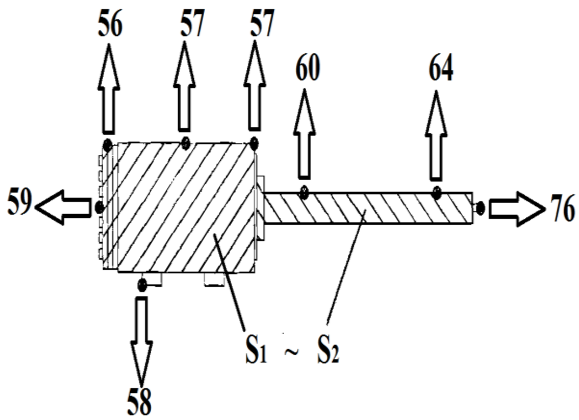

Figure 3. Sound intensity from the body and column of the non-redesigned steering unit. The measured values of SI (Sound Intensity) are in dB(A) / ref.: 1 mW); distance 0.25m.

Figure 3. Illustrates that:

- The relation between the surface of the body and column of the steering unit is just about the same.
- The sound intensity levels measured at various points, are much higher at the measurement points that correspond to the steering column, than those located on the body of the steering unit.
- The steering column emission is of exceptional significance, because it is situated in the cab itself, next to the ear of the driver.

Since the vibrations are emitted in the steering unit body itself, clearly the high sound intensity level on the body is the consequence of its dynamic characteristics. It follows that the solution, that is, the sound intensity reduction from the steering column, relies either on the:

(i) alteration of the dynamic characteristics of the column, or the
(ii) cutting of the path of spreading of structural vibrations from the body to the steering unit column.

In this case, there was applied solution (ii): the connection between the steering column and the steering body was redesigned. At the point of direct contact between the steel elements, elastic attenuating elements were put in (Figure 4.). After adjustment of the parameters of rigidity and dumping, the experimental verification of this solution was done. The same was done by measurement of the Sound Power Level (Lw) in the anechoic chamber as well as by measurement of the Sound Pressure Level (Lp) inside the cab.

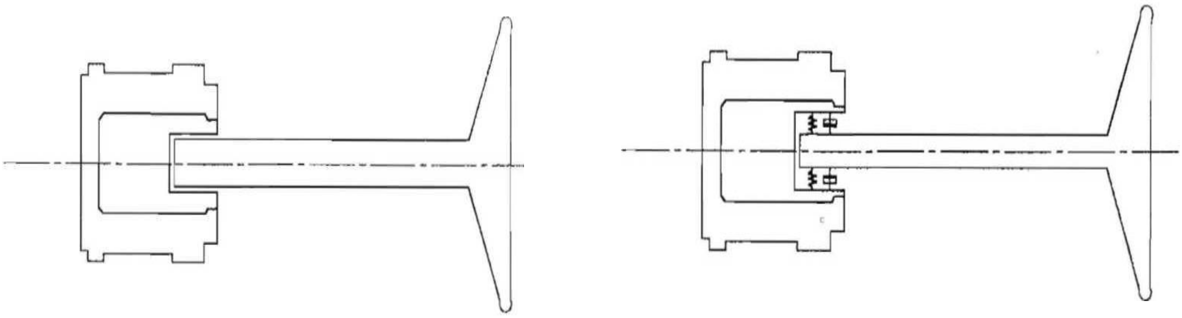

Figure 4: Steering unit before (left) and after (right) reconstruction.

TESTING OF THE REDESIGNED SYSTEM AND CONTRIBUTION OF THE INDIVIDUAL PARTS TO THE TOTAL SOUND POWER OF THE STEERING UNIT

The testing of the redesigned solution was performed in the area of higher frequency ranges, where significant emission reduction was desired to be achieved. In order to initiate all potential noise sources and increase the turbulence levee, during the verification testing of the new solution, the flow through the pipeline connection P was increased to 20 l/min. This flow level corresponds even to the highest permitted flow rate in the regularly fitted steering units (with the compulsory flow limiter). Figure 5. Illustrates the results of the measured of the sound intensity in the anechoic chamber. The analysis of these results points to the following conclusions.
In the area of the octave filter 1/1, with the central frequency of 1 kHz, the redesigned solution reduces the sound emission intensity for a maximum of 5 dB in the upper zone of the jacket of the column cylinder of the steering unit. This zone is of great importance, because it, for the most part, remains in the space of the cab. At the end of the steering unit column, where emission is directly pointed at the ear of the driver, the emission level was reduced from 53 to 35 dB. In the higher frequency ranges, there was observed the same character of attenuation in comparison to the initial solution: moving toward the end of the steering unit column, emission in the redesigned solution became gradually lower compared to the emission in the old solution. In higher frequency ranges, there can already be talk about a "complete" sound intensity reduction. It is especially important to observe that the highest extent to which the reconstructed solution reduces emission is 4 kHz (1/1 octave). Beyond that value, in the still higher frequency ranges, there can once again be observed a decreasing trend of the "A" curve, so that, performing the redesign, was not the purpose to insist upon noise reduction in that area. Putting it more simply, in the zones of higher sensitivity of the human ear ("A"), the intensity was maximally reduced.
The new design was subjected to total sound power measurement, and compared with the initial design, and the reference steering unit i.e. "Ref.". The total power of the initial design (observed in the operational position) was reduced from 51 dB(A) to 46 dB(A) - reduction of 4 dB(A). If this is compared to the "Ref." steering unit, the sound power level is higher for 3 dB(A).

The achieved results should be considered in the function of fitting as well. In the case of the redesigned solution, emission was reduced in the critical zones of the column particularly. Also, emission reduction was achieved at higher costs of about 10% than what is the costs of the steering unit column, therefore the costs can be considered as irrelevant. What is most important, the technologies of production of the steering unit body and the construction of the basic functional parts of the steering unit were not changed, so there was no danger of degradation of the functional characteristics.

In order to perform a verification of the new design from the aspect of emitted sound pressure in the cab, a testing installation, least favourable to the new design, was conducted for this purpose in cooperation with the manufacturer. So, having in mind the basic fact that no reduction should be made of the sound energy flux coming from those parts of the steering-unit which remain on the outside of the cab or below the instrument panel, the least favour fitting in cabs which do not have instrument panels, is the fitting of the whole steering unit.

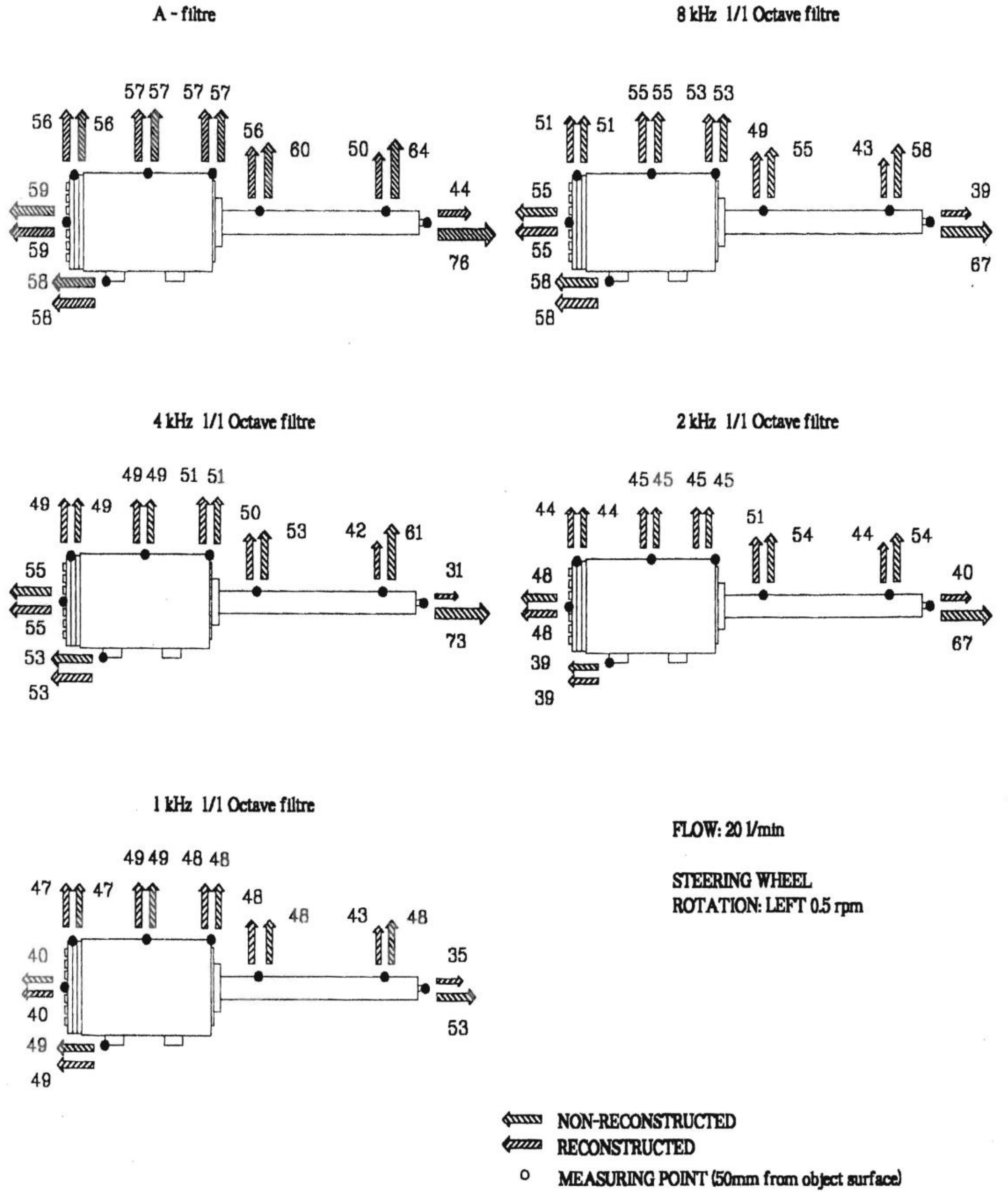

Figure 5. Sound intensity for the body and column of the non-redesigned and redesigned steering unit "A". The measured values dB: ,(ref.: l pW), distance 0.25m.

The obtained results undoubtedly emphasize justification of the applied concept of altering the noise in the cab, in the part in which it is generated due to the steering unit emission. The total sound pressure as measured according to the "A" curve, was reduced by 5 dB(A), without insisting on reduction of the sound energy flux in the frequency range up to 500 Hz. That part of the emission is relatively expensive to solve. Physically, it is connected to the steering shaft and requires changes in its own construction, which should be avoided. Going beyond 500 Hz, the sound energy reduction, and by that very fact, the sound pressure, is significant, ranging from 3 to 7 dB. The energy emission zones in this frequency range are closer to the ear of the driver, the ear is more sensitive to this part of the frequency range, so that all these factors put together contribute to the total sound pressure reduction of 5 dB(A).

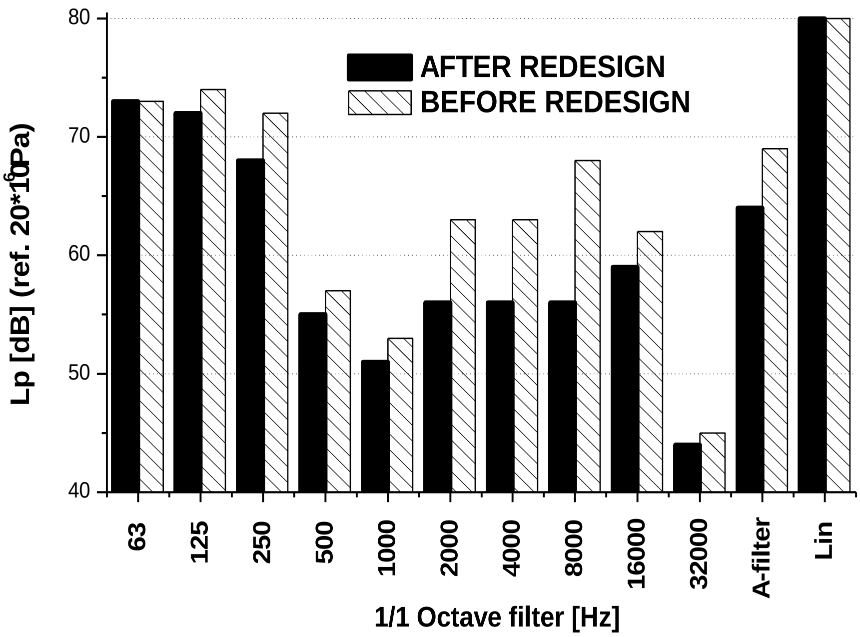

Figure 6. Sound pressure next to the ear of the driver in the tractor cab of a construction machine with no instrument panel. The changes in values were influenced by the emission of the steering system itself in the operational position and in conditions which completely correspond to those in Figure 2.

CONCLUSION

The sound energy emission of the steering unit contributes to the general level noise in the cab by increasing the sound pressure level in the higher part of the frequency spectre. In order to construct a steering unit that generates less noise, there was applied the method of sound intensity measurement, primarily because of:

- the localization of the dominant sound sources on the steering unit,
- the determination of the total sound power of individual solutions, and,
- verification of the improvements made.

The redesigned steering unit achieved significant reduction in total sound power. This result was achieved by cutting the path of spreading of structural vibrations from the body to the column of the steering unit.

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Session 5.

Designing and maintenance

EXPERIMENTAL MODEL FOR STUDY DINAMIC BEHAVIOUR OF INTERNAL FURNISHING IN SEISMIC IMPACTS

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Abstract: This report explores an experimental study of the dynamic behavior of the standard internal furnishing in seismic impacts. The furnishing is located in a two-story building. To realize the experiments is used Stand for modular dynamic testing of constructions, subjected on seismic impacts. The latter is part of the experimental base of the Lab for numerical and experimental dynamic modelling – UACEG, Sofia, Bulgaria. The stand allows simulation of seismic effects on scale 1:10. The experimental model of the building and its furnishings are made on the same geometric scale. The model of the vibrating building is made of steel and of the furniture - of wood. The connection between the furniture and the building as elements of the vibrating system with three degrees of freedom can be frictional or rigid on the floor. The model also allows for a rigid connection of the vertical panels of the furniture with the walls of the building. The seismic impacts are realized through the control system of the stand, which consists of a stepper motor, a driver and a controller. The controller is connected to a computer and is managed through a specially created program in Matlab environment. The results of the experiments are received through a system of light sensors that return the data back to the computer for processing and analysis. The report describes the individual elements of the experimental model and their linking in an experimental system. Concrete results of conducted experiments and their analysis are the subject of subsequent publications.
Key words: dynamic model, seismic impacts, experimental model, experimental set.

INTRODUCTION

We live in a well-informed insecure world, where news about natural disasters, such as earthquakes, floods, tsunamis, etc. sometimes cause more chaos than necessary, which additionally increases the devastation of the disasters. Sometimes, the physical loss is much less than the emotional stress, suffered by the victims of disasters. Very often during an earthquake, people run in panic to leave their homes or public buildings, which can further increase the consequences of the seismic influence. In such cases, the degree of destruction is influenced also by additional factors, apart from the standard ones, such as the structural stability of the buildings. Such additional factors are the location and stability of the internal furniture of residential and public buildings and the technological equipment in production facilities. Different installations, such as water supply, heating, air-conditioning, security, etc. could also adversely affect the impact of earthquakes, depending on their location and seismic stability.

The research in the report is part of a more global survey. The main goal of the last is to study some new concepts of the contemporary indoor architectural design for construction of seismically stable homes and limiting damages during earthquakes down to the possible minimum. The latter could be achieved if all furniture, equipment, and installations are designed in such a way as to ensure safe dynamic behavior during seismic influence without hindering the occupants from leaving the buildings.

The final goals is to ensure that the new concepts offer methods and approaches for design of furniture, equipment, and installations as intelligent systems, seismically stable components of the so-called "intelligent homes".

CURRENT STATE OF PLAY OF THE RESEARCH

When mentioning the concept of seismically stable buildings, we first mean structures, designed and built or redesigned and repaired based on the contemporary norms of design. In EU countries, the Eurocode 8 system is used, which lays down the parameters for design of structures for seismic influence. Less attention is paid to the influence of architectural and urban solutions on the seismic stability of structures. Earthquake Mechanics and Earthquake Engineering are well-established research fields, but there is no Seismic Architecture.

In terms of history, there are different developments, even by architects, on problems related to the architectural aspects of the seismic stability of buildings. Greater attention is paid to external architecture.

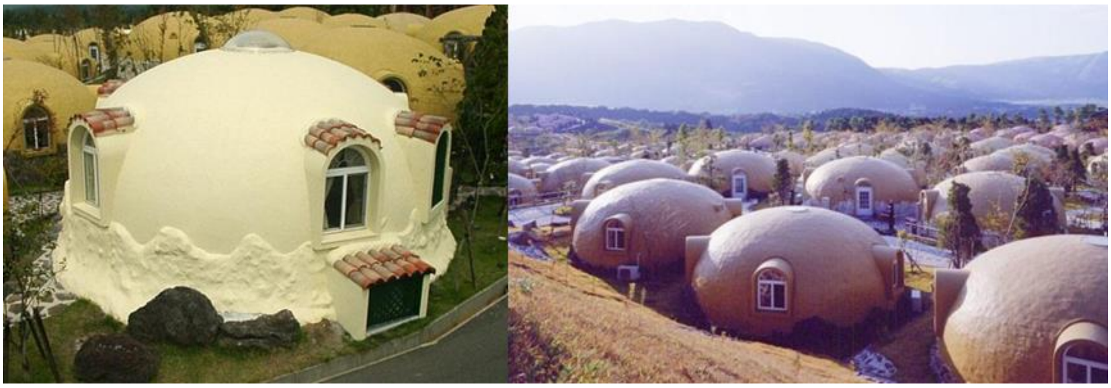

Figure 1. Seismically stable architecture

Fig. 1 shows an igloo-shaped house with a shape that resembles the ice houses of Eskimos. This type of houses is designed by Japanese architects from Japan Dome House Co., LTD and such complexes are built in Japan, China and USA.
There are developments that also take into account the seismic stability of non-structural elements in a certain structure [1],[2]. Fig. 2 clearly identifies the structural (in green) and non-structural elements in a standard building.

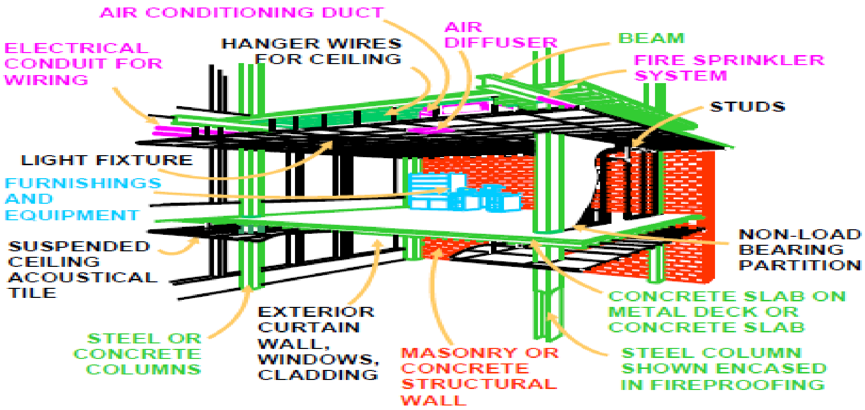

Figure 2. Structural and non-structural elements in a typical building

Non-structural elements of a given structure are each and every part of the building and its full content, excluding the structural elements, i.e. excluding columns, floors, beams, etc. In the most general case, non-structural components include ceilings, windows, office equipment, computers, inventory cabinets and cupboards, heating, ventilation and air-conditioning, security equipment, water and sewerage, and electrical installations, furniture, illumination, etc. Non-structural elements are usually designed by architectural designers, electrical engineers, engineers in water supply and sewerage and air-conditioning, or they are purchased by the owners or occupants, without the participation of the specialists after the construction of the building. Non-bearing elements are not analyzed by engineers, specialists in Earthquake Mechanics and Earthquake Engineering, and this could be fatal for the overall seismic stability of the structure.

STAGES OF EXPERIMENTAL REALISATION

The stages of experimental realization include the creation of a dynamic and experimental model based on the architectural one.

Architectural model

An architectural model of a separate room with different location of the non-structural elements within is shown in fig. 3 - left. An architectural model of an average three or four storey building with different location of the non-structural elements within is shown in fig. 3 – right.

Figure 3. Architectural models of a separate room and of an average residential building

Dynamic model

The dynamic model that is created is consistent with the possibilities for stand testing - fig.4.

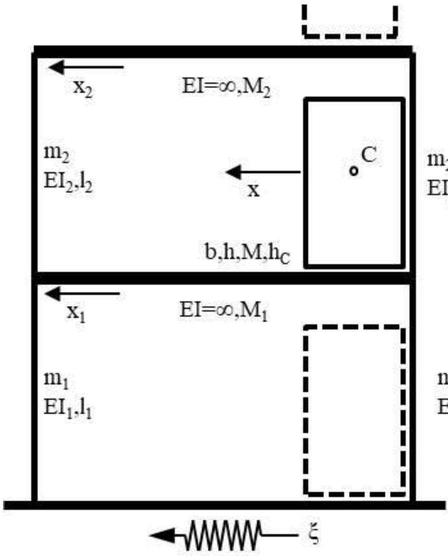

Figure 4. Dynamic model of vibrating system – building-furnishing

A two-story frame with infinitely rigid horizontal zones is accepted as a building. The vibrating body, shaping the furniture, can be located in the basement, on the first or second floor. The system have three degrees of freedom – the displacements of the horizontal floors and the horizontal displacements of the center of gravity of the furnishing. The figure shows the characteristics (geometric, inertia, mass, elastic) that influence on the dynamic behavior of the vibrating system.
The system is loaded by seismic impacts – vibrograms of real earthquakes.

Experimental model

The experimental model, realized in geometric scale 1:10 is shown on fig.5. The experimental model includes scale models of the bodies from the dynamic one. In addition to the experimental system, a computer system, a motion control system and the system for recording the results is included.
The experimental model of fig. 5, and more precisely, the model of the building and the furnishing can

be easily modeled numerically. For this purpose, the possibilities of the Matlab/ Simulinks programming system can be used, which offer infinity visualization capabilities,. The numerical procedure must be preceded by the creation of a mathematical model with the methods of Mechanics.

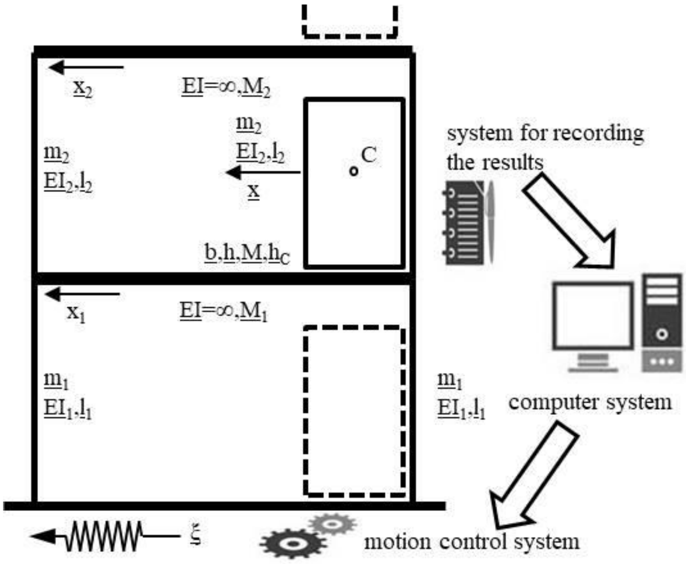

Figure 5. Experimental model of vibrating system – building-furnishing

Figure 6 shows a photo of the experimental set implemented in Lab for numerical and experimental dynamic modelling.

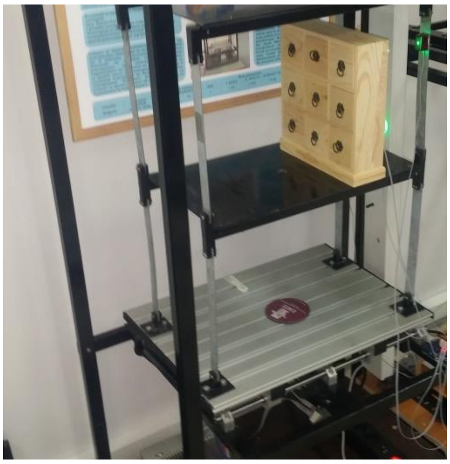

Figure 6. Photo of the experimental set

The next fig. 7 shows individual elements of the experimental system.

Figure 7. Photos of the main elements of the experimental set

From left to right are shown vibrating building, vibrating furnishing, motion control system and system for recording of the results.
The masses of the floor panels of the scale building may also to be increased by attaching to them special tared weights. The mass and vertical position of the center of gravity of the scale furnishing may to be changed by additional weights in the drawers of the model. The motion system are controled by program, created in Matlab environment. The results are processed again by a Matlab program.

RESULTS AND DISCUSSION

The created experimental model is a suitable simulator for conducting experiments related to study of the dynamic behavior of nonstructural elements from one construction. The model allows easy change in the position of the furniture on the building, changing the fastening, etc.
The experimental configuration is managed by a single computer configuration. On a computer window can be seen graphs of the seismic impact and the response of the vibrating system.
The report describes only the experimental system. Specific results from conducted experiments are subject to further development.
The expected influence and applicability of the results from the paper can be described with the inclusion of the characteristics and dynamic behavior of non-structural elements to the general list of factors that influence the seismic stability of structures, which could look like this: dynamic characteristics of the building structure, dynamic characteristics of the non-structural elements and their fixing to the load bearing structure, location of the non-structural elements within the building, function of the facility, importance of the different components for the normal operation of the facility.

CONCLUSION

The development experimental system will improve the level of integration between the interior and the structural system, which on its part will lead to design and development of contemporary “intelligent building structures”.

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ILLEGALLY CONSTRUCTED ROMA SETTLEMENTS IN SURDULICA CITY

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Abstract: The subject of this study are problems that occur during illegal construction, specifically in illegally built Roma settlement Čardačište and Mahala in Surdulica city, then the violation of the Law on planning and construction, poor living conditions, violation of urbanity, as well as recommendations of measures that contribute to the solution of this problems. Considering this fact, our idea was to approach detailed analysis of existing problems and to try to suggest potential solutions to these settlements in Surdulica. The main problems of the village are: violation of the Law on planning and construction, unsanitary conditions, a position that disturbs the potential development of the city, poor infrastructure, overcrowding and disruption of aesthetics of the urban structure. Illegal settlements in Serbia were widespread in modern towns of Serbia, so this is another reason why we opted for this topic. The aim of this study is to demonstrate that illegally constructed buildings have a negative impact on the urban structure of the city, for its further development, and thereby impairs the aesthetic and ecological characteristics of the city. In addition to the above, the aim of the study was and making recommendations in order to improve the illegally built settlement and their quality of life raised to a higher level.
Key Words: illegal construction, informal settlements, urban settlement structure.

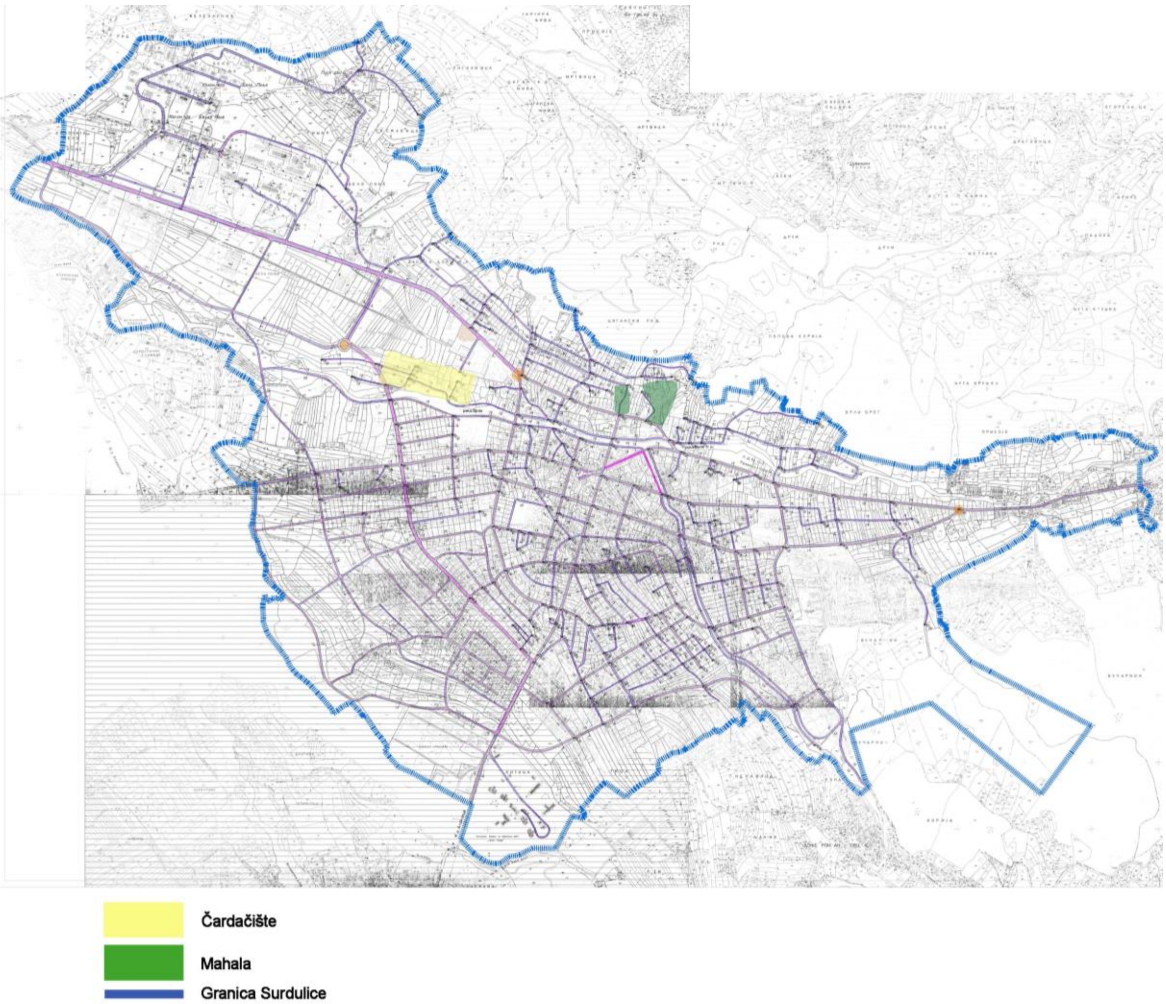
INTRODUCTION

The dominant trend and the special phenomenon of urbanization in Serbia is illegal, unplanned construction. Buildings constructed without planning and construction permits are located in central urban areas, in residential neighborhoods in peripheral urban areas, in zones of protected natural and cultural heritage, national parks, zones of sanitary protection of water sources, the planned infrastructure corridors, in villages and slums. This paper applied the following methods:

1. Gathering information about the spatial and functional characteristics of illegally constructed Roma settlements Čardačište and Mahala in Surdulica city. We used the Law on planning and construction by which we come to the necessary conclusions [10]. Of great importance were our photos of the village, as well as various newspaper articles about this current problem. One of the sources that we have used is the General Plan for the village of Surdulica city.
2. Analysis of the problems that occur in this village, how they affect its inhabitants, and how the surrounding population, limited operation regulations.

The work methodology is to introduce the concept of illegal settlements that. settlements and their main characteristics, and then navigate to a specific example - the illegally built Roma settlement Čardačište and Mahala in Surdulica. The present basic information about the settlement and way of life of its inhabitants, the analysis of the problems that exist in the village, how these problems affect the Roma population in the village, and how the surrounding population and what are the measures that must be implemented to the quality of the urban structure raised to a higher level that corresponds to human requirements and are in accordance with the Law on Planning and Construction. Illegal and informal settlements and illegal housing construction are widespread and long-lasting phenomena in Serbian cities.
This process is started sixties of the last century, together with forced urbanization and different concept Socialist society by residence in the cities and villages in the housing [3]. They recognize two

completely different types of illegal settlements: individual construction, large and permanent home, at relatively properly divided parcels and type of settlement, which has the characteristics of slums which is mainly inhabited by Roma population - which will be discussed in this paper. Slum is the colloquial term for settlements that were built without proper urban plan and the necessary approvals. There were also occurring in places that have very little developed infrastructure near major urban centers. As a rule, the pace of construction is not accompanied by the development of infrastructure that these neighborhoods have more or less distinctive material problems (Inadequate drainage, electricity supply, insufficient capacity of the roads, and so on.) The characteristic of these neighborhoods is to develop and no urban plan [1].
Serbia now has about 590 informal Roma settlements, with more than 270,000 inhabitants. Settlements, such as Čardačište and Mahal (top and bottom) are the result of non-assigned area used, leading to irregularities in all other properties that characterize this type of houses and settlements. The main characteristic of these settlements is the absence of a plan and urban structure.



General Regulation Plan Surdulica

MATERIAL AND METHODS

The problems of Roma settlements and waved čardačište associated with the regulation of the area of Surdulica, there are two Roma settlements Mahala and Čardačište, which evidently belong to the substandard settlements. They make up the majority of objects whose state can be characterized as very poor sanitary and health conditions are satisfactory, there is no complete public utilities and infrastructure equipment. The city authorities have repeatedly tried to solve the problems of these settlements, but these ventures usually ended in failure. The main reason for this was economic in nature, since actions such as relocation of entire settlements enormous financial undertaking.

However, a significant drawback of these projects was the involvement, or lack of involvement, representatives of the Roma community in the process of making decisions about the possibilities for solving the problems of these settlements [7].
We can identified two main problems that arise in the Roma settlement Čardačište and Mahala in Surdulica city. The first problem is the violation of the Law on planning and construction. Since Article 10 of the final with Article 70 of the Law on planning and construction ("Off. Glasnik RS", no. 72/2009) defines the physical and urban planning. Planning in these settlements does, because it is characteristic that they are being created spontaneously, without any rules, without planning.
There is a problem of overcrowding, because the houses are usually next to each other, stuck together, placed without any order [6]. Another problem that arises in the settlement is the environmental issue. As a main feature of Roma settlements, the environmental problem is probably the most visible. Lack of hygiene, poor living conditions, the problem of sewage, water and electricity, as well as other problems that occur in these settlements constitute inhumane living conditions. Failure to take appropriate measures to protect the environment is a problem for which the government is responsible [12].

a)

b)

Figure 1. The examples of illegaly constructed Roma setlements in Surdulica city

In the village of Mahala has been shown in Fig.1. a), 50% of houses are not connected to the sewerage system, while in the resort Čardačište better situation, where about 80% of households are connected to sewage. In both towns have over 80% of households have electricity. In the village of Mahala, 60%

of houses are connected to the water supply, while in the resort Čardačište the supply network is connected to about 80% of the houses. Another problem that arises in the settlement is the issue of ownership of land. In the settlement Mahal about 10% of the total area represents municipal land, in which the illegal buildings [5].
In the village Čardačište has been shown in Fig.1. b), about 50% of the houses were built on municipal land and water management, while the rest of the land in private ownership. The law does not allow anything other than temporary structures to be placed on water management land [11].

RESULTS AND DISCUSSION

The main goal of future activities aimed to be brought into the legal framework and improve informal settlements in is their official prisajedinjavanje system housing, as well as prevention of illegal building and the creation of new informal settlements [4].
The most important criteria that should be applied to achieve this goal is a comprehensive approach that would include the social, economic, legal, technical, environmental and ethical aspects of this phenomenon.
The question is what can be done and what they take to solve the problem. Of course, one comes to the conclusion that the whole situation must be improved, which means an improvement of the quality of the continent resorts to a higher level, which corresponds to more human requirements [2].
The guidelines to be applied in order to solve the problem of the settlement, must rely on the Law on planning and construction. The issue of bringing the legal framework of these settlements must be taken into account as a matter of wider public interest. Also, accompanying the most dangerous consequences of illegal construction are hygiene risks (pollution and unresolved sewage) and difficulties in securing access to each individual home. In order to ensure the vital functions of the settlement, it is necessary to establish separate and upgrade of the standard of urban furnishing, which would respond to local circumstances in [8]. Items for improvement would be:

- improvement of Roma settlements and housing is the responsibility of local self-government
- Roma settlement should not be neglected in comparison to non-Roma village
- exploring the solution for the situation in which the Roma live in illegally built settlements
- the authorities in Serbia should be more consultations with Roma communities and involve them in finding solutions that protect their rights and interests

CONCLUSION

Based on the fact that each settlement has specific problems to respond to specific programs, we can conclude that Roma settlements in Surdulica, according to their characteristics, problems and position in the city, are in settlements that must be improved. If anybody would like to volunteer initiatives in the field of Roma integration in the process of planning and decision-making, favorable outcome will be real and expected.
This approach is now not only solve the problems of Roma settlements as elements that distort the look and image of the city, but are treated so as to solve the problem of residents who live in them. Every village has specific problems and it is necessary to respond to these specific programs which will be an integral part of the project. Each program must be part of an appropriate social system that exists in the municipality, city or country. Within a project, the main beneficiaries are the Roma, but the project also should provide gains and non-Roma population. Since housing projects are part of a broader strategy, relevant ministries should approach the financing of such projects in an integrated way, taking into account aspects such as utilities, needs in terms of social cohesion and possible initiatives and opportunities in the field of culture, education and employment.
In addition, one of the key success factors is the involvement of local authorities, Roma communities, other citizens, private businessmen, investors and developers. In general, solving the housing problems of Roma also involves working with the majority population, and particularly at the local level, the municipal officers responsible for housing. The old inner-city Roma settlements should be retained in the process of urban reconstruction, not displaced. The displacement of Roma settlements should be

the last measure that municipalities must apply. As part of a project it is necessary to connect the four key programs-education, employment, health and housing. National authorities should make it clear that access to adequate housing, both for Roma and other groups, a basic human right.

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REPROGRAMMING THE CHURCH IN ROTTERDAM IN A RESIDENTIAL BUILDING

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Abstract: This paper shows the process of rescheduling the old abandoned church in a modern villa. The church is located in Rotterdam and many long has been out of operation until these architects' Ruud Vissen "did not project its repurposing. This work represents one of the most successful of this kind, which we are using the available data failed to show. This shows that the conversion "flexible", ie. it is possible to convert the building any purpose into something new as a city need. Interestingly, the most common carriers of the idea that architects loads posed, convert it, and then sell or rent.
Key words: conversion, rescheduling, reallocation of functions, church in Rotterdam.

INTRODUCTION

Reprogramming or conversion architecture in the process of conversion of the tool means that one facility to another while preserving the facility. The conversion is considered a kind of preservation of architectural heritage [11], [12], [13]. Conversion is not a stand-alone process and her accompanying revitalization and adaptation [13]. How times change is very important to the preservation of cultural and religious elements that tell the story of the peoples, but sometimes it is not necessary to preserve the rituals, but facilities where these ceremonies held earlier [11].
Trend conversion churches in objects most diverse purpose was started back in the twentieth century and beginners are considered Canadian entrepreneur Peter Gatien [14]. It was back in 1983 opened the iconic night club Limelight in downtown New York on Sixth Avenue, moving on him in church. A few years after Gatien's Limelight moved to London, this time in a former Presbyterian church built in 1754. New York's Limelight is now closed, and since last year the church was repurposed in the market with its designer shops. Since then, the idea of renovating and repurposing of churches that were once shrines taken hold around the world, and abandoned church become most wanted properties. Such conversions are therefore very common today, especially in countries in northern Europe, where many churches were abandoned, mainly because they are less and less people visiting. Fewer and fewer people go to church and costs for maintenance are no longer acceptable.
Particular in the Netherlands, there are hundreds of empty churches, which have changed their function. The purpose of the reuse of the church is to revitalize the building with as little architectural intervention. Since 1970 more than 1,000 churches have been closed by the church community. More than a third have been destroyed, and half of Catholic churches was demolished. The rest is preserved, but has lost its original function. Fortunately, the demolition is less common today, in part because the church introduced to the list of monuments. Reusing is the only way to prevent decay or demolition. Therefore, churches and other historic buildings are reusability type.

MATERIAL AND METHODS

Architectural analysis facility

The subject of conversion is the Church, so that in this building architecture followed function and had been completely subordinate. The original church was extensive building with a high roof, covered with wood paneling and a large choir platform on one side, where there are two large

skylights. Design consists of creating a home within the old structure, which would enable the protection of some of the original characteristics of the chapel, as these wooden panels or wooden poles.
The church has a capacity of 3000 m^2, and is as big as six average family houses, which was a lot of space for a single family home as shown in Fig. 1. and Fig.2. The challenge was that in this vast space create a sense of comfort, without losing the grandeur of the church [5].
Although the architect Ruud Visser easiest able to design a sixteen room house, he instead decided to design a luxurious house, but with a normal number and size of rooms. The house is located in the church, but as an independent object. Inside the house can see a family atmosphere. Outside the house, but still in the church, it is a representation of the church. Because at the same time, in the house of the family home, but also see the preserved elements of the church are shown in Fig. 3. That repsresents a unique home environment, which allows for the simultaneous feeling of life in a normal family house, but also occupies a large interior space area of 550 m^2. The building was started construction in 2009. and completed in 2010.

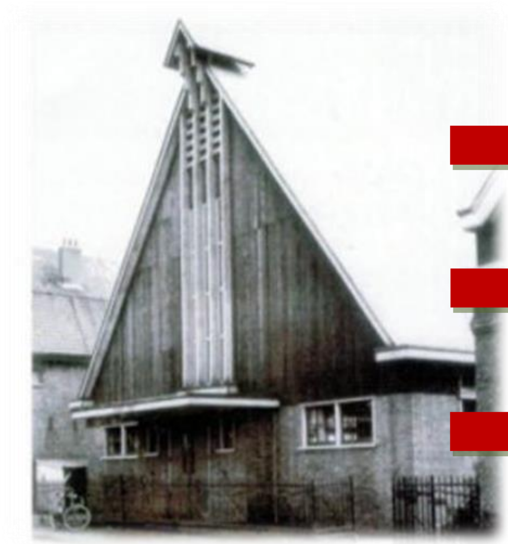


Figure 1. Church before conversion **Figure 2.** Church after conversion

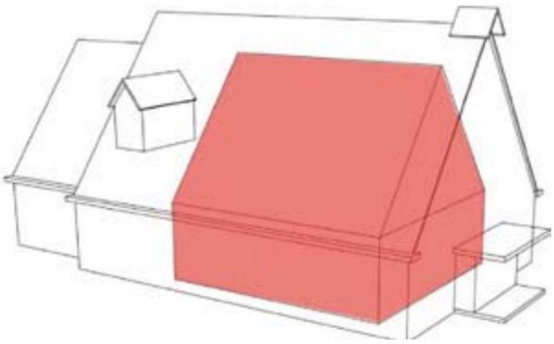

Figure 3. The concept of home within the church

Building construction

Before starting any work on the building, the architectural team has reviewed the state of wooden pillars and the roof. They found quite damaged condition due to long neglect. Wood was collapsed and was attacked by the beetle. All wooden elements have been replaced by [4].
The largest work on the reconstruction of the church was to break the choir, on the back side of the building, which was in very poor condition. Since that part of the holding and the roof were made

reinforcing pillars, and placed the steel holders [6]. The new part of the former choir had the same obilk as old, but was shallower. Given that the foundations were not sure, was carried out and strengthening the foundations. Also, the outer walls were very brittle, so that all the walls were replaced. The same applies to the windows, they were altered, and set the double pane windows [2]. Where it was possible, were returned to their original frames, glass. Most of the original frames is on the top floor.

Exterior building

The building is rectangular, with sloping gabled roof. The architect tried to keep the original appearance of the church, so that the front and side facades retained their original appearance from 1930.god. Only the facade that overlooks the river changed. It has become completely transparent to allow an unobstructed view of the river [3] as shown in Fig. 4.
The glass facade has large sliding doors, height of 3.2 m and a width of 5.5 m. All the windows are framed with white steel frame. An interesting detail of this façade represent a blinds, framed in triangular frame. These specially designed blinds start automatically depending on the position of the sun.
The largest part of the building is covered with wood and brick dark colors. Front and side facades have very few openings and the building itself is working very monumental. The front door and the garage door are of wood, painted in white. Only last facades transparent. The reason is obvious, namely vistas. Double glass all the better isolation [9]. And also with a view to the saving of energy on board are placed solar panels.

Figure 4. Facade to the river

Interior and materialization of the building

Unlike the old church, the new building main entrance was moved to the side, primarily for reasons of privacy, but also for convenience. The distance between the entrance and the living room is about 20 m. This is quite a large distance. However, thanks to the central hall with a staircase, the line between the living area is a short and efficient. Transverse direction that occurs in the home, parts of ground at a residential area, a section with a garage and storage. On the ground floor there is a spacious kitchen, dining room and living room [10]. A clear line of separation between these rooms do not exist, ie. it does not share a single wall. So they make a great compact area. The only separation that occurs between the dining room and the living room is the fireplace, which allows the use of both of the two rooms, as shown in Fig. 5.

a) Plan of the church from 1930 b) Plan of the house from 2008

Figure 5. Plan of the church and the house

One area of the church that the architect left the space formerly occupied by the pulpit. This place is illuminated with natural light with the help of the roof, as shown in Fig. 6. This space is left open in the house, like a huge void. But on the way home from seeing the beautiful landscape that surrounds this place [1]. Is left of this empty space, he became a buffer zone between the outer part of the public- and private-unutrašpnjeg of the house, as shown in Fig. 7.

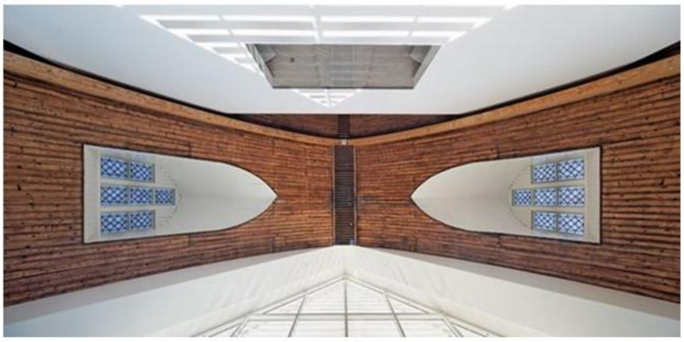

Figure 6. Roof illumination

Figure 7.The room of the former preacher room

On the first floor there is a spacious master bedroom with private bath, shower, toilet and cloakroom. In the room where it is not physically separated from the sleeping area. Dressing room and bathroom in the master bedroom are both elegant and impressive as anything else. In the room there is a deep black tub, as shown in Fig. 8. The room with a sink and shower, separated by a partition wall from the rest of the room, as shown in Fig. 8. White sink is mounted on the dresser of light wood [14], [8].
All were done with style and each detail was taken into account. Large window in the bedroom provides a direct view of the space of the former choir and pulpit. Accordingly, this room has a view of the river.

Figure 8. Details from the main bedroom

Figure 9. Interior of the house

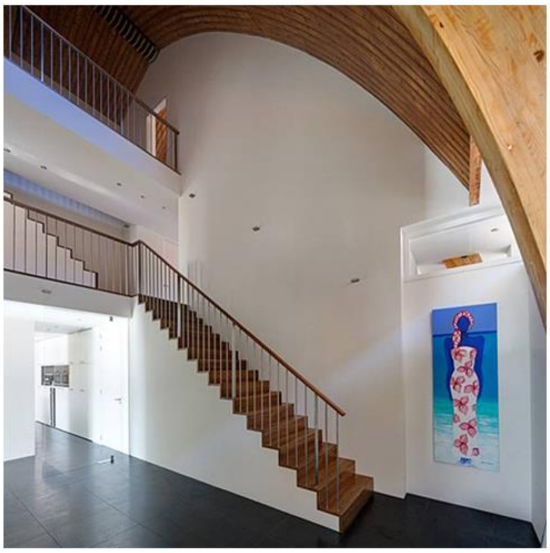

Figure 10. Preserved wooden structure

The other three bedrooms upstairs share another bathroom. In addition to the first floor there is a toilet and laundry.The second floor is designed in part to housing. Upstairs is a bathroom with shower, toilet and pantry.This part of the house has been supplemented by a sauna, office, library and playground for children. Ruud Visser Architects have successfully managed to beautify and renovate the old church in a modern villa, which is mesmerizing not only outside, but also inside. The Dutch group has been able to use his ideas for the interior design and create a decoration of the house, which also has aesthetic and functional value [12]. Every corner of the house has a great artistic value. Even when it comes to home furnishings, attention was paid to the fact that it does not look cluttered. All the furniture is of modern design and with sharp edges. Furniture, curtains and other elements are substantially white in order not to dominate first, to the most visible inherited structures [11], [7].

The whole furniture in the interior is designed minimalist and works almost imperceptibly leaving the main thing the design of the building. The house is in the interior plastered white and the floor is made of black granite, as shown in Fig. 9. In the house there is a combination of white color and the original church wooden panels [12].

The supporting structure of wooden posts and beams is visible, and used as an integral part of the interior space, as shown in Fig. 10. The architect was so eager to join the tradioconalno and modern. The color palette in most rooms is gray. On the floor in the room is dominated by various shades of gray, and white colors of the walls and floor. The bathroom walls are gray material Stucco. This material is applied in several layers and is waterproof. Only the part of the cabin and bath tiling.

CONCLUSION

The conversion of the old church in Rotterdam is one of the most representative examples of religious architecture. The project was completed two years ago and is present everywhere in the world. This is an good example of the implementation of the inherited structure and its symbiosis with modern trends. Functional church is completely subordinate to the religious process, and now is subordinate to users who live there. The entire structure and its organization to provide a pleasant feeling of staying at home. It can be said that the main terms of the conversion were - to create a unique building in a flexible form that can meet the needs of modern living and make a connection between the traditional setting and contemporary features, and lay the foundation to preserve the historical heritage of the introduction of modern facilities.
The Netherlands is a country that is very different mentality than us, and new currents and trends to intelligently take advantage of inherited structures and prevent degradation in this case gladly accepted. Awareness of the architectural recycling and conversion is at a higher level than ours, and planners and investors have not had any problems to adopt a project that is current in the world. However, as our country is concerned, although we are in the XXI century mentality in our country is still tied to tradition and is a rule that must not touch the holy things. This case repurposing and adaptation would be condemned as an attempt by the loss of national identity or as blasphemy. This paper of repurposing the church is a very good indicator of the positive aspects of the conversion of religious architecture and we hope it will be with us this tendency seen as very positive and helpful.

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BENCHMARKING OF TECHNOLOGIES OF BALING PRESSES MACHINES IN THE ELV RECYCLING PROCESS

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Abstract: Enormous amounts of the automotive waste create a problem in terms of negative impact on the environment. Because of that the sustainable development during the complete life cycle is necessary, namely from building automobile, collection, transports, storage and final treatment. Since most of the automotive parts are made of metal, the preparation process for adequate preparation of metal for blast furnace is needed. In order to fulfil this requirement producers of the automotive recycling equipment have developed various types of hydraulic balers of different sizes, construction types and powers. This paper presents Benchmarking analysis of the latter specialized pieces of equipment of the internationally known producers and the one developed on the national level, with respect that the decision making results are a function of the decision making conditions (current market situation and needs, as well as the financial options).

Key words: Pressing, Pressing devices, Benchmarking

INTRODUCTION

The Republic of Serbia defined the manner, method and the legislation of the ELV (End of Life Vehicle) in its territory by the document named *The Directive of the manner and procedures of ELV management (in Serbian)*, [1].

According to the Directive, the management of ELVs is organized in a way to:
1. Prevent generating waste of ELVs;
2. Enable and encourage reuse and recycling of the parts in order to reduce landfill;
3. Improve environmental quality by the automotive manufacturers, importers, distributers, and end users during the exploitation period as well as at the end of life cycle.

Among others, the Directive defined the manner and procedure of ELV management. The conclusion is that the management of ELVs and their parts is a set of measures that includes: collection, transport, storing and treatment of ELVs and landfill of the final waste after the treatment, [2].

REASONS FOR THE DEVELOPMENT OF AUTOMOTIVE BALER IN THE RS

Using the data of the number of 35000 of vehicles that have not being registered annually, and the data of the average age of 20 year for automobiles in Serbia, one may conclude that a significant number of these vehicles have been scrapped. The national strategy of waste management as well as *The Directive of the manner and procedures of ELV management (in Serbian)* predicts and imposes safe collection, transport, storing and treatment of ELVs and landfill of the final waste that may be harmful to human and the environment.
Most of the material at one ELV is a sort of metal scrap, not only by its amount, but also by its volume. Thus it is necessary to prepare the material for the economical transport as well as for its direct and effective input to blast furnaces. The most effective devices for this purpose are hydraulic balers of different sizes, types and capacities that may adjust the scraped material for our needs, [2].
Car Baler is used for the compression of ELV car bodies making it is the perfect choice for auto recyclers who need scarp packages for efficient storage or transportation, [3].

DEVELOPMENT OF A MODERN BALER

Globalization in the market of automotive recycling imposed the need of high specialization in the production of component such as compressors, electrical installation etc. Thus the development of mobile balers for ELV recycling is based on combining solutions that may be adjusted to any individual request of final users, [4].
Development of a mobile baler for the purpose of automotive recycling may create a positive impact to:

- The economic gain of the proposed recycling model;
- Providing the quality new raw materials from the process of automotive recycling;
- Minimization of landfill waste, previously the hazardous one;
- Sustainable use of natural resources;
- Development of the industry of ELV recycling and the opening of new job positions.

In order to achieve the latter mentioned we propose the mobile baller that may achieve the imposed criterions in terms of economic, ecological and legislative demands.
Further in the paper the benchmarking of different pressing technologies is introduced, including modern European technologies as well as the one for the proposed mobile baler for national needs.

DEFINING OF THE CONDITIONS FOR THE IMPLEMENTATION OF BENCHMARKING

In the aim of comparation (benchmarking) Technical solution for mobile baler with the existing devices it is necessary to define equipment with which the coparasion will be done. In this paper next devices are choosen:

NU - TR 35033 Car baling machine (new equipment to be compared with the existing ones);
BU1 - SEDA Car Baler;
BU2 - VORTEX Roter Car / Metal Baler;
BU3 - ROTER Recycling Shear Baler – RR550.5;
BU4 - ROTER Recycling Shear Baler – RR550.6;
BU5 - ROTER Recycling Shear Baler – RR715.6.

The next step is to define criteria basis of which is do comparison of mobile baler with the existing ones. Criteria with marks, units, types of criteria (requirement for maximum or minimum) and weights of criteria are showed in the Table 1. It should be emphasized that the baling speed is one of the most important criterions. However, these data were not available to the authors. That is why the criteria wiht the highest weights are taken the Engine power and the Working pressure, that may represent the paramenters of the baling speed.

Table 1. Criteria in the model

Identification criteria	Name of criteria	Units	Type of criteria	Weight of criteria
K1	Price	[€]	min	0.25
K2	Box material	-	max	0.05
K3	Box length	[mm]	max	0.125
K4	Bale size	[mm]	min	0.125
K5	Engine power	[HP]	max	0.2
K6	Working pressure	[bar]	max	0.15
K7	Weight	[t]	min	0.1

In the Table 2 the real and referent values, analyzed for each device, for every criterion individually, are presented.

Table 2. Start table for benchmarking with real values

Criteria with weights	Mobile baler	Equipment that are used for benchmarking				
	TR 35033 Car baling machine	SEDA Car Baler	VORTEX Roter Car / Metal Baler	ROTER Recycling Shear Baler – RR550.5	ROTER Recycling Shear Baler – RR550.6	ROTER Recycling Shear Baler – RR715.6
K1 (0.25)	105000	158000	200000	305000	330000	365000
K2 (0.05)	HARDOX 400	HARDOX 400 / 450	HARDOX 400 / 450	HARDOX 400 / 450	HARDOX 400 / 450	HARDOX 400 / 450
K3 (0.125)	5000	6000	5000 or 6000	5000	5000	6000
K4 (0.125)	800 x 500	880 x 650	880 x 650	880 x 650	880 x 650	800 x 650
K5 (0.2)	110	145	145	225	225	250
K6 (0.15)	250	280	280	280 / 320	280 / 320	280 / 320
K7 (0.1)	20	22	22	42	44	45

THE METHOD OF BENCHMARKING WITH THE RESULTS

The benchmarking procedure is implemented based on the reference, [5]. Values from Table 2 are necessary to be quantified in order to be comparable. In that purpose various procedures may be implemented. Here, the procedure, in which all values from Table 3 are transformed into values of the interval [0, 1]. Values of Table 2 are adopted as the referent ones for further computations.
Functions presented in Figure 1 are used at three criterions (K1, K5 i K7). It may be observed that functions for criterions K1 and K7 are non increasing ones (there is a request for minimum value), while the function for K5 criterion is a non decreasing one (there is a request for maximum value)

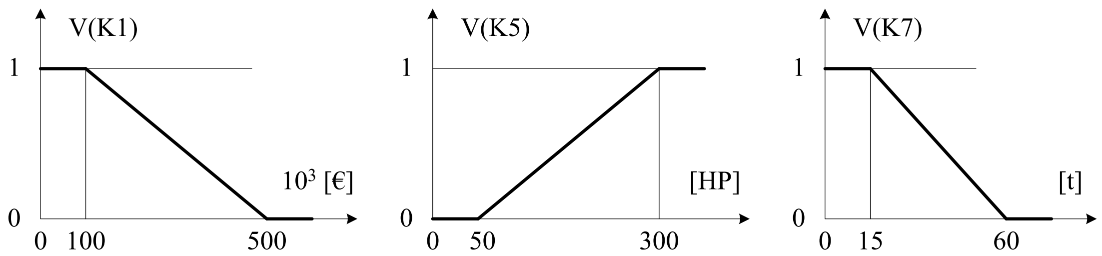

Figure 1. Function for quantification of references values for the K1, K5 and K7

The other criteria (K2, K3, K4 and K6) have uniform referent values, so the direct marking of the interval [0, 1] is implemented. This procedure is introduced in Table 3.

Table 3. Quantification of referent values of criteria K2, K3, K4 and K6 (direct procedure)

Criteria	**Referent value**	**Mark of the interval [0, 1]**
K2	400 / 450 400	1 0.75
K3	5000 / 6000 6000 5000	1 0.75 0.5
K4	800 x 500 800 x 650 880 x 650	1 0.75 0.5
K6	280 / 320 280 250	1 0.75 0.5

By appliying of described methods for the quantifications of values from Table 2, all reference values are quantitative (reduced to the interval [0, 1]), Table 4. shows that. At the same time in the Table 4. It could be seen and overall grades for NU and all BU_i. Overall grades are calculating by this formula:

$$SA_j = \sum_{i=1}^{n} V_{ij} \cdot w_i \qquad (1)$$

Where stands:
SA_j – overall grade for j device, wherein: j = 1, 2,…, s, where is s – number of analyzed devices (including and NU),
V_{ij} – grade for i criteria for j devices, wherein: i = 1, 2,…, n, where is n – number of criteria,
w_i – weight of i criteria.
For example, for NU (j = 1), overall grade i calculating:
$SA_1 = 0.96 \cdot 0.3 + 0.75 \cdot 0.05 + 0.5 \cdot 0.15 + 1 \cdot 0.15 + 0.24 \cdot 0.15 + 0.5 \cdot 0.1 + 0.889 \cdot 0.1 = 0.596$
Thus calculated overall grades represents OWA operator of aggregation, [6].
The final row of Table 4 shows total ranks of the analyzed equipment (including NU).

Table 4. Start table for benchmarking with quantification of references values and ranking of analyzed equipment

Criteria with weights	**NU**	**Equipment that are used for benchmarking**				
	TR 35033 Car baling machine	**SEDA Car Baler**	**VORTEX Roter Car / Metal Baler**	**ROTER Recycling Shear Baler – RR550.5**	**ROTER Recycling Shear Baler – RR550.6**	**ROTER Recycling Shear Baler – RR715.6**
K1 (0.25)	0.988	0.855	0.750	0.488	0.425	0.338
K2 (0.05)	0.750	1	1	1	1	1
K3 (0.125)	0.500	0.750	1	0.500	0.500	0.750
K4 (0.125)	1	0.500	0.500	0.500	0.500	0.750
K5 (0.2)	0.240	0.380	0.380	0.700	0.700	0.800
K6 (0.15)	0.500	0.750	0.750	1	1	1
K7 (0.1)	0.889	0.844	0.844	0.400	0.356	0.333
Overall grade	**0.6839**	**0.6929**	**0.6979**	**0.6270**	**0.6068**	**0.6653**
Overall rank	**3**	**2**	**1**	**5**	**6**	**4**

Data from Table 4. enable to carry out next step. Next step is to determine the partial and differencial between the NU and all BU_j. Accordingly is created Table 5. Center section of Table 5. are the relative distances of NU by every criteria with regard to every BU_j. Sign „-” show that NU dragginess with regard to observed BU_j, and the opposite, sign „+” show that NU precede with regard to observed BU_j. Relative distances are determnine by the formula:

$$d_{ij} = (V_{i,NU} - V_{ij}) \cdot w_i \tag{2}$$

Where stands:
d_{ij} – relative doistance NU and j BU, for i criteria, wherein: i = 1, 2,…, n, where is n – number of criteria, j = 1, 2,…, s, where is s – number of analyzed devices,
$V_{i,NU}$ – grade of i criteria for NU,
V_{ij} – grade of i criteria for j BU.
For example, with regard to criteria K1, relative distance for NU and BU_1 is:
$d_{11} = (0.988 - 0.855) \cdot 0.25 = + 0.0332$

Final column of the Table 5. gives the overall situation of individual criteria for NU with regard to all BU. This values are obtained by addition of relative distances of all rows. Final row of the Table 5. gives the overall situation of NU with regard to BU_j. These values are obtained by addition of relative distances of all columns.

Table 5. Determining of partial and total distances NU in terms of BU_j

Criteria with weights	**NU**	**Relative distance NU from BU_j**					**Total position of some criteria**
	TR 35033 Car baling machine	**SEDA Car Baler**	**VORTEX Roter Car / Metal Baler**	**ROTER Recycling Shear Baler – RR550.5**	**ROTER Recycling Shear Baler – RR550.6**	**ROTER Recycling Shear Baler – RR715.6**	
K1 (0.25)	0.988	+ 0.0332	+ 0.0595	+ 0.125	+ 0.1408	+ 0.1625	+ 0.5210
K2 (0.05)	0.750	- 0.0125	- 0.0125	- 0.0125	- 0.0125	- 0.0125	- 0.0625
K3 (0.125)	0.500	- 0.0312	- 0.0625	0	0	- 0.0312	- 0.1250
K4 (0.125)	1	+ 0.0625	+ 0.0625	+ 0.0625	+ 0.0625	+ 0.0312	+ 0.2812
K5 (0.2)	0.240	- 0.0280	- 0.0280	- 0.0920	- 0.0920	- 0.0840	- 0.3240
K6 (0.15)	0.500	- 0.0375	- 0.0375	- 0.0750	- 0.0750	- 0.0750	- 0.3000
K7 (0.1)	0.889	+ 0.0045	+ 0.0045	+ 0.0489	+ 0.0533	+ 0.0556	+ 0.1668
NU position with respect to BU_j		- 0.0090	- 0.0140	+ 0.0569	+ 0.0771	+ 0.0466	

Now calculate similarities of NU with every BU_j, as well as similarities between all BU_j. Based on data from Table 4. it is formed Table 6, where are presented all mutual measure of similarities for eight monitored devices. Similarity measures are determined by a suitable formula – measure. Here is used measure which is defined based on the distance of Hamming:

$$m_{ab} = 1 - \sum_{i=1}^{n} |V_{ia} - V_{ib}| \cdot w_i \tag{3}$$

Where stands:
m_{ab} – measure of similarity of a device with b device,
V_{ia} – grade of i criteria for a device,
V_{ib} – grade of i criteria for b device,
n – number of criteria.

Subtrahend in the exponenet actually present a relative difference (distance) of a and b device. Similarity measure use values from interval [0, 1]. Thereto equality $m_{ab} = m_{ba}$, as seen in Table 6. Companies are not compared by self, because of that diagonally fields in the Table 6. are empty. For example, similarity measure for CC and BP_1 is:

$m_{NU,1} = 1 - [\,|0.988 - 0.855| \cdot 0.25 + |0.750 - 1| \cdot 0.05 + |0.500 - 0.750| \cdot 0.125 + |1 - 0.500| \cdot 0.125 + |0.240 - 0.380| \cdot 0.2 + |0.500 - 0.750| \cdot 0.15 + |0.889 - 0.844| \cdot 0.1] = 0.7906$

The final column of the Table 6. gives the average measure of similarity ($m_{av,j}$) of one device with regard to other devices. They are calculating on the next way:

$$m_{av,j} = \frac{\sum_{\substack{i=1 \\ i \neq j}}^{s} m_{ij}}{s-1} \tag{4}$$

For example, for NU, average measure of similarity is:

$m_{av,NU} = (0.7906 + 0.7330 + 0.5841 + 0.5639 + 0.5480) : (6 - 1) = 0.6439$

Table 6. Similarities of analyzed equipment and average similarities

	NU	BU_1	BU_2	BU_3	BU_4	BU_5	$m_{av,j}$
NU	-	0.7906	0.7330	0.5841	0.5639	0.5480	0.6439
BU_1	0.7906	-	0.9426	0.7311	0.7110	0.6670	0.7685
BU_2	0.7330	0.9426	-	0.7261	0.7060	0.6620	0.7539
BU_3	0.5841	0.7311	0.7261	-	0.9798	0.8734	0.7789
BP_4	0.5639	0.7110	0.7060	0.9798	-	0.8935	0.7708
BU_5	0.5480	0.6670	0.6620	0.8734	0.8935	-	0.7288

CONCLUSION

Based on the Table 4 one may observe that total marks are very similar. That means that prices and characteristics are very well balanced for all devices, so the final users are about to determine if they are going to give the advantage to the price of specific options of a device. Under these conditions new device (NU) takes third place in total, that may be considered as a very well result taking into account the opponents. The high placement is a consequence of the fact that the NU is the best in three of seven in total criteria. One of the criteria is price which is one of the most important criteria in the model.

However, as in all models of multi criteria analysis, here should keep in mind that the results (total marks and ranks of the observed devices) depend on decision making conditions and of preferences of the decision makers. The results ought to be different should the analysis was repeated in different conditions. Latter conditions consider wealthier company and the society in general, where the price is to a question of choice, but other criterions i.e. the amount of used energy. Thus, the NU is designed for the conditions in Serbia, so it can provide low price, small size of compressed packages and low weight of the device.

Results from the last row from Table 5. are consistent with ranks from Table 4. Because of that NU has a negative total score with regard to BU1 and BU2. The last column of Table 5. shows that NU has a positive total score according to K1, K4 and K7 but has a negative total score with K2, K3, K5 and K6 criteria. In a positive way, especially emphasizes competetive price of NU while the largest fault is observed through low referent values for K5 – Engine power and K6 – Working pressure.

Based on the Table 6 one may observe that NU has the smallest average similarity, followed by BU5. The reason is because this devices differ mostly of others, specifically they take extreme referente values accordint to all criteria (K1 - Price, K5 - Engine power and K6 - Working pressure). Simultaneously, the smallest similarity in the model is exactly between NU and BU5. Other devices has referent values that are between mentioned extremeness. That is the reason why their average similarities are higher.

Finally, the choice of device depends on the given situation, needs and financial possibilities of a company. Totally, NU has been shown as a very good solution, especially in the situations when a company has limited economy and is not demanding in terms of the efficiency of the process.

Acknowledgment

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MODELS OF FAILURE OF HYDRAULIC SYSTEMS

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Abstract: In the work are defined models of failure of hydraulic systems: Parametar model, Model wearing, Model of ″gleam″ clip and Model of lassitude.

PREFACE

In the process of functioning of hydraulic installation different kinds of interruption have effect upon it and they also cause aberration of the basic technical parameters and characteristics from nominal (set) values and the loss of work-capability.
Different models of failure are applied in order to create a method for calculation of reliability of installation and they are based on physical representations of manifestation and development of the processes which cause failure. Thereat casual-consecutive relations of accidental phenomena should be considered.
Depending on a character of a process and casual-consecutive relations of manifesting of different failures all of them are qualitatively described by the following models: Parameter model, Model wearing, Model of "gleam" clip and Model of lassitude.

Parameter model. The state of hydraulic installation which is functioning in the condition of accidental influences can be completely characterized by the integrity of physical parameters or by a vector of parameter of state $X(t)=\{X_1(t), X_2(t),..., X_n(t)\}$, which is taken as determining one from the aspect of installation's purpose. The execution of an installation's purpose is also determined by permitted change limits of certain parameters from below [1]

$X_D(t)=\{X_{D1}(t), X_{D2}(t),..., X_{Dn}(t)\}$ and from above $X_G(t)=\{X_{G1}(t), X_{G2}(t),..., X_{Gn}(t)\}$.

Thereat it is considered that dislocation of any parameter out of corresponding limits $X_{Di}(t)$ and $X_{Gi}(t)$ causes failure.
For the time t possibility of non-failure work is $P(t)=Ver(\tau>t)=Ver[X_D(t)<X(t)<X_G(t)]$.
Because of the aberration of elements' characteristics, conditions of an exploitation all the parameters will be accidental functions of time. Permitted limits $X_D(t)$ and $X_G(t)$ if given in exploitive documentation are not accidental functions of time. However they should be often considered as accidental functions assorted in that manner that in each moment of time t one can find such a correct value of a limit that in a case of a parameter $X_i=X_{Di}+dX_{Di}$ the element is work-capable and in a case of parameter $X_j= X_{Dj} - dX_{Dj}$ the element is incapable of work.
In that manner the state of an installation is described by a vector of accidental function, thereat all the functions in that vector are subordinate because they display the work of a same element.
Parameters of state (pressure, flow rate, rotation frequency, ratio of useful effects, etc) are reciprocally correlated in installations whereupon they can be limitted by one or two parameters of state which are called general because they describe the integrity of properties and characteristics of an installation. In the process of exploitation of an installation the most dangerous work-regime always occurs when effective obstructions are at their maximum.
If these permissions are applied and if the functions of distribution of parameters $X(t)$, $X_D(t)$,$X_G(t)$ are given the task is reduced to calculating of probability $P=Ver(X_D<X<X_G)$.

Picture 1 represents graphical interpretation of the task when densities of probability *f(X), f(X_D),f(X_G)* are given [2].

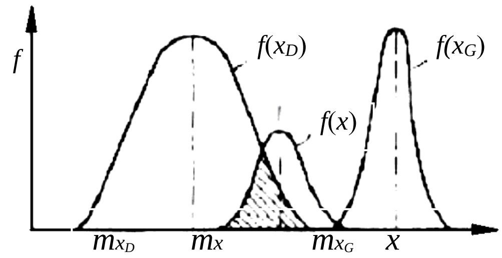


Figure 1. Densities of distribution of parameters

Graphed surface corresponds to probability of parametric failure.
Let us induct accidental magnitudes

$$Y_D = X - X_D \quad i \quad Y_G = X_G - X$$

Then that is probability that accidental magnitude *X* will not come out of limits X_D and X_G,

$$P = Ver(Y_D > 0,\ Y_G > 0).$$

Accidental magnitudes Y_D and Y_G are subordinate since they contain one and the same accidental magnitude *X*, what indicates the necessity of knowing common (general, simultaneous) probability of density $f(Y_D,Y_G)$, and if it is known, then $P = \int_0^{\infty}\int_0^{\infty} f(Y_D, Y_G)\,dY_D\,dY_G$

If a dangerous exit of an accidental parameter is out of a limit XD or XG then the following integral will be simplified:

$$P = Ver(Y_D > 0) = \int_0^{\infty} f(Y_D)dY\,; \qquad P = Ver(Y_G > 0) = \int_0^{\infty} f(Y_G)dY\,.$$

If accidental magnitudes *X, X_D, X_G* are independent and have a normal distribution with the density

$$f(X_i) = \frac{1}{\sigma_{x_i}\sqrt{2\pi}} e^{-\frac{(X_i - m_{x_i})^2}{2\sigma_{x_i}^2}} \quad ,$$

then Y_D and Y_G also have normal distribution and the density of probability is determined by subordination

$$f(Y_D) = \frac{1}{\sigma_{Y_D}\sqrt{2\pi}} e^{-\frac{(Y_D - m_{y_D})^2}{2\sigma_{y_D}^2}} \qquad f(Y_G) = \frac{1}{\sigma_{Y_G}\sqrt{2\pi}} e^{-\frac{(Y_G - m_{y_G})^2}{2\sigma_{y_G}^2}} \quad ,$$

where X_i*=X; X_D; X_G;* σ - is medial quadratic aberration of accidental magnitude ; *m*-mathematical expectancy;

$$m_{y_D} = m_x - m_{x_D}; \quad m_{y_G} = m_{x_G} - m_x;$$

$$\sigma_{y_D} = \sqrt{\sigma_x^2 + \sigma_{x_D}^2}; \quad \sigma_{y_G} = \sqrt{\sigma_x^2 + \sigma_{x_G}^2}.$$

In that case the requested function $f(Y_D, Y_G)$ will also be regular but with other parameters

$f(Y_D, Y_G) = \frac{1}{2\pi\sigma_{y_D}\sigma_{y_G}(1-\rho)} \exp\left\{-\frac{1}{2(1-\rho^2)}\left[\frac{(Y_D - m_{y_D})^2}{2\sigma_{y_D}^2} - \frac{2\rho(Y_D - m_{y_D})(Y_G - m_{y_G})}{\sigma_{y_D}\sigma_{y_G}} + \frac{(Y_G - m_{y_G})^2}{2\sigma_{y_G}^2}\right]\right\},$	$P = \int_0^{\infty}\int_0^{\infty} \frac{1}{2\pi\sigma_{y_D}\sigma_{y_G}(1-\rho^2)} \exp\left\{-\frac{1}{2(1-\rho^2)}\left[\frac{(Y_D - m_{y_D})^2}{2\sigma_{y_D}^2} - \frac{2\rho(Y_D - m_{y_D})(Y_G - m_{y_G})}{\sigma_{y_D}\sigma_{y_G}} + \frac{(Y_G - m_{y_G})^2}{2\sigma_{y_G}^2}\right]\right\} dY_D\,dY_G\,.$

where ρ - coefficient of correlation of accidental magnitudes Y_D and Y_G.

In order to determine coefficient of correlation one has to find the moment of correlation first.

$$K = M\left[\left(Y_D - m_{y_D}\right)\left(Y_G - m_{y_G}\right)\right]$$

After multiplication of the constituents in brackets and applying the characteristics of mathematical expectancies of sum and product of accidental magnitudes and similar constituents resuming together with considering the subordination $\sigma_y^2 = M\left[Y^2\right] - m_y^2$ in the end we get

$K = -\sigma_y^2$ and coefficient of correlation $\rho = \dfrac{K}{\sigma_{y_D}\sigma_{y_G}} = -\dfrac{\sigma_x^2}{\sqrt{\left(\sigma_x^2 + \sigma_{x_D}^2\right)\left(\sigma_x^2 + \sigma_{x_G}^2\right)}}.$

Let us consider several individual cases that often occur in practice

A. General (common) case. Accidental parameter X should not come out of the limits X_D and X_G. All the accidental parameters are distributed in a normal arrangement and have statistical characteristics m_x, σ_x i ρ.

The probability of non-failure work is determined by solving a double integral [3]

Solution of this integral has the following form $P = 0{,}5\left[F(\alpha_D) + F(\alpha_G) - T(\alpha_D, \beta_D) - T(\alpha_G, \beta_G)\right]$,

Where $\alpha_D = \dfrac{m_{y_D}}{\sigma_{y_D}}$; $\alpha_G = \dfrac{m_{y_G}}{\sigma_{y_G}}$; $\beta_D = \dfrac{\alpha_G - \alpha_D\rho}{\alpha_D\sqrt{1-\rho^2}}$; $\beta_G = \dfrac{\alpha_D - \alpha_G\rho}{\alpha_G\sqrt{1-\rho^2}}$.

Values of function $F(x) = \dfrac{1}{2\pi}\int\limits_{-\infty}^{x} e^{-t^2/2}\,dt$ should be given in a table.

Calculating of the possibility P can be simplified if the system of two normally distributed Y_D, Y_G is divided into two independent magnitudes Y_D' i Y_G' with the following statistical characteristics:

$$m_{y_D'} = m_{y_D};\quad m_{y_G'} = m_{y_G};$$

$$\sigma_{y_D'}^2 = \sigma_{y_D}^2 \cos\alpha + K\sin 2\alpha + \sigma_{y_D}^2 \sin^2\alpha;$$

$$\sigma_{y_G'}^2 = \sigma_{y_G}^2 \sin\alpha - K\sin 2\alpha + \sigma_{y_G}^2 \cos^2\alpha;$$

Where $\alpha = \dfrac{1}{2}arctg\left(-\dfrac{2\sigma_x^2}{\sigma_{y_D}^2 - \sigma_{y_G}^2}\right)$. **Then** $P = Ver\left(X_D < X < X_G\right) = F\left(\dfrac{m_{y_D}}{\sigma_{y_D'}}\right)F\left(\dfrac{m_{y_G}}{\sigma_{y_G'}}\right)$.

B. Functions Y_D, Y_G are independent (ρ = 0) and distributed in normal arrangement. In that case densities of probability *f(Y_D, Y_G) = f(Y_D), f(Y_G).* $P = F\left(\dfrac{m_{y_D}}{\sigma_{y_D}}\right)F\left(\dfrac{m_{y_G}}{\sigma_{y_G}}\right)$.

C. It is inadmissible that an accidental parameter come out of limits X_D or X_G. In that case we have

$$P = Ver\left(Y_D > 0\right) = F\left(\frac{m_{y_D}}{\sigma_{y_D}}\right);$$

$$P = Ver\left(Y_G > 0\right) = F\left(\frac{m_{y_G}}{\sigma_{y_G}}\right).$$

D. Limits X_D and X_G are not accidental. In that case the task is simplified; the only thing one needs to know in order to solve the task is probability of density.

E. $f(X) = \dfrac{1}{\sigma_x\sqrt{2\pi}}e^{-\frac{(X-m_x)^2}{2\sigma_x^2}}$.

Considering that $F(-X) = -F(x)$, we will get $P = Ver\left(X_D < X < X_G\right) = F\left(\dfrac{X_G - m_x}{\sigma_x}\right) + F\left(\dfrac{m_x - X_D}{\sigma_x}\right) - 1.$

If it is necessary under the same conditions to calculate the probability of going of accidental magnitude X only out of upper X_G or lower X_D limit, then

$$P = Ver\left(X < X_G\right) = F\left(\frac{X_G - m_x}{\sigma_x}\right);$$

$$P = Ver\left(X_D < X\right) = F\left(\frac{m_x - X_D}{\sigma_x}\right).$$

Model wearing. In the case of contact of two linked (connected) surfaces and their relative shifting in surface layers there are mechanical and molecular reciprocal influences which in the end cause destruction of a surface by microvolume (microcapacity), that is to say wearing. Wearing is always connected with relative shifting and it can occur in the following situations: friction of sliding, rolling and rolling with sliding [3].

Depending on a presence and compactness of material for lubrication between the surfaces in contact we can distinguish friction without a material for lubrication and with a material for lubrication with liquid and terminal (marginal, ultimate, critical) lubricating oil (picture 2).

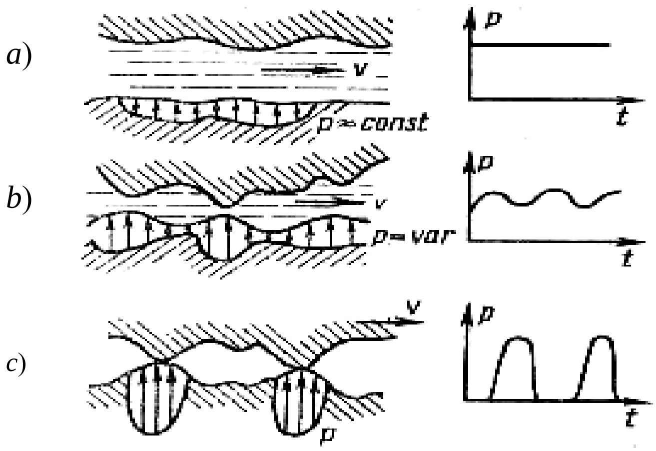
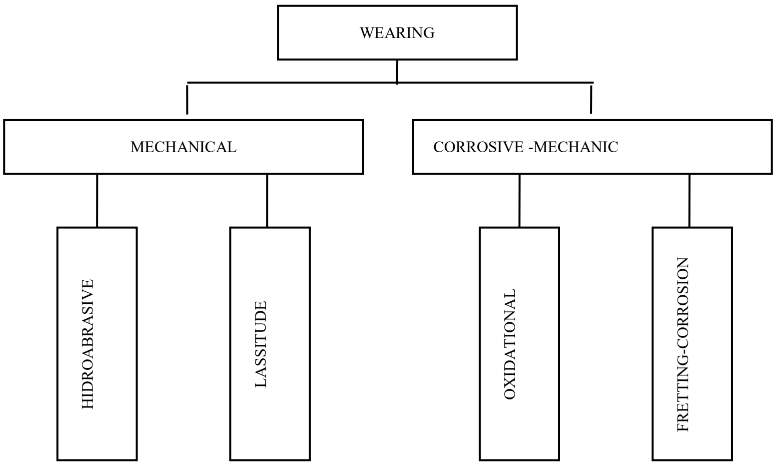


Figure 2. The change of pressure p on microprotuberances under friction:
a, b – with lubricating material
(a-with liquid lubricating oil,
b-with marginal lubricating oil);
c – without lubricating material.

Different processes that occur in surface layers cause different kinds of wearing and the main ones are (picture 3): mechanical, seized by rust (oxidation), corrosive-mechanical.



Picture 3. Basic kinds of wearing classification

Mechanical wearing occurs as a result of mechanical interactive influences of surface's material.

Subspecies of mechanical wearing is *abrasive* wearing of a material as a result of hard particles impact which cut and rip (scratch), and they can be found in a free or attached condition. Abrasive particles develop as a result of wearing and they also can be found in a material for lubricating because of the insufficient filtration of liquid [4].

Mechanical wearing as a result of *destruction because of lassidute* in the case of another deformity of microvolume (microcapacity) of material's surface layer is called hardness wearing.

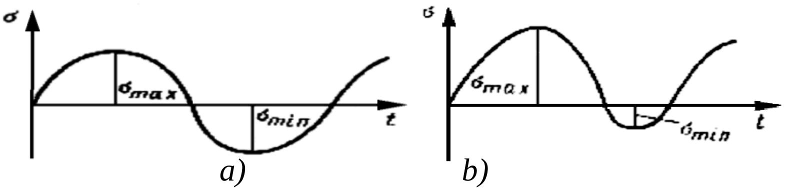
Jaming - is wearing that occurs as a result of joining, digging the material from depth, its transition from one friction surface to another one and the impact of uneven area that appears on the joined surface. This form of wearing appears, as a rule, in a case of marginal lubricating or in the case of friction without a material for lubrication and it causes inadmissible damage.
Corrosive-mechanic wearing occurs in the case of friction of materials which enter chemical interaction with environment and it is divided into oxidational and fretting-corrosion wearing.
Oxidational wearing occurs in the case of protective coating existence on the surface friction, which develop as a result of material and oxygen interaction and they are not hard and can be destroyed quickly. In the case of rolling friction the existence of great deformities in surface layers alleviates diffusion of oxygen and its interaction with metal. Protected by the oxygen, the layer of metal is brittle and can be destroyed easily.
Wearing in case of *fretting-corrosion* occurs in rolling friction with the oscillations of surfaces that have contact as a result of vibrations or periodic deformities. For the parts of contacts the characteristics are joining of metal, surface layer destruction, and the increasing quantity of wearing products [3].
Model of "gleam" clip (complex, constructing part). Deformity and destruction of the parts are caused by unfavourable joining of loading and hardness. Parametric model is justified in this case, although it is necessary to take the loading Q for the general parameter of condition, for parameter of marginal condition – supporting capability R_H. Then the destruction will occur if the condition R_H-$Q>0$ is fulfilled.
Reasons for destruction can be internal changes of the characteristics of the loaded material because of thermo-activating process. Kinetic process of destruction is worked out in detail. In concord with this model of material's deformity is determined not only marginal (maximal) loading but also thermo-chemical processes which depend on characteristics of materials and temperature. Appearing and developing of fissures in materials are conditioned by interruption of inter-atomic connections on account of heat fluctuations and hollows diffusion towards fissures [1,3]
First we will consider failure appearance due to interruption of inter-atomic connections. Let there be one ideal element that will imply material body of final dimensions, homogenous in all the axises and protected from the outer influences beside additional loading. Under the loading pressure there occur accumulation and energy shifting in the body. Brought energy is characterized by loading and accumulated energy by strain. Brought energy in the element accumulate intensity extension of inter atomic connections that are created by electrostatic power. The body cannot accumulate energy infinitely. So when the energy that an element acquired in a process exceeds critical value it comes to interruption of inter-atomic connections and the failure. The considered model explains the failures in the case of high strain (intensity) and relatively low temperatures [2].
In the scope of small exertions and high temperatures there works diffuse mechanism of destruction which is based on the increase of micro-fissures. The rapidity of micro-fissure's development depends on local exertions (tightness). In the beginning the micro-fissure, which appeared because of unimportant defects (secondary turnings on, scratches, faulty materials, etc) develops slowly and then in great rapidity and then approaches the rapidity of sound [1]: $a = a_0 e^{-\alpha\sigma}$
where a_0, α - consonants, determined by the quality of matter; σ - additional exertion.
There is exponential relation between the rapidity of fissure's development and tightness (exertion) which explains the development of the fissures of avalanche's type. The considered model of destruction is characteristic for ideal elements.
An installation is heterogeneous system that consists of a large number of ideal elements. In that kind of system conducted energy is distributed unevenly over the whole object, which as a consequence have a different loading on certain elements. Besides that, certain elements have different characteristics and initial conditions if fissure's development. The time of their destruction will be different. As a result of demonstrative differences some elements may fail at low values of accumulated energy. That kind of elements is called "gleam" and they are the reason of whole object's failure. Indeed, let an object has N elements, out of which n "gleam" will failure. As a consequence of that the loading on the other elements will increase $R_H=R_0N(N-n)$ (where R_0 is initial loading); if it exceeds the supporting capability of "gleam" clip (complex) then the element will fail, and the loading on others increases, etc.

The considered model of “gleam” clip (complex) makes it possible to explain the appearance of failure by the existence of local over –exertions, which are caused by small undetected material defects.

Model of lassitude. Elements of hydraulic installation in the process of exploitation operate in the conditions of unstationary loading regime when loadings which do not change in time have effects on them. It is established that manifold loading causes destruction of elements of construction in the case of exertions which are smaller than at single loadings. Under the influence of changeable exertions occurs the process of gradual accumulation of material damage which causes the accumulation of its physical-chemical characteristics change, fissures creation, their development and destruction because of lassitude [3].

Micro-fissures that originate from lassitude most commonly appear in the places where there are concentrations of exertions (where the concentration of exertion is great, tightness, tools process tracks, transitions from section to section, etc).

Considering its character unstationary loading can be different. Approximately it can be considered as cyclic, symmetric and asymmetric (picture 4). [1].



Picture 4. Loading cycle: a - symmetrical; b – asymmetrical

Loading cycle is characterized by maximal σ_{max}, minimal σ_{mix} and medium

$\sigma_m = (\sigma_{\max} + \sigma_{\min})/2$ exertions, amplitude $\sigma_a = (\sigma_{\max} - \sigma_{\min})/2$ and $R = \sigma_{\min}/\sigma_{\max}$.

Regarding that the exertion of drawing out is positive and the compression – negative, each form (kind) of exertions' cycle can be described by using the introduced relations. So for the symmetric cycle we have

$$\sigma_{\max} - \sigma_{\min} = \sigma_a; \quad \sigma_m = 0;$$
$$R = -\sigma_{\min}/\sigma_{\max} = -1.$$

Basic (main) indicator which characterizes material's resistance to destruction because of lassitude is the limit of endurance σ_{-1} at screwing and τ_{-1} at twisting.

The term limit of endurance includes the greatest exertion of cycle σ_m, which an element can endure without destruction in the case of lassitude in the determined time of operation's duration. The limits of endurance are determined according to books of reference or empiric theories.

For asymmetric cycle of loading the limit of endurance is $\sigma_{-1} = \sigma_a + R\sigma_m$.

Researching of the influence of form (kind) in loaded condition on resistance of steel to lassitude made it possible to establish for symmetric cycles of loading a relation between limits of endurance in the case of screwing izvijanju σ_{-1}, twisting τ_{-1} and drawing out $(\sigma_{-1})_i$ . . For smooth samples $(\sigma_{-1})_i = (0,7 \ldots 0,8)\ \sigma_{-1}$, $\tau_{-1} = (0,57 \ldots 0,62)\ \sigma_{-1}$.

As a result of experimental data's elaboration it was established that in the case of samples of different dimensions (magnitudes) disposition of maximal exertion that destructs ($\sigma_{-1} = \sigma_{max}$) in the zone of concentration corresponds if we consider the constancy of relation of cutting (section) parameter of a sample L and relative gradient (gradient degree, inclination) of exertion $\overline{G}$. On the contrary, if a sample and a part have different values L and $\overline{G}$ realize $L/\overline{G}$ correspond then the limits of endurance will correspond too.

The limit of endurance of a part considering the measuring factor can be determined in comparison to approximate subordination [2].

$$\sigma_{-1} = \frac{1}{\alpha_0}\left(\sigma_{\min} + 10^{A - B\lg\left(L/\overline{G}\right)}\right),$$

where α_0 - theoretical coefficient of exertion's concentration; A and B coefficients that depend on material's characteristics. Theoretical coefficient of exertion's concentration is determined according to the methods of theory of elasticity or experimentally. For round samples with annular grooves coefficient of concentration is approximated by a linear function the form of which is $\alpha_0 = 0{,}34 + 0{,}37\sqrt{t_0/R_S}$, where t_0 is depth of annular abrasion;

R_S - radius of a curve (distortion) of abrasion.

Relative gradient $\overline{G}$ of the first main exertion in the zone of concentration is to be found experimentally. For the round in the case of screwing (curving) $\overline{G} = L/R + 1/\alpha$, and in the case of drawing out and compression $\overline{G} = 2/R$. The determined marks of magnitude for materials $\chi = A/B$ and $\varepsilon = \sigma_{\min}/\sigma_{-10}$ are constants (table 1). Magnitude σ_{-10} - the limits of endurance of a smooth sample with a diameter of 7,5 mm in the case of screwing (compression) with rotationwhich is to be found by examination [3].

Tabela 1. Values of the coefficient χ i ε

Material	χ	ε
Steel : carbonic	10	0,6
alloy	10	0,5
Alloy: aluminum	8	0,55
magnesium	4	0,5

Material's consonants:

$$B = \frac{\lg \sigma_{-10} + \lg(1-\varepsilon)}{\chi - 1{,}946}; \quad A = \chi B; \quad \sigma_{\min} = \varepsilon\sigma_{-10}.$$

In that way, knowing σ_{min} and proportional coefficients *A*, *B* and i ε, one can determine the limit of a part's endurance in the condition of exploitation.

The second criterion that characterizes the resistance to lassitude is a cyclic duration, that is to say the number of the loading cycles *N* that an element endures before the fissure creating of a certain length or before destruction. Subordination $N(\sigma)$ or $\lg N(\sigma)$, that is called curve of lassitude is to be determined as a result of examination.[1].Curve of lassitude is defined by $\sigma_i^m N_i = const$,

where *m* – is an indicator that depends on the part's geometry, surface's section, coefficient of exertion's concentration. Curve of metal's lassitude asymptotically approaches a horizontal line which corresponds to the limit of endurance. The relation between σ, *m* i N_0 (number of cycles of loading which correspond to the limit of endurance, that is to say destruction) depends on material's characteristics, operating conditions, and other factors. However quantitative influence of these factors on curve of lassitude is not defined yet. A number of experimental data is known on the basis of which empirical subordination are recommended for defining of basic (primary) number of loading cycles. Suggested subordination is [3]

$$N_0 = (-0{,}435 + 0{,}785HRC + 0{,}8m)10^6,$$

where *HRC* is material's hardness according to Rockwell; *m* – coefficient of curve of lassitude (for steel in the case of cubic temper and *HRC < 40m = 2,7 ... 3,5,* in case of *HRC > 40m = 5 ... 6,75;* in the case of surface temper *m = 5,7 ... 8,0*).

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POWER LOSS REDUCTION IN A TRANSMISSION SYSTEM BY USING FACTS DEVICES

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Abstract: The electrical power system represents a complex technical creation that is characterized by the same frequency on all elements of the system at any given moment. 43 transmission system operators from 36 countries are led by the ENTSO-E organization and together form the Continental Synchronous Area. The growth of energy consumption further increases the current in transmission lines and losses with it. Reduction of electrical losses in transmission decreases usage of primary energy needed for electrical energy generation. Economic management of space, population growth and limited area for transmission infrastructure call for a more intelligent usage of existing resources. The need for intelligent and directed transmission led to the development of Alternating Current Transmission Systems – FACTS. Implementation of FACTS devices enables power flow control, reduction of power losses and power oscillation damping. The benefits of FACTS device implementation is analyzed on a real electrical power system.
Key words: ENTSO, Electric Power System, FACTS

INTRODUCTION

Complex technical systems call for continuous operation and control. Proper choice of optimal operation and maintenance results in energy savings. Energy savings further results in environmental protection and further development of power systems. The electrical power system is a complex system were all subsystems work together in order to maintain a set frequency and produce sufficient electrical energy. In order to assess the improvement on a simplified model of Transmission Area Osijek, a part of Republic of Croatia's transmission network, the conditions are analyzed on the 400 kV and 110 kV parts of the system. Changes in system parameters (losses, power flow and node voltages) are observed after the installation of thyristor-controlled reactors (TCR) and thyristor-switched capacitors. A solution is given which fulfills strict demands on voltage levels and reduces losses.

ENTSO-E

National power systems are interconnected in order to reduce expenses and increase power delivery reliability, [1]. European countries use CSA (Continental Synchronous Area) system led by ENTSO-E (European Network of Transmission System Operators), which consists of 43 transmission system operators from 36 countries, figure 1.

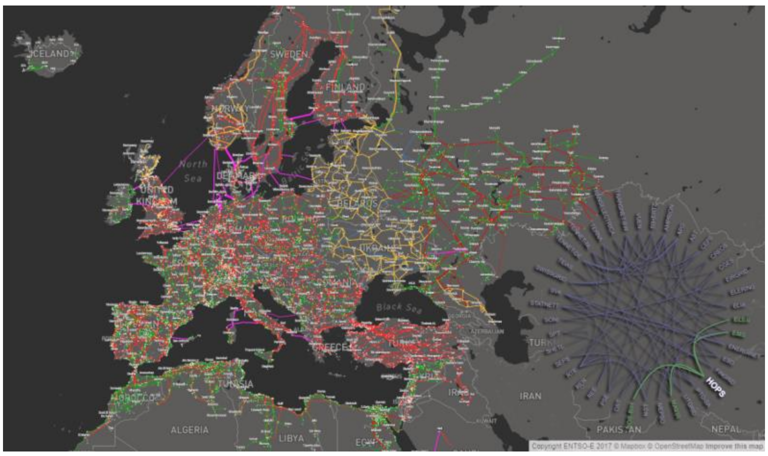

Figure 1. ENTSO-E and HOPS connections

HOPS d.o.o. is one of those operators, [2]. Increased power generation of a power system also increases its complexity and decreases its reliability during major faults. During such events, large power flows with unacceptable levels of control, high reactive power and strong power oscillation can be observed. Power generation and consumption have to be balanced at all times since the capacity of electric power storage is negligible with respect to power generation. If generation is lower than consumption, a voltage and frequency drop occurs. In such event, consumption has to be lowered (automatic regulation is possible at smaller unbalance). In case of voltage increase due to injection of reactive power, consumption rises and frequency drops until breaking point. If the system lacks reactive power, voltage collapse may occur.

EES RH

Croatian transmission system is connected to neighbouring countries' transmission systems on 400 kV, 220 kV and 110 kV voltage levels. 400 kV power lines (total of seven lines where three are two-system and four are single-system) are connected to:

- Bosnia and Herzegovina (PL 400 kV Ernestinovo - Ugljevik and PL 400 kV Konjsko - Mostar),
- Serbia (PL 400 kV Ernestinovo – Sremska Mitrovica 2),
- Hungary (PL 2×400 kV Žerjavinec – Hévíz, PL 2x400 kV Ernestinovo – Pécs),
- Slovenia (PL 2×400 kV Tumbri – Krško, PL 400 kV Melina – Divača).

Croatia's 400 kV transmission network is not looped, rather it stretches from its eastern part (Ernestinovo), through the northwest (Zagreb), to west (Rijeka) and then south (Split). Interconnection with other neighbouring members of ENTSO-E is also realized through eight 220 kV power lines. 110 kV are also present in interconnection through 18 power lines in permanent or occasional operation. [3] Sufficient connection with neighbouring systems allows for import and export of electrical energy and makes Croatia an important link between power systems of central and southeast Europe. Figure 2 shows a part of the ENTSO-E network, including Croatia and neighbouring countries.

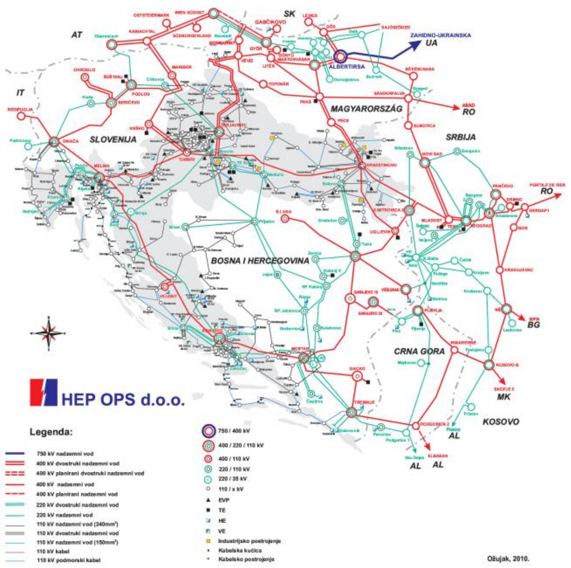

Figure 2. Part of ENTSO-E transmission system

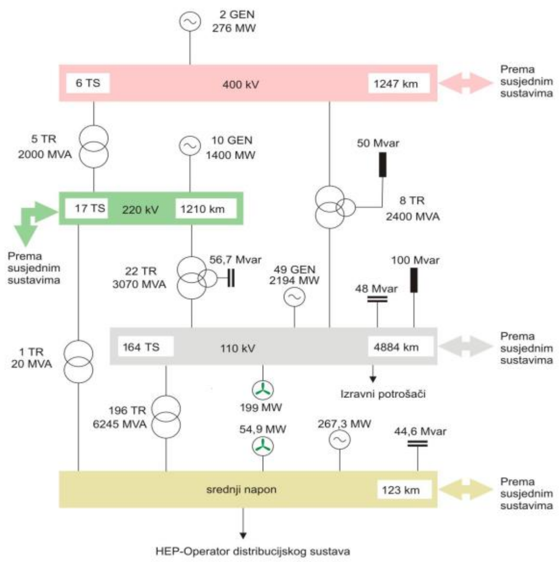

Figure 3. Technical indicators of Croatia's transmission system by voltage levels, from 2013.

FACTS DEVICES

FACTS (Flexible Alternating Current Transmission System) devices are based on power electronics and lately have been used more often because of the need to use the full potential of existing infrastructure.

FACTS devices can be divided into four categories:

1. Series devices
2. Shunt devices
3. Combined series-series devices
4. Combined series-shunt devices

Series devices are implemented as variable impedances (reactor or capacitor) or a variable voltage source. The basic working principle of series devices consists of voltage injection in series with the line. Shunt devices can be implemented as variable impedances, variable voltage sources controlled by power electronics circuits or as a combination of both. The idea behind shunt devices is injection of current in the node where the shunt device is connected to the system. Combined series-series devices have two different implementations. The first implementation uses multiple series devices, each on their own separate lines, connected to the same controller to achieve coordinated control. The second implementation consists of independent devices on separate lines for series compensation, but with a DC power link between series devices to enable transfer of real power. An example of such device is IPFC, Interline Power Flow Controller. Combined series-shunt devices use a DC power link between the series and shunt devices to transfer real power, much like the IPFC. Combined series-shunt devices inject current into the system with the shunt part and voltage with the series part of the device, [4].

PRACTICAL EXAMPLE ON PrP Osijek

Transmission area Osijek (PrP Osijek) is situated on the eastern part of Croatia and consists of transformer stations at 110 kV and higher; that is, every part of the transmission system east from transformer station Daruvar. Figure 4 shows simplified models of 400kV and 220 kV parts of the system.

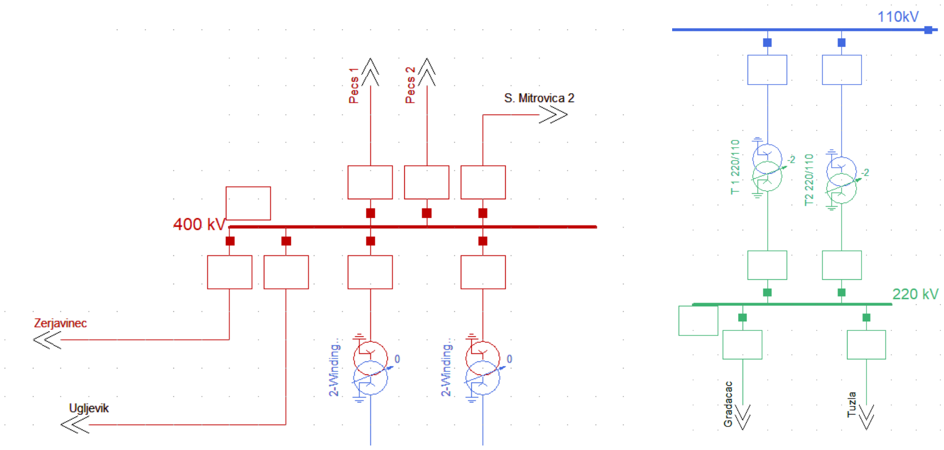

Figure 4. Simplified models of 400kV and 220 kV systems in PrP Osijek [6]

Table 1. Line parameters without compensation

Line	P [MW]	Q [MVAr]	P_L [MW]	cosφ	Loading [%]
SL-VR	55.17	22.75	1.162	0.92	44.18
SLB-DA	50.71	19.42	0.628	0.93	37.41
ERN-VK	30.71	6.43	0.297	0.98	21.00
VK-VU	3.60	4.04	0.006	0.67	5.36
OS1-NA	27.99	8.24	0.405	0.96	19.84

SVC on the 400 kV bus in TS Ernestinovo

Uncompensated system parameters are taken for initial conditions. The selected FACTS device is a static var compensator (SVC) implemented as a thyristor-controlled reactor (TCR) and thyristor-switched capacitor (TSC). Observed parameters in this simulation are bus voltages U [p.u.], real power flow P [MW], reactive power flow Q [MVAr], real losses P_L [MW], power factor cosφ and line loading [%]. If bus voltage resides in the [0.95, 1.05] interval, voltage levels are deemed satisfactory. For U_S greater than 1.05 the bus is marked red and for U_S less than 0.95 the bus is marked blue. Compensation (TCR) is carried out in 25 MVAr steps, from 25 MVAr to 150 MVAr. Mentioned parameters are observed on the 400 kV system. Line loading and losses are most heavily reduced on power lines Pécs 1 and Pécs 2, for the 400 kV side and SL-VR power line on the 110 kV side. For 150 MVAr TCR installation in Ernestinovo, losses are reduced by more than 25% on Pécs 1 and Pécs 2 lines. Greater flexibility in control and lower injection of higher order harmonics is achieved by using SVC, [5].

Table 2. 110 kV line parameters with compensation connected on 400 kV bus

Line	P [MW]	Q [MVAr]	P_L [MW]	cosφ	Loading [%]
SL-VR	55.21	22.97	1.205	0.92	44.99
SLB-DA	50.77	19.57	0.648	0.93	37.99
ERN-VK	30.74	6.58	0.306	0.98	21.30
VK-VU	3.62	4.13	0.006	0.66	5.50
OS1-NA	28.05	8.52	0.419	0.96	20.17

SVC on the 110 kV bus in TS Ernestinovo

The impact on 110 kV buses is more significant with compensation connected to the 110 kV side of TS Ernestinovo. Furthermore, equipment cost is different for different voltage levels, which must be taken into consideration. However, main transformer loading is 71.57% when connected to the 110 kV side, but drops to 58.2% when connected to the 400 kV side. The problem with 400 kV connection point is that bus voltages do not fall below maximum set value of 1.05 p.u.

Table 3. 110 kV line parameters with compensation connected on 110 kV bus

Line	P [MW]	Q [MVAr]	P_L [MW]	cosφ	Loading [%]
SL-VR	55.32	23.53	1.319	0.92	47.05
SLB-DA	50.91	19.98	0.70	0.93	39.48
ERN-VK	30.81	6.96	0.328	0.98	22.05
VK-VU	3.67	4.36	0.007	0.64	5.86
OS1-NA	28.2	9.2	0.456	0.95	21.03

System balancing will be further done with 150 MVAr of TCR on the 110 kV side of TS Ernestinovo. Problems arise in bus voltages on the 110 kV buses Slatina, Požega, N. Gradiška, Međurić, Daruvar and Virovitica, as can be seen in Table 4.

Table 4. 110 kV bus voltages, initial; with TCR only on 110 kV side of TS Ernestinovo; after balancing with TSC; with TCR only on 400 kV side of TS Ernestinovo

Naziv DV	U_p	U_{comb} 110	$U_{comb,b}$	U_{comb} 400	Naziv DV	U_p	U_{comb} 110	$U_{comb,b}$	U_{comb} 400
OS1	1.07	1.03	1.04	1.06	SL	0.97	0.92	0.98	0.95
OS2	1.07	1.03	1.04	1.06	DM	1.05	1.01	1.03	1.04
OS3	1.07	1.03	1.04	1.06	DA	1.04	0.99	1.02	1.03
OS4	1.07	1.03	1.04	1.06	SLB	1.02	0.97	1.01	1.00
VK	1.06	1.01	1.03	1.04	SLB2	1.02	0.97	1.01	1.00
DJ	1.06	1.01	1.03	1.04	PO	0.98	0.93	1.00	0.96
DJ2	1.06	1.01	1.03	1.04	NG	0.97	0.91	1.01	0.95
NJ	1.06	1.01	1.03	1.04	ME	0.95	0.89	1.03	0.93
ZU	1.03	0.98	1.01	1.02	DR	0.92	0.87	0.98	0.91
NA	1.05	1.00	1.03	1.03	VR	0.93	0.87	0.96	0.91
BM	1.06	1.01	1.03	1.04	VU	1.06	1.01	1.03	1.05
VA	1.06	1.01	1.03	1.04					

In order to adjust mentioned bus voltages, thyristor-switched capacitors must be installed in the system. The selected node was 110 kV Bus Međurić because of it's proximity to buses with low voltages. The compensator consists of five capacitors, each with 15 MVAr maximum reactive power. Through the thyristor switching circuit, three out of five are operational and the SVC exchanges 45 MVAr of reactive power with the system. Such configuration sets all voltage levels within the set range. Table 5 shows observed parameters on selected lines with 150 MVAr thyristor-controlled reactors connected to the 110 kV side of transformer station Ernestinovo, after balancing the system voltage levels with a 45 MVAr thyristor-switched capacitor. Compared to Table 2, it can be seen that line loading and real power losses on the line are further decreased. Even though line losses and loading is higher in case of 110 kV connection, by balancing the system with TSC, the observed parameters are lower compared to 400 kV-connected compensation.

Table 5. Line parameters with combined compensation

Line	P [MW]	Q [MVAr]	P_L [MW]	cosφ	Loading [%]
SL-VR	54.69	1.96	0.956	1	39.95
SLB-DA	50.95	6.28	0.58	0.99	35.86
ERN-VK	50.22	9.37	0.532	0.98	34.94
VK-VU	3.54	1.89	0.003	0.88	4.04
OS1-NA	27.84	1.7	0.385	1	19.2

REDUCTION OF LOSSES AND CO_2 EMISSION

Table 6 shows the loading and loss reduction for 400 kV-connected compensation with the premise that line losses are 1% at set loading, meaning that loading difference achieved through compensation equates to loss reduction.

Table 6. Primary energy saving with TCR

Observed lines	Total Loading [MW]	Loading Reduction [MW]	Loading Reduction [GWh/year]	Power Loss Reduction [MWh/year]	Power Loss Reduction in 30 years [MWh]	Primary Energy Savings [GWh]
No Compensation	168.18	0	-	-		-
400 kV-connected compensation	164.89	-3.29	28.82	288.2	8646	13.95

It can be concluded from Table 6 that that real power loss reduction for this relatively small test grid is 28.82 GWh per year, and when taking into account the life expectancy of electrical equipment (30 years), 8646 MWh of electrical energy less can be produced for the same effect. Using conversion coefficients, 13.95 GWh less primary energy has to be used, which translates to 3.28 less megatons of CO_2 emissions.

CONCLUSION

The electric power grid combined into the ENTSO-E system represents a complex entity in which every part of it contributes to the stability of the entire system. The importance of such a system configuration can be seen at the moment of subsystem instability, when other subsystems ensure uninterrupted power delivery and system stability. The task of every subsystem is maintenance of its own power grid which ensures stability. Simulation done on a part of the Croatian power grid shows that the application of FACTS devices in the system reduces power losses, which in turn increases maximum power transfer over a set line. That allows for increased assistance to other systems when needed. Loading reduction achieved through compensation reduces CO_2 emissions and bring them closer to the requirements set by national energy policies. The need for compensation has led to the development of direct current transmission at extremely high voltages and passive compensating devices. Complex systems require active compensation as passive compensation will not be fast enough to keep up with more advanced and complex systems. For this purpose, FACTS devices are being developed, a flexible technology whose automatic regulation can keep up with rapid changes in system parameters. FACTS technology also play a significant impact on transient system stability.

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HYDROKINETIC TECHNOLOGIES AND APPLICATION

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Abstract: Known by all parties, the use and prevalence of renewable energy is essential because of the global warming and environmental pollution effects of fossil fuels. Hydrokinetic is a renewable energy source. Marine currents and river currents at high-altitude internal regions create significant hydrokinetic potential. Hydrokinetic energy conversion systems are in development and new application stages. Researchers and organizations are working intensively on this topic. During some systems are in the phase of research and prototype development, others are at commercialization phase. This study presents some informations to understanding the existing systems, the implementation possibilities, the application difficulties and some solution suggestions.

INTRODUCTION

Depleting fossil fuels, increasing environmental pollution due to the widespread use of fossil fuels, changing and developing consumption habits, and rising energy consumption per person require the introduction and better evaluation of new and alternative energy sources Hydrokinetic energy has a significant place among these sources. The power of the water current creates hydrokinetic energy. Renewable hydrokinetic energy can be harnessed from water currents via hydrokinetic technology [1]. Hydrokinetic technologies are similar in many asspects to wind energy conversion systems. With another explanation, we can think of them as being immersed in water of wind turbines by taking necessary precautions. Hydrokinetic sources can be divided into two groups as ocean /sea and river currents. In some cases, tidal energy and wave energy are considered hydrokinetic sources. However, they vary in terms of their structure, conversion systems, and Technologies. Since water is 832 times denser than air, hydrokinetic energy conversion systems are able to obtain the same power from much smaller rotor swept area comparing with wind energy.

Process losses are occurring in all of the conversion systems. Therefore process efficiency emerges during such conversions. All of these losses are substituted by the system performance coefficients. The performance coefficient of the hydrokinetic and wind energy conversion systems are limited to the Betz limit of 59.3%, which is the maximum theoretically possible conversion efficiency.

Special incentive schemes are being implemented in some developed countries to promote the development and deployment of hydrokinetic Technologies [2]. Interest in the progress and development of hydrokinetic energy conversion technology has grown significantly in recent years. The hydrokinetic industry has advanced by taking necessary steps beyond the testing and prototype phase and will soon install demonstration projects with arrays of full-scale devices [3].

Despite all this, hydrokinetic energy conversion systems and technologies are in the developmental stage in some aspects. In addition, there are many prototype or new project implementation stages. It is important that these studies are gathered together and discussed. In this context, it is essential to raise awareness what is the application frame of the hydrokinetic energy, how it is applied,and the challenges and differences in applications. In this work, hydrokinetic energy, the power to be obtained from it, performance coefficient, classification of turbines, application and information about turbines have been tried to be given.

MATERIAL AND METHODS

Hydrokinetic power

Hydrokinetic turbines generate power only from the kinetic energy of moving water (current). This power is a function of the density of the water and the speed of the current cubed. The available hydrokinetic power depends on the speed of the river, ocean, or marine current [3]. Most of the principals of this type of turbine are based upon wind turbines, as they work in a similar way. During the quiet flow state, a column of wind upstream of the turbine with cross-sectional area A of the turbine disc has kinetic energy passing unit time as follows [4-6].

$$P=1/2\ \rho.A.U^3 \tag{1}$$

The power that can be obtained from the hydrokinetic turbine or wind turbine when using the performance coefficient instead of process and conversion losses is as follows [6].

$$P_T=1/2\ \rho.C_P.A.U^3 \tag{2}$$

Here: ρ the density of the fluid passing through the türbine (kg/m^3)
C_P performance coefficient of the system
A rotor swept diameter (m)
U free water flow velocity (m/s)

The system performance coefficient indicated by Cp is limited by the Betz limit as mentioned earlier and can be maximum 59.3%. However, in practical applications it seems to vary between 0,1 and 0,4, Figure 1 [7]. As water is involved in hydrokinetic conversion systems, the density may vary depending on the salt content of the water. In addition, the system performance coefficients vary depending on the flow rate (velocity). Creating power is raising in proportion the the rotor diameter. the power to be obtained from the system varies with the cube of the free flow velocity.

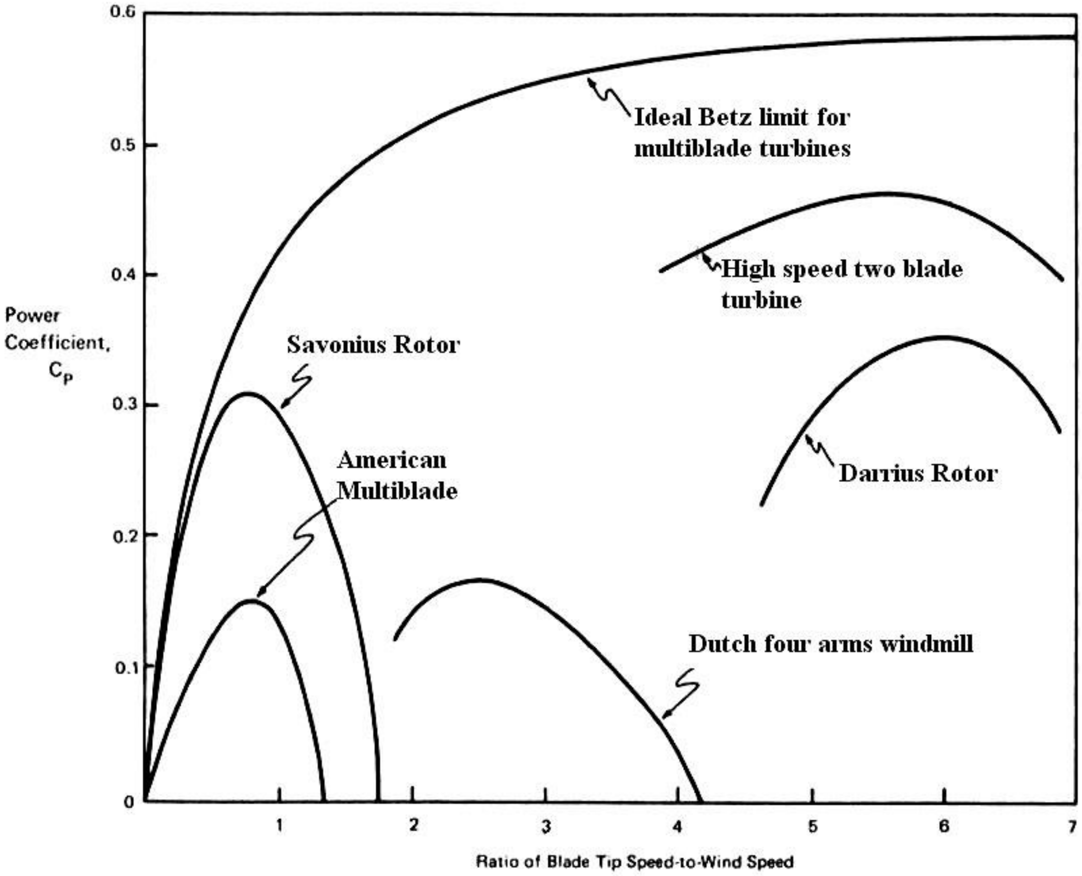

Figure 1. The power coefficient C_p as a function of the tip speed ratio for different wind machines designs. [7]

The total hydrokinetic energy resource in a region can be estimated using two alternative methodologies. The first approach involves calculating energy expenditures in rivers, and second involves tracing potential hydrokinetic energy back to its source. In the second approach, total potential hydrokinetic energy for a region equals the sum of the potential energy of the water that drains towards the outlet [8].

Hydrokınetıc turbınes

The classification of hydrokinetic turbines can be made basically as horizontal axis and vertical axis. The horizontal axis turbines can be separated into two groups. The rotational axis of the first one is parallel to the water stream direction. The rotational axis of the other is perpendicular to the water stream direction. Water wheels or cross-flow turbines can be classified as perpendicular horizontal axis turbines, Axial flow turbine can be usually constructed as two-, three- or multi-blade. The structure can be opened or ducted [9]. Horizontal axis turbines have passed the development phase and are now starting to commercialize.
If the rotational axis of turbine rotor is perpendicular to the water surface, such turbines are named vertical; typical examples of vertical axis are Savonius, H- Type, Darrieus, Helical turbine [9]. H-Type (cross-flow), Tropostien/Darrieus and Gorlov helical turbines are encountered in practice and work extensively on various organizations and researchers. They can be reached partly by commercializing among vertical axis turbines. In addition, the combination of Darrieus and Savonius turbines in a single body has been tested.

RESULTS AND DISCUSSION

Hydrokinetic turbines can be arranged directly to the regions where the ocean or marine water currect occur. This application can be done to sea bottom as well as close to sea level. Horizontal axis turbines are often seen in this type of marine application. In practice of this type, it is possible to take measures to increase the water flow rate by using ducted structure. Vertical axis helical turbine is used in surface applications. In this case floating platforms and mounted turbines are involved. The hydrokinetic turbines can be utilized in principle at the main turbine outlets in the hydroelectric power plants based on the water accumulation and drop because the water velocities are very high. Axial turbines seem to be more suitable here, but it is important to consider how and where the turbine base mechanism is to be mounted. Axial turbines can be directly applied in river application if there is adequate water depth available. Necessary precautions should be taken in these applications by taking into account special conditions such as river sediment structure, movements and flood cases. Moreover, hydrokinetic turbines can be conveniently and optimally used in man made water flow channels, such as water mill channels formed at the edge of the river. In that application, measures to prevent fish and other aquatic entrances from entering the channel can also be easily taken. Turbines can be serially connected in succession into these hydrokinetic channels. Both horizontal and vertical axis turbines can be used in these channels. The system may be simpler by vertical axis turbines since components such as generators and speed increasers can be mounted on the water level. Fyrthermore, It is also possible to increase the water flow velocities 2 to 3 times by using smooth surface channel materials as the sediment structure decreases water flow in the river [6, 9].

CONCLUSION

Hydrokinetic turbines are immersed in water from wind turbines. Significant increases in hydrokinetic turbine applications should be expected over the next decade although not as much as the prevalence of wind turbines. The main bodies of the turbines will not be as noticeable as the wind turbines because they are usually underwater in the sea and ocean applications. In such applications, it should be possible to establish well the regions where there are sufficient water currents and to establish and construct the transmission lines which will be produced with electricity so as not to obstruct the sea traffic and marine life. In such applications it is necessary to determine well the regions where there are sufficient water flows. it is important to safely transport the electricity to be produced. Transmission lines should not obstruct and harm marine traffic and marine life. Wind turbines are capable of delivering 1 MW power at wind speeds of 13-14 m / s with rotor diameter of 50 meters.

Hydrokinetic turbines can reach the same power values at water speeds of about 3 m / s with 11 meter rotor diameter units. Utilizing the water currents in the rivers will gain prevalence even easier via hydrokinetic channels. The hydrokinetic channels that will be formed here will offer advantages both in terms of increasing of water speed and ease of taking precautions to prevent any live habitat entry. Also, changes in water velocities in the canal will be very slight, so they will not be too complicated in frequency regulating mechanism. Consequently, It is possible to convert both the ocean and the river water current into electricity by well-designed, with scrutiny measuring systems for potential negative effects on the environment.

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IMPLEMENTATION OF AirDB MOBILE APPLICATION FOR BUSINESS AVIATION INDUSTRY

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Abstract: The main task of this work is to show and explain life cycle model, the specification and implementation of AirDB mobile applications for tablets and smart phones in the aircraft industry. In this paper, the basic characteristics of this mobile application and its advanced functionality are detail explained. The innovation of AirDB project lies in its domain i.e. in the field of business aviation industry and there are not exsist similar application on the market. This paper presents the detailed analysis of using AirDB project by various users and global companies all over the world in the aircraft industry.
Key Words: mobile applications, aviation industry, database.

INTRODUCTION

it is impossible to imagine today without information technology. In work of author [8] explained the impact of ICT on productivity of airline industry. The other author [3] has bben researched about strategic and tactical use of ICTs in the airline industry. Generally, the desire of all busniess companies in airline industry is to leave competition behind, and to market their products in as much and as short a time as possible. For that reason, there are no surprises for the growing number of mobile applications for Android, iOS and Windows platforms [9], [14], [16]. There are three types of mobile applications: native, web and hybrid mobile applications [2], [10], [15], [19].

Native mobile applications are applications built using the programming language of a particular mobile platform [4]. The main feature of the native application development is that it is generally difficult or almost impossible to switch such a platform to another platform, without the need for the complete existing program code to be written from the start. The advantage is that they are tailor-made for the default platform, and as such give the best result that can be achieved on that platform. The disadvantage is the high cost of developing and maintaining several different versions of the application.

Web applications have emerged as a need to reduce costs and ensure transparency of the platforms or its operating systems [15]. Lately, more and more companies is using web mobile applications as an alternative to native applications. The advantage is that once created mobile web application easily covers multiple platforms for a lower cost, thus faster reaching the market and expanding on it. The main disadvantage of this type of application is that specific problems may occur on certain platforms, which make them slower and worse function on them.

Hybrid mobile applications are the third option and are the worst solution for web applications [12], [18] It's about a native application made for a particular platform, which execute a web application in web components. The process of creating a mobile application is complex. It includes the team effort of a large number of experts. If we need the implemented application to work on iPad, iPhone and iPod touch devices, the platform that we have to use will be iOS [6], [7]. Required iOS application programming tool: MAC OS X10.9.4 or later, Xcode and iOS SDK. Xcode is integrated into Apple's software offer [1]. It contains all the necessary tools to program the iOS mobile application. Codes are written in Objective-C or Swift programming language. Swift is the latest programming language for iOS, OS X and watchOS applications [13], [17]. Many parts of Swift are known to developers who have had experience in developing C and Objective-C programs [11].

MATERIAL AND METHODS

AirDB Mobile Application Specification

AirDB is a mobile application for smartphones and tablets, which in its database stores a large number of data on many models of aircraft from different manufacturers. Software Requirements Specification is a document that contains a description of the project being developed [5]. It represents a detailed plan that defines the appearance and functionality of the future product and as such enables all participants in the project to clearly visualize the final product and its stages of development. It often also includes use case diagrams or diagrams of usage cases that display collected user requests, and they simplify communication between the application's user and the implementing team. The functional specification of the mobile application is a part that relates to its specific functionalities. The benefits of a well-designed functional specification are multiple. It saves time and money with clearly defined requirements and development flows. Changes in later phases of the project are avoided, which are more complicated and therefore more expensive and more durable. It is possible to detect possible problems on time and thus react in a timely manner. It is important that participants in the development can detail themselves in detail with the knowledge that later corrections will not be necessary. Also, the defined requirements are used for testing and maintenance of the project. The content of the specification (Screen Structure) of the AirDB mobile application is attached in Fig. 1.

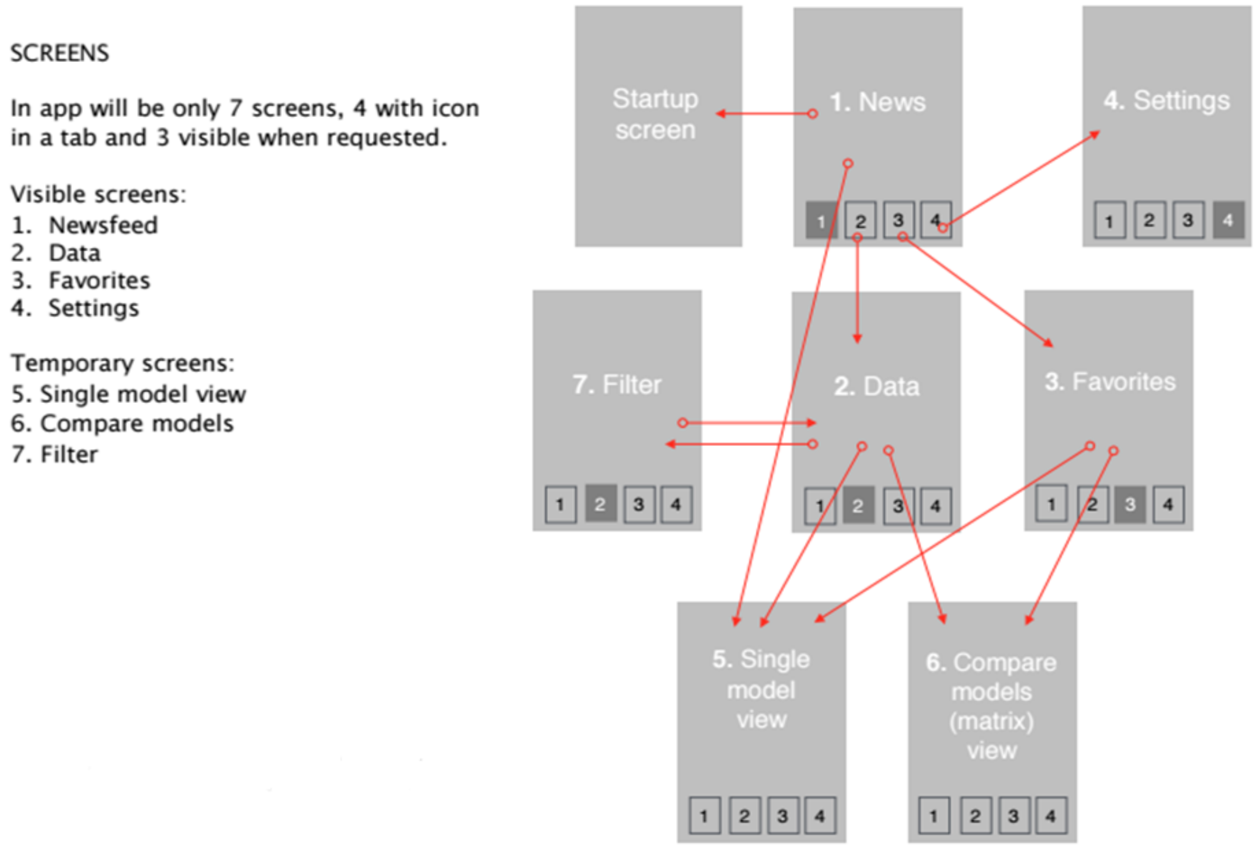
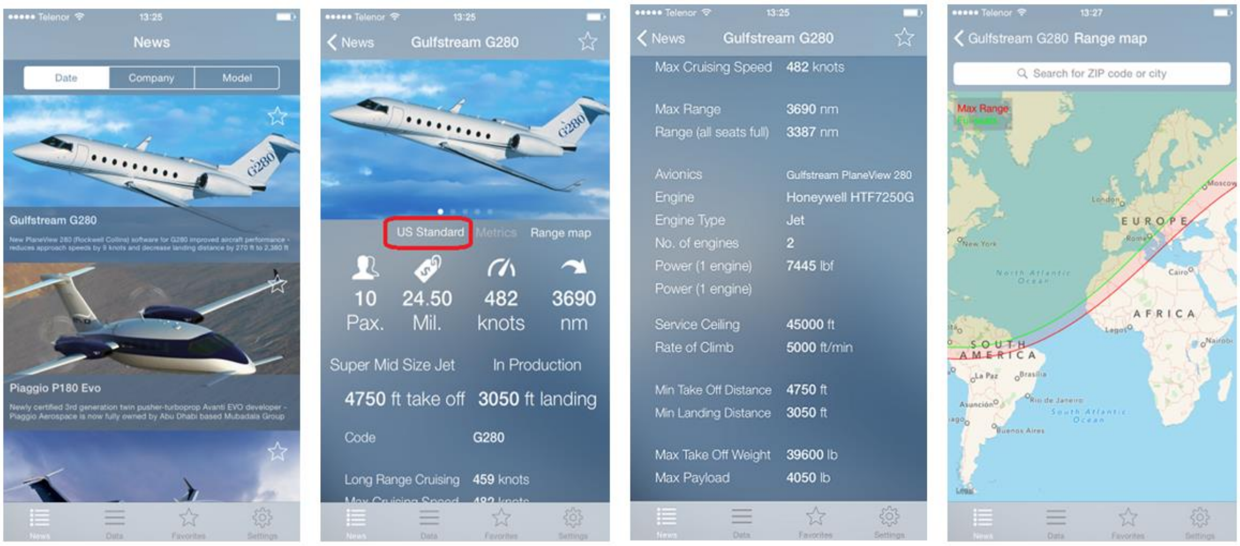


Figure 1. Screen Structure of AirDB mobile application

AirDB has seven screens, four with an icon on the screen, and three are visible on request. As far as the application is intended to be used on on mobile devices, it is important to be simple and intuitive. Through the following Figures, we will present the functionality of the AirDB application.

The functionality of airdb mobile application



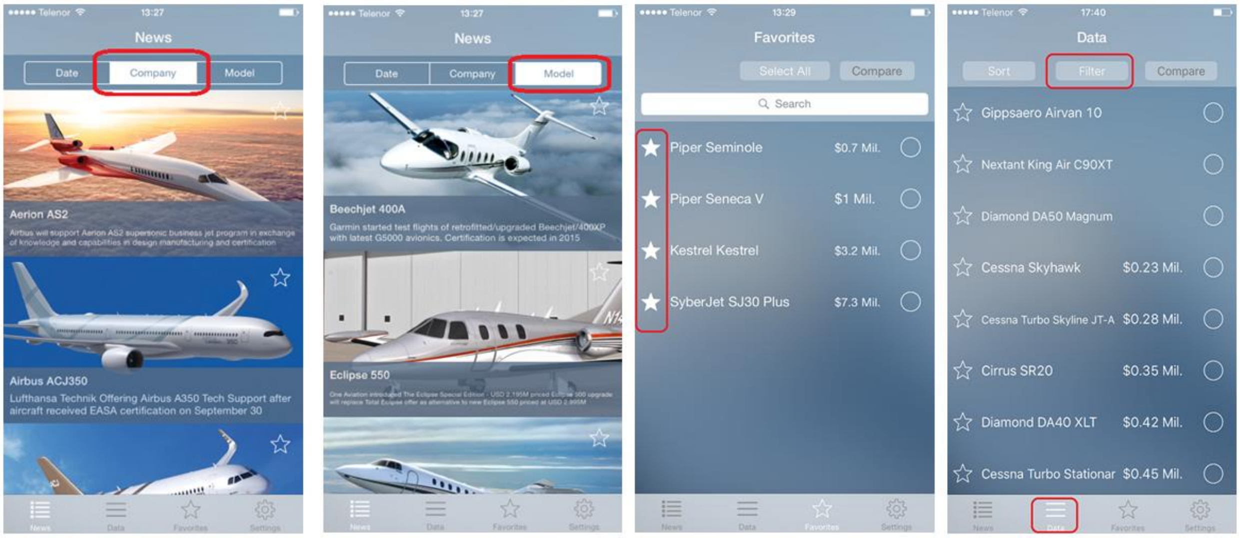
a) *News* b) *Basic Model data* c) *Additional model data* d) *max path airplane*

Figure 2.

Figure 2a shows the side view with the news. The application is updated regularly, and in the latest version there is the option "push notifications" which means that the user receives real time information when a new news item about the model that he has put in favorites is published. The new news is listed on this page, and all are listed in chronological order. This is the first page that the user meets and here can find the latest news in the field of business aviation (announcements of the premier, promotion, fair events and others).

Figure 2b) shows the layout of the page with images and model data. In the upper part of the screen, there is a cover image that can be enlarged to the full screen by touch, and by dragging the finger in the left-to-right direction, we can list more image of the model. All images are in the latest version of the HD application. The information we see tells us about the maximum number of passengers in the aircraft, price, speed and speed in the first row, and then all the other information is scrolled. Here the units are according to the US standard, which is in the application variable.

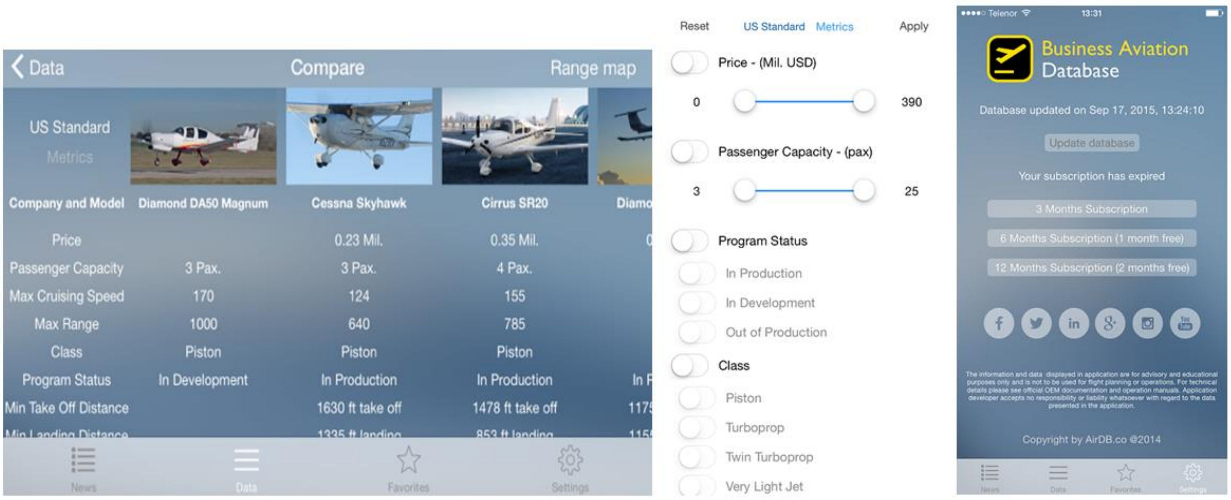
Figure 2c shows the layout of the page with additional information such as: maximum filling with loaded capacity, engine type, engine number, power, how far the distance is necessary to service the plane and more. Figure 2d shows the layout of the world map and the maximum plane of the aircraft. By touching the "Range map" field, the user is on this page. The option is given to enter the name of the city, and then it is taken as the starting point for a graphic view of the route. The red border represents the maximum range, and the green maximum throw with the filled capacity. This is an overview of a single model, and the application provides the ability to compare the aircraft to this map.



a) *Company* page b) *Model* page c) *Favorites* page d) *Data* page

Figure 3.

Figure 3a shows the look of the side with the company overview. By touching the "Company" field, a list is displayed in which the craft is sorted by producers. And this is one of the options that aims to make it easier for the user to navigate through the application. By touching the star of the aircraft, it is included in the favorite list. In Figure 3b), the layout of the side with the models is shown. This page is intended to list news about aircraft sorted by model. What is unique to this page, but also to the pages we have seen so far, is that the news is published in a maximum of 250 characters, and by touching it we are going to the page with features. Figure 3c) shows the layout of a page with a list of aircraft marked as favorites. By tapping on the field marked with a star in the lower right corner, a list of all aircraft for which the user shows an increased interest opens. They are sorted by value. By touching the name of the model we enter the data side. In Figure 3d), a re-view of the page with the favorites is displayed. Here, in addition to finding a more interesting model of interest, the option to mark the circle with the "Compare" option is compared to the models. By touching the "Compare" box, we go to the side with a comparative overview of the characteristics of the selected models.



a) *Compare* page b) *Filter* page c) *Settings* page

Figure 4.

Figure 4a) shows the layout of the side to compare the model. This page is also the highest usage value of the application. Various factors of the airline industry: journalists, analysts, sellers, and even airplane lovers have the need to have various information about aircraft. This information is available, it is easiest to be found on official company sites and in annual bulletins they issue, but to compare this information it is necessary to visit multiple sites at the same time, and written material has a big shortcoming that quickly outdates in fast industries. This application optimized this process . By touching the "Range map" field, a graphic view of the all-flybridge mapping from the comparison list opens, so it's easy to compare them in this way.

Figure 4b shows the layout of the page in which the user has the freedom to base his search criteria. Various criteria are available to the user: number of passengers, prices, classes, production stages and many other options. When the parameters are specified, the database filters and displays a list of models that fit into the specified criteria.

In Figure 4c, the layout of the "Settings" field appears in which the user receives information about the date and time when the last time the database was updated. The user to whom the subscription has expired uses all the data from the database, but there is no regular update of the data. The user has the ability to share and recommend the application to their friends on social networks by simply tapping on the social network logo.

Figure 5 shows the appearance of the AirDB analytics analyst, that is data flow over a period of two weeks. We can create analytics by various criteria. Some of them are the date, the type of device from which the database is accessed, and many others, depending on what we want to learn from the report. Analytics data is available in real time, which allows for successful campaign tracking. It is crucial that each user can access the server through the application at any time and that it has no difficulty or interruptions in operation.

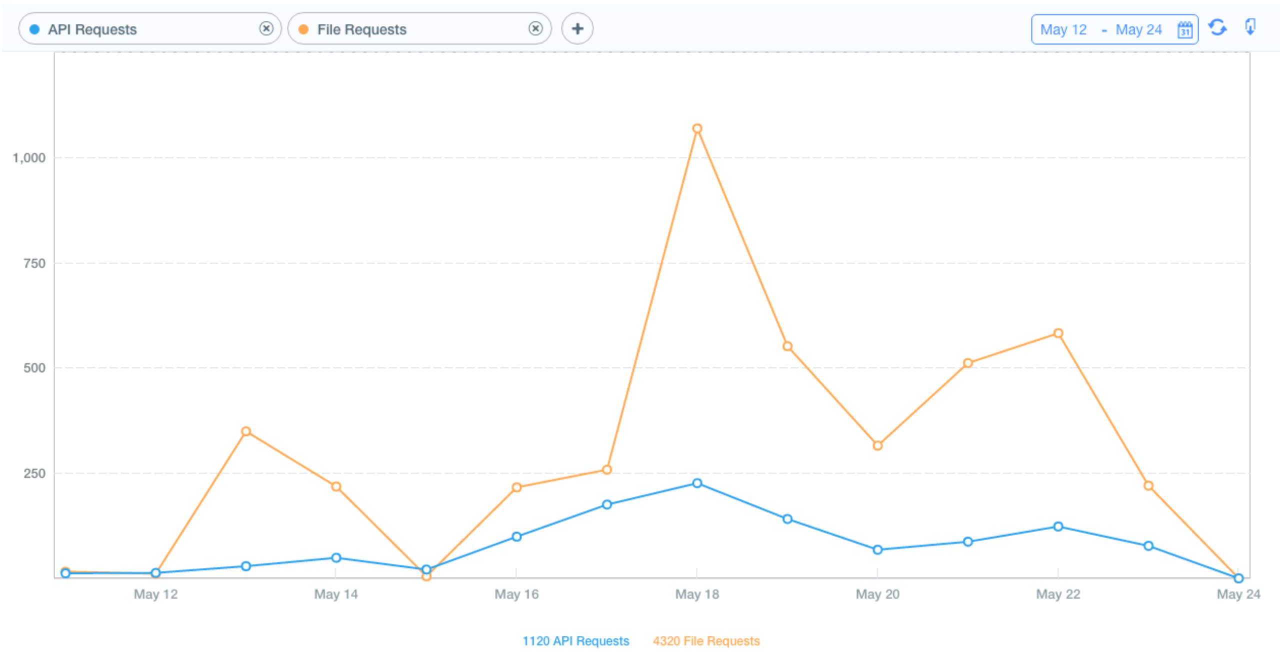


Figure 5. AirDB analytics server

CONCLUSIONS

It has to constantly invest in state-of-the-art technology because it develops and changes rapidly. AirDB is a project that is the result of years of market research and success. There are similar applications on the market, but not with the functionalities we have described in our work.

AirDB mobile application has reputed the very best of the following functionalities: side by side multiple models compare tool, interactive range map for multiple models, HD images, database and newsfeed updated daily, offline mode - data stored in local database and available without Internet connection, database updated first time when device is online, light data traffic, for all of devices - iPhone, iPad and iPod Touch, with one month subscription for database updates, Advanced Search,

Sort, Filter & Compare, Newsfeed to keep you informed of latest developments, Select favourite aircrafts for your fleet, Range map to remember last used position/location, Pull-down to refresh news/database in newsfeed screen.
New parameters in database structure:

- Operating Cost per flight hour
- Cabin Volume
- Payload with full-fuel
- Sea-level Cabin Altitude

The future research is focused in two directions. The first direction involves making an application on identical technology only with another database: helicopters, commercial and military aviation. The second one is based on cooperation with large homes that sell private jets and are interested in buying technology to save time for development.

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ONE APPROACH FOR TRACKING SPECIFIC PRODUCTION PROCESSES REALIZED AS A WEB APPLICATION

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Abstract: There is a variety of software tools for tracking the production process on the market. These tools are usually based on product marking and automated product tracking throughout the entire technological process. Particularly problematic are productions where it is not possible to mark the product and where it comes to dealing with specific production processes, unique elements and products of very small dimensions that are manually processed. In this paper, one software and hardware solution is proposed, which allows monitoring of individual data on workers, production by shifts and machine efficiency with these types of products. The proposed solution allows manual data entry in specially created user terminals, as well as a centralized form of monitoring and analysis of the received data.
Key words: production process, production tracking, web application

INTRODUCTION

Automation of technological processes is a very important factor in every form of mass production [1]. The concept of automation refers to a very wide spectrum of activities and can involve a better and more efficient preparation, realization, production process tracking and control of the final product [1], [2], [3]. Improvement of each step in the production process contributes to the optimization of final production costs and to a more competitive price of products, so it has a very significant impact, especially in the conditions of the market economy.
Different forms of automatic control contribute to very efficient improvements in the production process [3]. Sophisticated and computer-driven machines additionally provide a better scope for optimization and cost reduction [2], [4]. However, aside from improving all phases of the technological process of production, a very important role in real production processes has the tracking of technological processes. The tracking can be realized in different ways – starting from a human factor that monitors the process to complete automation and detection of each processed element [5]. With the development of a wide range of software tools and hardware solutions, it is becoming increasingly easier to adapt specific software solutions to specific production processes [2], [6].
There are a number of software solutions available on the market that enable tracking of the entire production process, generating reports, comparative analysis [7], and the like. Almost all of them are based on automatic recognition of the completion of certain phases of an object in the process of production. In order to automatically detect each of the objects observed, a number of different technical solutions are used, the most popular of which are different forms of NFC (Near Field Communication) and QR code. Almost all technologies of this type require a marking to be made on the object, that will follow the object through all subsequent stages of production [2], [6], [8].
However, when the objects are small, non-standard or unique, and when no type of identifier can be placed on them, existing software solutions cannot be used and the problem of tracking the process becomes quite complicated.
This paper is based on a specific software solution aimed at allowing the tracking of the production process, efficiency of workers and quality of the machines used in cases where hand-created elements, which are very small, could not be uniquely marked [6]. In addition, the production process is very specific and non-standard, so the use of all classic and high-quality software solutions for tracking the production process was impossible. To this end, a dedicated application was created, called Line monitor, which successfully implemented all the technical requirements and which can be used for similar specific production processes.

This paper presents one software and hardware solution for tracking and analyzing the performance of workers and machines in specific production conditions. The paper is organized in four chapters: After the introduction, the technical requirements that were required by the contractor were defined. The third chapter explains the architecture of the proposed solutions and the technologies used. In the fourth chapter, the realized application is presented in several characteristic phases of work in order to gain the impression of the quality of the proposed solution. At the end of the paper are given the conclusion and the list of the used literature with guidelines for further development of the proposed solution.

TECHNICAL REQUIREMENTS

The proposed solution was supposed to respond to the real requirements of an undertaking dealing with the specific production of jewelry parts. These products pass several stages of the production process within the observed factory and are realized in mechanical production but as unique elements.
In addition to monitoring the efficiency of the machine, its precision and usability, it is necessary to monitor the efficiency of the workers. A worker has a defined norm, but his expertise, the speed of work and the capabilities of the machine must be kept track of, so that any problems can be detected and resolved as soon as possible.
Since the products cannot be marked on the machine it is necessary to manually enter the data on each processed item after each production phase. In this way, the efficiency of the machine and the efficiency of the workers, the amount of waste and the number of processed elements are all being monitored.
As the data must be entered by workers, it is also necessary to create an appropriate hardware terminal. The entire system, client terminals and server applications, aims to record production statistics and measure the performance of workers and machines, the data of which are further used for analysis and creating reports. The application should provide the functionality of tracking individual data on workers, shift production and machine performance. As the users of the application are people of different levels of technical and IT knowledge, it is necessary to provide easy access to both the data entry terminals and the statistical analysis section. Due to the extreme variety of end devices and ways the data is accessed, it is very important that the server application can be accessed from several types of devices, and that the application can be used not only in the local network, but also that the system can be accessed over the Internet.
The system's settings should be able to provide flexibility in the administration of the production drive. The application should allow easy administration of users, workers and machines in the system, and should not require any changes to the application itself if the production volume changes.
Workers and the company management should be enabled to track their workstation's or production performances in real time.
All data from the system should be stored permanently in the database, which may be on the site itself or in a remote location. Also, for users of the application, it is necessary to export data from the database to EXCEL for further analysis, reports and graphs creation

ARCHITECTURE OF THE PROPOSED SOLUTION

In accordance with all defined technical conditions, the application should have: client and server part, database and client terminals. The presentation layer is decided to be in the form of a web application that uses HTML, Javascript and CSS and that can be displayed on a variety of user terminals [9]. The server part of the application was written for the .NET platform in ASP.NET MVC technology [10], [11]. Microsoft Sql server [12] was used as a database.
A three-layer architecture was chosen for the application. In order to improve the quality of the entire code, programming principles such as dependency injection, repository pattern, automapper, ORM and generics were used. All the tools, technologies and libraries used are free to use for non-commercial projects or small businesses, which significantly influenced the lower cost of the application and greater competitiveness on the market.
In order to reduce the need for administration of the entire system, the application was realized in such a way that it can be hosted in *cloud,* or some remote location, thereby reducing the need for the factory or workshop to take care of the stability and reliability of the system, servers, operating system and backup of the entire system.

The languages and technologies used are [9], [10], [11], [12]:

- .net Framework 4.5.2
- Asp.net MVC 5.2.3.0
- MS SQL server 2014 express
- HTML 5
- CSS 3

The development tools used for the server part of the application are:

- Microsoft Visual Studio 2015 community edition
- Microsoft SQL Server Management Studio
- Atlasian SourceTree for Versioning
- Atlasian Bitbucket repository for storing code versions

The following libraries were used to increase the performance of the entire system and its ease of use [13], [14]:

- EntityFramework 6.0.0.0
- Autfac 4.0.0.0
- Automapper 5.1.1.0
- Bootstrap 3
- Jquery
- Modernizr

As the application was supposed to enable the collection of data on the production process in production, the system was meant to describe the processes involving machines and people at a factory or a workshop. The requirement for superiors to administer machines, workers, final products and work tasks via desktop or mobile computers, and for workers to receive work tasks and machines they will operate, and have the ability to keep records of their work in the system through the terminals, has contributed to the choice of Web technology as the optimal solution for an application that meets the above requirements.

Analysis and planning identified two logical units to which the application is divided:

- Administration
- Terminal

The administration part is the command center of the whole application. This section controls user accounts, machines, workers, work tasks and products. This part of the application cannot be accessed without authentication. There are 2 types of accounts for accessing the application:

- Administrator
- User

The users have different levels of authorization in the system, depending on their account type, and the options are different for these two types of accounts. To create new accounts the user must be an administrator.

The system comes with one predefined user account that has administrator rights. In case of need, the administrator can use this account to create other accounts that may have different authorizations and who can further create new users, provided they have been assigned an administrator role.

Based on this proposition, the system can be graphically described with a structure of functionalities, as shown in Figure 1.

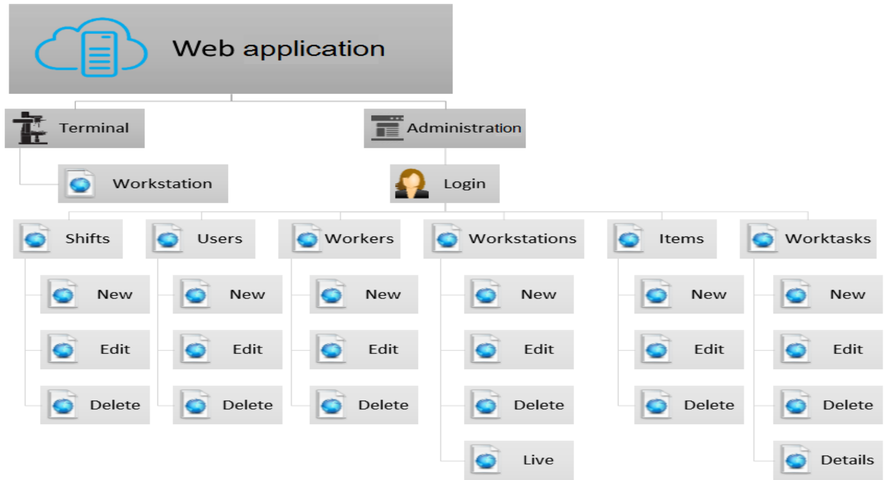


Figure 1. Organizational and functional diagram of the application

RESULTS AND DISCUSSION

In accordance with the defined requirements, a completed application was realized both on the client and server side. Login page is the first page that meets the user when entering the system having not previously been logged in. If the user had selected the option to remain logged-in in after logging in, this page will be skipped. Depending on the role of the user in the system, the navigation will be displayed differently. The navigation has one hierarchical level and the user easily navigates through the main modules. Choosing an option from the navigation will redirect the user to the desired module with display of all data for that module.

After user login, the first page that will open, and that is available for both roles, is the workstation list page. This page shows all machines in the production process, with basic data and options for setting new machines, editing or deleting the existing ones. Depending on the user's role, the options will be different.

The administrator has access to all of the options in the administrator view. He can create new workstations, change existing ones, delete and view details. To create a new workstation, the administrator should select the option "Create New". This will take him to the page with a form containing information fields for the machine. Editing machine information is always an option and will also take the user to a separate page with a form. The option to delete machines is only available for machines that have not been used, which is to say if a machine has been used before the page was opened, it will not be possible to delete it from the system. If the user wants to turn off a machine that has been used in the production, he needs to go to the edit page for that machine and uncheck the *Active* option. The *details* option takes the user to the page with current information about the events on the selected machine.

The *details* page shows the current state of the selected machine. The information screen is the same as the one the worker on the machine can see. This page can be accessed by all administrator users. If the machine is not active, i.e. it does not have any work tasks, a message that currently there are no work tasks for that machine will be written on the screen.

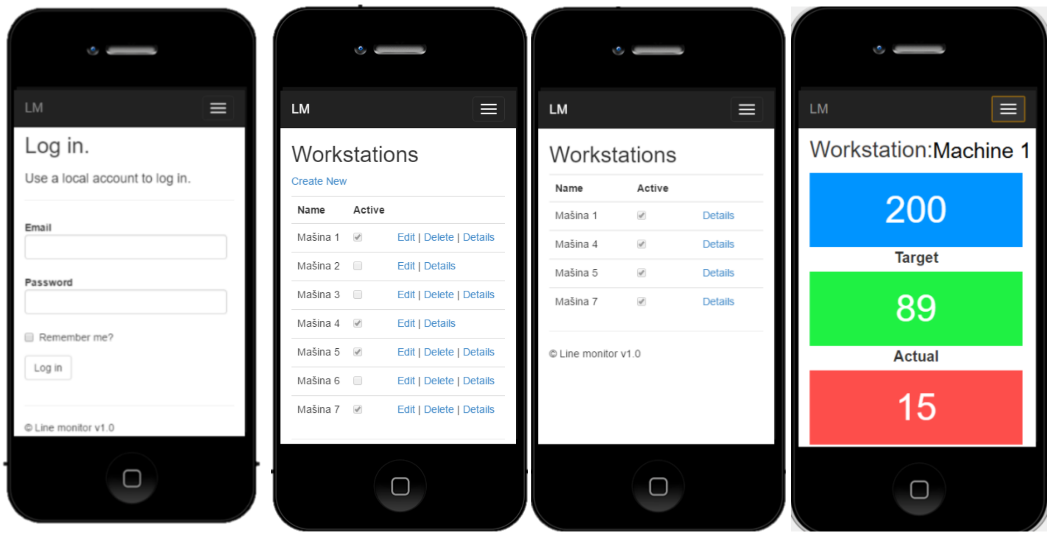
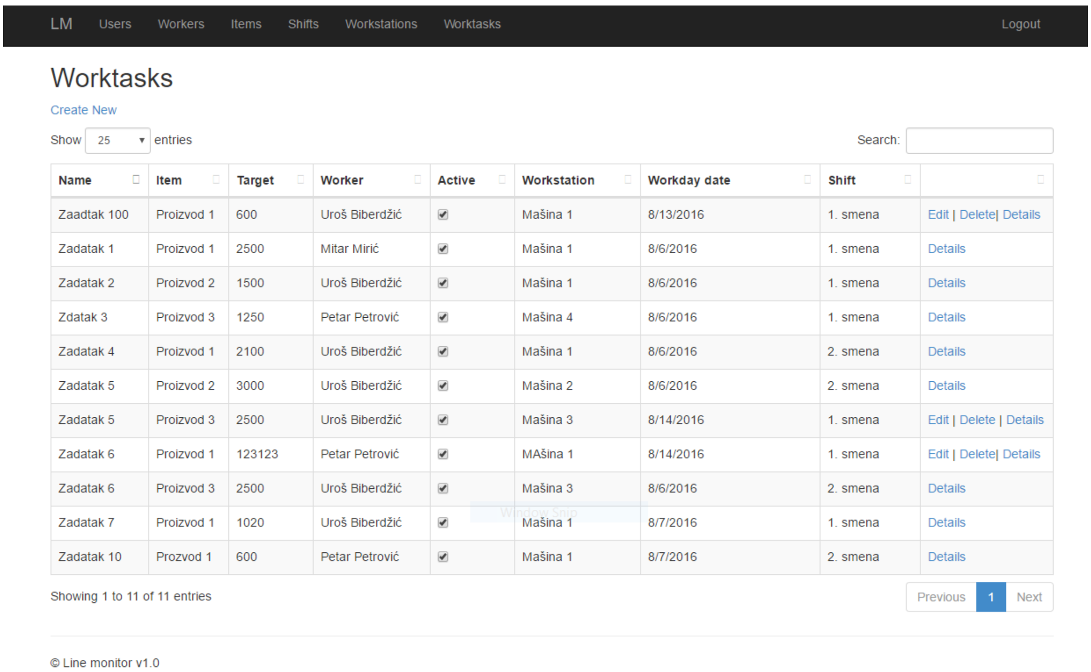


Figure 2. Displaying the login page on a mobile phone. Displaying available workstations on a mobile phone. Displaying the workstations page for administrators on a mobile phone. Displaying current information from a machine on a mobile phone.

All authorized users have access to the page that shows all work tasks. This page contains a table that allows easier search and overview of work tasks. The table was applied because of the possibility of a large amount of work tasks appearing in the system. Users can search the table by the value of any column and sort by any column. From this page the user can go to the page for creating new work tasks, edit and delete existing tasks that have not been put into use and view details for work tasks that were completed earlier.



Name	Item	Target	Worker	Active	Workstation	Workday date	Shift	
Zaadtak 100	Proizvod 1	600	Uroš Biberdžić	☑	Mašina 1	8/13/2016	1. smena	Edit | Delete| Details
Zadatak 1	Proizvod 1	2500	Mitar Mirić	☑	Mašina 1	8/6/2016	1. smena	Details
Zadatak 2	Proizvod 2	1500	Uroš Biberdžić	☑	Mašina 1	8/6/2016	1. smena	Details
Zdatak 3	Proizvod 3	1250	Petar Petrović	☑	Mašina 4	8/6/2016	1. smena	Details
Zadatak 4	Proizvod 1	2100	Uroš Biberdžić	☑	Mašina 1	8/6/2016	2. smena	Details
Zadatak 5	Proizvod 2	3000	Uroš Biberdžić	☑	Mašina 2	8/6/2016	2. smena	Details
Zadatak 5	Proizvod 3	2500	Uroš Biberdžić	☑	Mašina 3	8/14/2016	1. smena	Edit | Delete | Details
Zadatak 6	Proizvod 1	123123	Petar Petrović	☑	MAšina 1	8/14/2016	1. smena	Edit | Delete| Details
Zadatak 6	Proizvod 3	2500	Uroš Biberdžić	☑	Mašina 3	8/6/2016	2. smena	Details
Zadatak 7	Proizvod 1	1020	Uroš Biberdžić	☑	Mašina 1	8/7/2016	1. smena	Details
Zadatak 10	Prozvod 1	600	Petar Petrović	☑	Mašina 1	8/7/2016	2. smena	Details

Figure 3. The all work tasks display page on a desktop

Terminal is a part of the application that is displayed to the worker who works on the machine in the production. This part of the application can be accessed from various devices.

Because of the limited paper extent, the realization and possibilities of the terminal were not discussed, as well as various other additional features of the application that are in accordance with the defined requirements.

CONCLUSION

In any production process it is of great importance to record and keep track of production statistics. In large automated systems the machines come with these functionalities. In semi-automated systems or manufactures these data are not recorded and there is less possibility for further planning or forecasting possible problems. An application like Line Monitor solves this problem and allows smaller factories or workshops to have control and data over their production.

The web technology used by the application also allows, in this modern age of mobile devices and mobility, the system to be accessed in various ways. The application provides connectivity to the Cloud technologies, which can greatly facilitate the installation and maintenance of the monitoring and management system.

Further plans for the development of the application are focused on its adaptation for a greater range of different technological processes and different production approaches.

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THE BENEFITS OF APPLICATION OF CAD/CAE TECHNOLOGY IN THE DEVELOPMENT OF VEHICLES IN THE AUTOMOTIVE INDUSTRY

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Abstract: The development of various software packages enables easier and faster designing and development of the existing systems in the automotive and other industres. CAD technology tests allow faster and much economical designing of different parts and systems in vehicles. With this technology, it is possible to speed up the process of designing and making of the most complicated systems and parts in the vehicle without additional experiments. However, the problem arises with designing parts and systems that do not have a sufficiently developed field of theoretical assumptions. This paper presents different applications on specific complex systems and parts of vehicles and each of them has been given the importance in the research.
Keywords: Vehicles, design, development, CAD, CAE.

INTRODUCTION

The development of automotive industry and its products requires a set of challenging and elaborate researches and series of complex experiments. With the development of technology, many software solutions have been created that facilitate and enable faster testing of certain parts and assemblies in vehicles. The use of these software solutions is diverse, and in the automotive industry they have various applications, e.g. determining the load of individual parts or assemblies, examination of a vehicle's design etc. This paper shows the application and importance of CAD technology in this industry, and its advantages in relation to some real experiments.

Even in the earliest age of computer technology, graphic simulation has proven to accelerate all engineering and design processes for several hundred times in relation to "manual" design, and to speed up production of various documents and, consequently, the research. The development has led to creation of a model and research of three-dimensional interpretation. All the technologies rely on the principles of mathematical sciences, descriptive geometry, informatics and applied electronics. ISO standards define computer graphics as a set of methods and techniques for converting data that are sent to or from the graphic display, via computer. Some of the most famous CAD technological processes are CATIA, SolidWorks, AutoCAD, ProENGINEER.

Nowadays, the development of software in the automotive industry and industry in general goes mainly into three directions – design, engineering and production. CAD (Computer-aided design) is the use of computer systems to help in the creation, modification, analysis, or optimization of a design. Computer-aided engineering (CAE) is a widespread use of computer software to help in engineering analysis tasks. It includes finite element analysis (FEA), computational fluid dynamics (CFD), multibody dynamics (MBD), and optimization. Software solutions used for production purposes are CAM (Computer-aided manufacturing) technologies. In this paper, we will carry out the analysis of benefits of only CAE and CAD technologies in the process of development itself, which represents the very purpose of this paper; as well as the advantages they have in designing and developing the vehicle in relation to experimental methods. One of the main advantages of technologies is faster testing of the development of some parts or the entire vehicle, the reduction of cost of experiments and development (the easier way of checking the weaknesses and disadvantages of a part), and the acceleration of the process of creating technical documentation. The use of technologes has allowed manufacturers to reduce the cost and product development time, and to improve safety, comfort and durability of the vehicles they manufacture.

GENERAL IMPORTANCE OF THE PHASES OF A VEHICLE DEVELOPMENT

By observing all the phases of the development of one vehicle, and all the products in its life cycle, as can be seen in Figure 1, it can be noticed that there are different tests in all phases of the life cycle and, consequently, different studies. These researches and tests are highly complex and elaborate, therefore, the application of CAD/CAE is of great benefit and importance due to its advantages in relation to the real experiments that would be carried out. Today, the so-called virtual laboratories are developed, and they greatly reduce the cost of testing and the time necessary for researches. Virtual laboratories represent an innovation in the use of information technology for the purpose of education. They represent a unique link between the laboratory test desk from the past and the experiments of the future. With the use of existing databases, the latest electrical equipment is available from any place at any time. In this phase, the exactness of technical documentation is of great importance, thus, CAD technology is used for the making of accurate and precise technical documentation.
The next type of vehicle testing is testing of new innovations, which implies possible changes to already existing systems, in this case, on vehicles. The tests regarding the mentioned changes are completed with the help of CAE technologies. With this technology, the characteristics of such an altered system with all these innovations can be freely determined. Such testing, or a research, represents an option that in relation to some physical researches enables the development and testing of these examinations with many changes and possibilities it has provided.
When using a products, in this case a vehicle, its reliability is of great importance – CAE technology allows us to accurately determine the reliability of each vehicle system, even after a longer period of its being used.

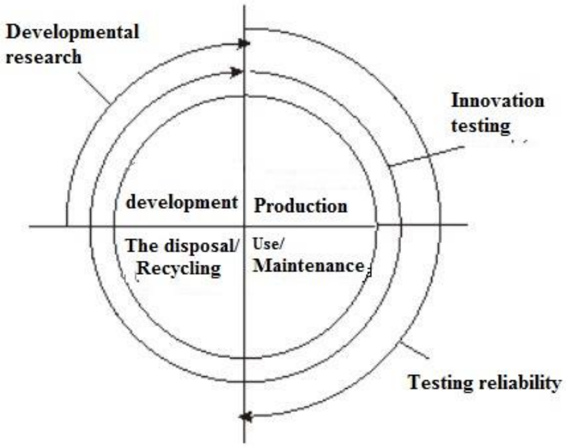

Figure 1. An overview of tests and researches in the product's (vehicle's) life cycle

Comparison of virtual and physical experiments

Testing was an important part of product development in the past. The weaknesses of a design could be detected by testing before the product came into the customer's hands. However, the ability to carry out a thorough analysis of many aspects of a design using the computer-assisted engineering (CAE) tools has reached the point where "virtual" product development can be considered to be a realistic proposal. Virtual experiments have certain advantages, namely the ability to control the experiment, the repeatability of performance and results, the ability to perform accelerated tests, the safety of the experiment implementation, the ability to simulate real conditions, the ability to optimize the implementation of the experiment, the specific experiment implementation plan. The development of a new product is one of the most powerful and most difficult activities in the industry.
In addition to the mentioned advantages, the use of technologies considerably reduces the cost of testing and the reseach. The security is very important, as well as the repeatability of the experiment, because some researches can be extremely expensive; therefore physical testing can be carried once, and with CAE technology it can be repeated.

Cases when it is not possible to apply CAD/CAE technologies

Despite the development of the existing technologies, there are cases when it is not possible to apply modern technology in the development and research of some systems, or in the automotive industry in the development of certain systems in the vehicle.
The reason for this is that certain theories or some phenomena have not been sufficiently explored, thus simulations cannot be properly or at all completed. There are also simulations that are extremely difficult because it is hard to simulate some physical phenomena, therefore the software is not sufficiently developed. For example, the analysis of the fatigue of the hot exhaust system is currently extremely difficult for simulation (due to uncertainties about the properties of the material, the crack propagation at elevated temperatures, the influence of the geometry of the welds and the change in the properties of the material at elevated temperature), but it is relatively easy to set the exhaust system to the engine and perform a test in order to determine whether the exhaust system will develop cracks. Such systems are often better developed using traditional physical testing. Also, if the working conditions are not specified, then it is very difficult to have confidence in the results of the virtual experiment.

APPLICATION OF CAD/CAE TECHNOLOGY IN DESIGNING A VEHICLE

Advanced technologies have a major role in designing vehicles in the automotive industry because it is possible to accurately model the desired shape of a vehicle. With the use of these technologies we have an overview in the design phase, because creating 3D parts in the space provides an ideal insight into geometry, keeping in mind that the body of the vehicle itself has a large number of parts, the defined elements are easily grouped into assemblies and sub-assemblies. With the help of technologies the creation of vehicle's appearance is accelerated, it is possible to create desired view at the drawing, the expenses of probing the body of the car are reduced, the co-operation of co-workers is simplified etc. These models are significant because they allow the comparison of the quality of all parts of a vehicle. The design phase itself is not so simple – there are several phases that have to be completed and these technologies allow all this to be done virtually, which is much simpler and cheaper. Figure 2 shows the stages in the designing of a vehicle.

Figure 2. An overview of a vehicle design development, [2]

Benefits of CAD/CAE technology when analyzing vehicle's design

Not only is CAD technology important in designing vehicles, but its role is substantial in testing of a design, that is, it simplifies the testing of a known design. The importance of aerodynamics, the flow of air over the surface of a vehicle is very well known. Air resistance plays a very important role in all resistances, therefore it is a priority to maximize the aerodynamics of a vehicle.
With the help of these technologies it can be accurately determined which points on the vehicle are critical, and certain parts of a vehicle can be reconstructed if there is a suspicion that air spinning is increased. The use in these cases is very important because it is possible to reconstruct the design of a vehicle without expensive aerotunels and without the prototype, which greatly reduces the cost, and

consequently lack of prototype saves time in the vehicle development. Figure 3 shows the look of a test using one of the technologies.

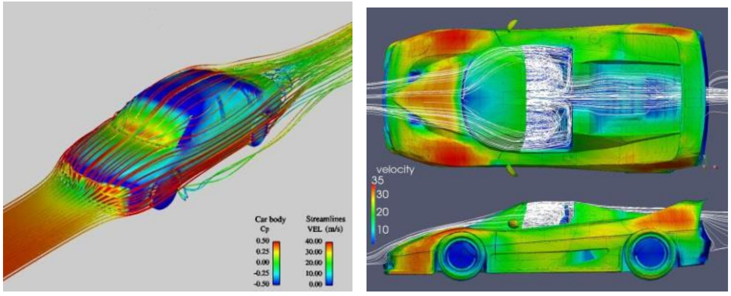

Figure 3. A demonstration of a vehicle’s aerodynamic testing, [3]

CAE technology has also been used in the simulation of crash tests or in vehicle’s body safety checks. These tests are very expensive and require specialized testing centers. In addition to rigorous and precise testing requirements, as well as prototypes of vehicles being tested, CAE technology produces precise results of vehicle deformation during testing, which is very useful and is possible to perform corrections to the virtual model of the vehicle with reduced cost of testing and time saving. Figure 4 shows an example of this test.

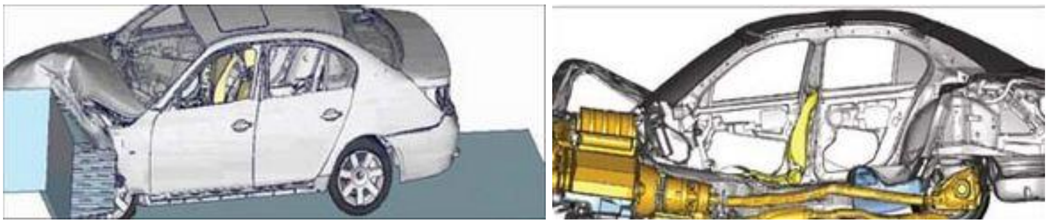

Figure 4. Safety test of the body of a vehicle, [4]

APPLICATION OF CAD/CAE TECHNOLOGY TO CHECK VEHICLE’S ERGONOMIC CHARACTERISTICS

Ergonomic characteristics of vehicles are significant for the reduction of fatigue and facilitation of car driving. One of the software that is developed according to the principles of CAE technology is RAMSIS. RAMSIS is the world-leading 3D-CAD-ergonomics tool, designed in cooperation with the German automobile industry for the ergonomic development of vehicles and cockpits. Ergonomics is increasingly seen as a quality factor by the customer and it is becoming a significant differentiation criteria. RAMSIS is the world's leading CAD tool for the ergonomics design and analysis of vehicle’s interior design and analysis of vehicle interior and working places and is used by 70% of the automobile manufacturers [5]. This software package allows you to check the ergonomic characteristics of the vehicle, or the comfort of the driver or other passengers in vehicles. RAMSIS is not only available to the user as a pure CAD application (eg integrated into CATIA or as stand-alone version) - as RAMSIS and VR, this ergonomics system can also be used for extensive real-time tests in virtual reality laboratories of automotive manufacturers. Figure 5 shows the example of a driver in the vehicle and one of the possible analysis of the driver's comfort at a particular driver's position in the vehicle.

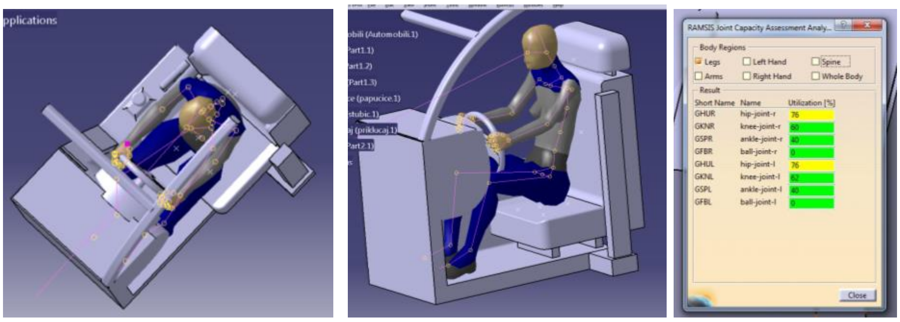

Figure 5. The analysis of the driver's comfort in the vehicle and the analysis in the CAE software

Significance of CAE technology in examining the elements of passive interior safety

Bearing in mind the previously mentioned concern regarding the ergonomics of the vehicle, which in this case concerns the interior of the vehicle, the application of CAE technology is very important in the examination of the operation of individual elements of passive safety, such as an airbag, which, in the case of a traffic accident, should prevent the driver from hitting the steering wheel or other element of the interior. Figure 6 shows an example of an analysis of driver's impact in the airbag. This application is very important in the analysis of the position and shape of the airbag, because it replaces long-term and highly complex physical work about driver’s impacts in the airbag, as well as analysis of the shape and position of the impact, baring in mind that passengers can be found in different positions in a traffic accident.

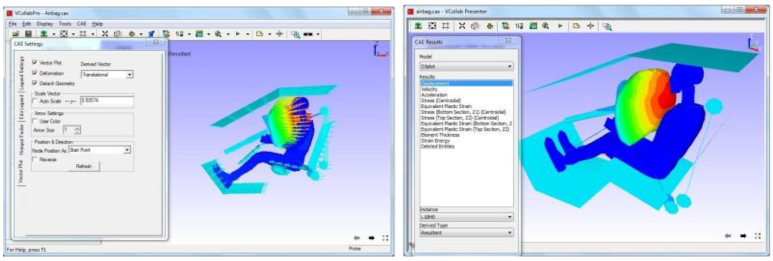

Figure 6. A demonstration of the analysis of driver's impact in the air bag by using CAE technology, [6]

The importance of CAE technology in testing the performance and efficiency of certain systems in vehicle

In addition to benefits of all previously shown elements regarding ergonomics of the vehicle, CAE technology also enables the display of the flow of certain fluids through the various systems on the vehicle. CAE technology is used for testing air conditioning system (AC). Figure 7 shows a simulation of the operation and flow of air using this technology. With CAE, the flow of air in the vehicle is accurately determined as well as the impact on air temperatures in different vehicle zones. CAE simplifies tests of the validity of the operation of this system without complex experiments or expensive equipment. It is also possible to complete a simulation of cooling down of the engine or the air flow in the engine compartment.

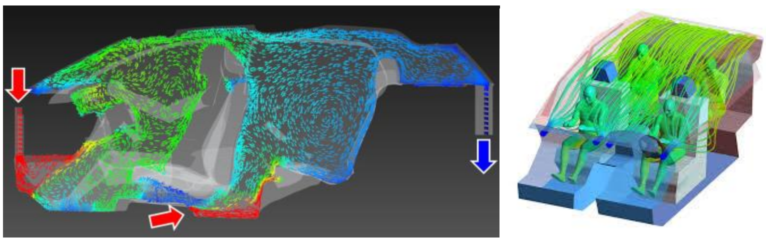

Figure 7. Demonstration of air flow simulation using CAE technology, [7]

THE IMPORTANCE OF CAD/CAE APPLICATION WHILE PROJECTING VEHICLE'S PROPULSION UNIT

Nowadays, the process of designing and manufacturing internal combustion engines (ICE) cannot begin without an adequate verification of the idea which is the first and most important stage in this business. Modern motors are mostly made by improving the existing ones, that is, by modernizing older solutions using software tools. Captured parameters are put into the appropriate software that through a complex mathematical model mimics complex physical and chemical processes in the engine. When such constructed engine is put into propulsion, the parameters of the monocylinder operation (engine indication) are collected, on which basis a mathematical model is developed and is further processed on the computer. Mathematical models of the engine are made based on the laws of thermodynamics, fluid mechanics, chemical kinetics and other sciences. Depending on the type of engine on which it is operated (two-stroke, four-stroke, slow-moving, high-speed, diesel, otto-engine, etc.), the appropriate software is selected to mimic the given engine. Having in mind that most of the processes and phenomena in the engine can be modeled and calculated using a computer, that motor parts can be "made" on the computer and that the engine itself, ie, its assemblies and subassemblies can be successfully simulated on the computer, we come to the concept of "virtual" engine. It means that the engine can be engineered, simulated, and tested on a computer before making the real prototype and testing it. The programs display the gas temperature during the operation of the virtual engine, as well as the temperature assumptions that certain mechanical parts of the engine are subjected to. Thus, the constructor is able to monitor the flow of temperature, pressure and flow rate of gas, and to optimize it with various interventions on the virtual engine. After the thermodynamic calculation and the first modeling stage provide the approximate dimensions and shapes of the motor parts, thorough examination is performed on several types of strains, which during the modeling give an insight about overloads and possible distruction of elements. Finite Element Methods (FEMs) are used today. On the basis of these calculations, computers perform complicated analyzes, solve problems straight away and allow easy change of engine performance parameters, saving both time and money.

CONCLUSION

Nowadays, product development is a very complex process because modern products are more elaborate since there is a demand to maximize efficiency with minimal consumption of certain means. The development in the automotive industry follows this trend, given the characteristics of today's vehicles. There are several stages in which it is possible to develop them.

The use of various modern software such as CAD and CAE technology, enables us to perform various researches very effectively and efficiently, and it is possible to test different modifications in order to improve the characteristics and develop them. The benefit of these systems is that they enable faster and cheaper research and development of the vehicle. The adoption of this technology allows better communication between all members of the vehicle development team, because each problem can be graphically displayed, better production of technical documentation, possible repetition of each simulation or research with the possibility to change the model itself, at minimal cost, the posibility to test one vehicle or its elements several times under different conditions, it is not necessary to create a prototype for testing, it eliminates the need for expensive test equipment, allows designers to inspect all faults on a vehicle or system, ...

Compared to physical experiments, which are carried out in real conditions and environment, the virtual experiments may have certain disadvantages, however, they are quite developed and can simulate real conditions, and they will continue to develop and eliminate their drawbacks.

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Session 6.

Student papers

THE IMPORTANCE OF AUTOMATED SYSTEMS IN THE CUTTING PROCESS

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Abstract: The focus of this paper is on the theme regarding a modernization of technical systems and their components. The authors have paid a special attention on the importance of the modern automated CNC systems and their impact on the manufacturing process, viewed from several aspects. Some of these aspects are - time aspect, mass production and the product quality. 21st century demands an extremely fast production, mass production, which can be achieved only by a total system automation, the introduction of software packages and their application of the existing machines. A work principle is nearly identical but the speed is considerably increased. The best part is the fact that besides the increased speed a satisfying quality of product is achieved as well. One of the novelties brought by new technologies is the control of production, which means that reject is minimized - this in fact represents TQM or Japanese aspiration to perfect production.
Key words: automation, CNC systems, TQM, quality.

INTRODUCTION

Modern times require fast changes in every field of work. The implementation of modern technologies is spreading to all corners of life, it enters all industrial processes and production technologies. Electronics started its expansion at the end of 20th century while the automation of systems increased its influence at the beginning of 21st century. Speaking on mechanical engineering as a science, it can be observed from two sections, one from the aspect of mechanical systems and the other from the perspective of automated systems. Modern society sets quality as its strategic aim and also a competitive priority in providing cusomer satisfaction. Namely, it is crucial to achieve a balance regarding all interested parties, consumers and producers, service providers and users of different types, but above all intellectual ones. The process of transforming needs and desires of various users into a final product or a service could be named a quality cycles [1].
Under the technological process of mechanical processing – removal of metal shavings - it is implied systematically gradual transformation of a raw piece into a final mechanical part – a product of a defined shape, dimensions and quality [2][12].
Mechanics as a base of mechanical engineering slowly goes to history, in other words, old systems and ways of work within the production system are being exchanged for some new systems which are aided by appropriate installed softwares. The principle of work regarding new technologies in its essence is not much different from the basic mechanical mechanisms, more precisely, the principle is pretty much the same, but the automation improves the system's work from the aspect of reducing errors, increasing quality and speed of production. Precise sciences like mechanical engineering need this type of improved technology so a process of long preparation of production could be minimized, regarding time. Classical processing methods are pretty limited in cases of making a product of complex geometry. The answer to these requirements can be a technology of fast production of prototypes [3].
CNC (**Computer Numerical Control**) technologies have been widely implemented in big industrial plants and their development in our region dates back in 1990, while during the first decade of the 21st century this type of technology became the necessary part of every production program which dealt with mass production. In the field of metal processing by cutting as well as in general part of processing by cutting, CNC softwares are most implemented in lathes and grinders.

CLASSICAL SYSTEMS OF PROCESSING BY CUTTING

Processing technology studies the procedures of making and processing (forming) mechanical parts in a desired shape and dimensions of semifinished products obtained by casting, forging, rolling and similar. Simply said it includes the issue of producing and forming the finished parts.
Depending on the basic principles of removing the surplus of material and forming the main parts (by using mechanical or other types of energy),processing technologies are classified into:

1. Technologies of mechanical processing, and
2. Unconventional processing procedures [4].

Metal processing by cutting is a procedure of forming, done by removing the surplus of material mechanically, by tools, frequently more solid than the solidity of the material which is being processed. The best known procedures of metal processing by cutting are:

1. Scraping,
2. Milling,
3. Drilling [4].

Processing methods by cutting include scraping, milling and as an additional procedure, drilling.
Figure 1. Processing by cutting – classical systems, lathe and grinder [5];[6].

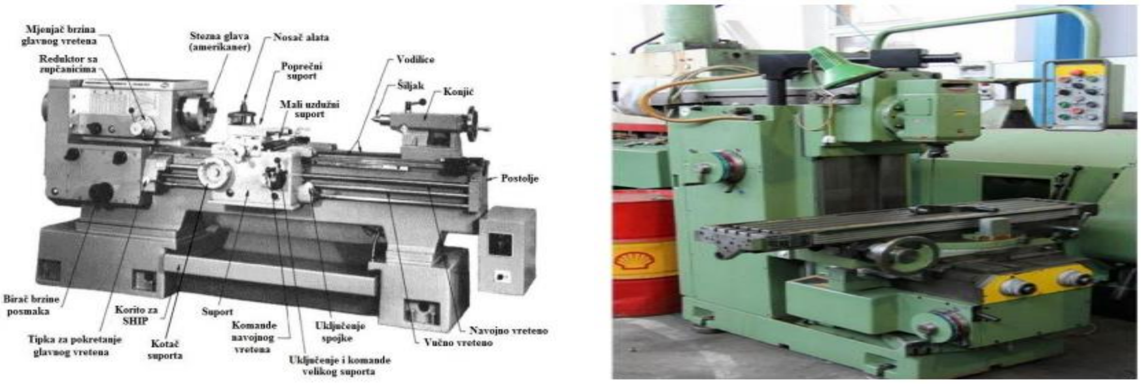

Figure 1. Universal lathe and grinder

A presentation of classical systems for processing by cutting, a universal lathe and a vertical grinder give a clear picture of the dimensions of these machines. One of the main parameters that has to be followed at processing by cutting is the quality of the surface or roughness. Figure 2**.** shows a surface roughness after processing by cutting [5].

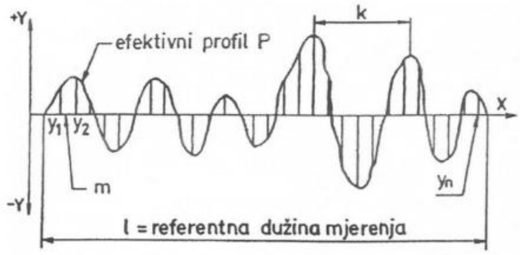

Figure 2. Presentation of the surface roughness after processing

AUTOMATION OF PRODUCTION SYSTEMS

Market requirements set numerous questions to modern companies. A way out seems to be in the integration of business activities (information and processes). This integration has been enabled by a fast development of Information Technologies in the last several years. The aims of CIM organization originate from the basic aims of the company and in recent years the most dominating aims have been: increase of flexibility, quality and productivity. The biggest impact on the increase of productivity has technological development. In the modern world this type of a system is called Flexible Production

System (FPS), and it serves for the production of different elements in mass quantities. The main ptoduction aims are, on one hand, minimization of intermediate stocks, delay, and time flow and on the other hand, maximization of the volume of production [7].
Figure 3. Schematic diagram of the production system flexibility

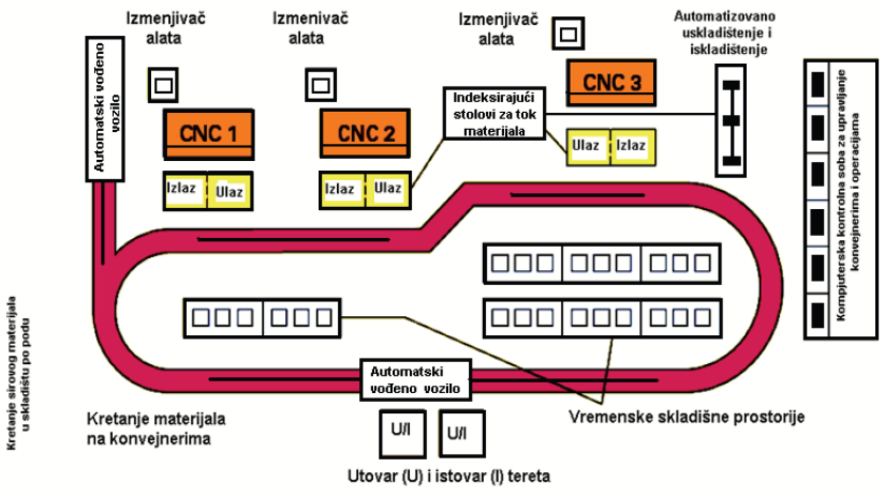

Figure 3. Flexible production system [8]

IMPLEMENTATION OF AUTOMATED CNC SYSTEMS IN PROCESSING

CNC automated systems belong to computer integrated systems (CIM). As said before, scraping and milling are the main types of processing by cutting. Unlike scraping, the advantage of a milling cutter is in the fact that it represents a three-axis system which enables moving of the tools together with a workpiece, therefore, the very process of cutting is performed in three-axis system. CNC system was in mid-eighties applied on mechanical machines for the first time, on a milling cutter as well, and it was so efficient that even nowadays, in the 21st century, the system of computer aided milling cutters is still developing. Figure 4. shows information flow at processing on the automated CNC systems [9].

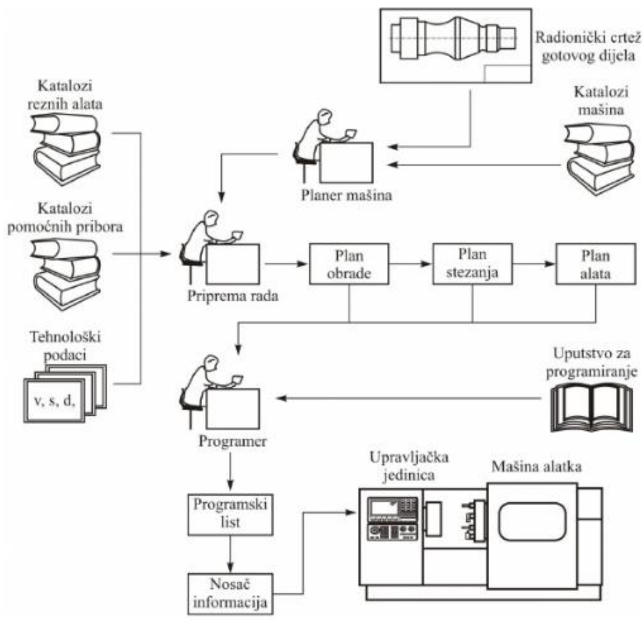

Figure 4. Processing on CNC machines

Figure 5. shows time saving by the application of CNC machines during the processing by cutting [10].

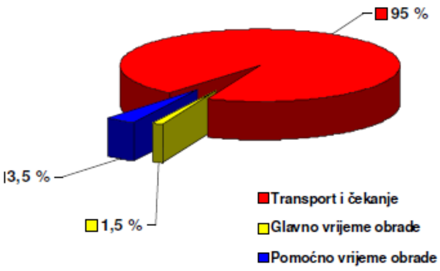

Figure 5. Time savings during the processing on CNC machines

According to the diagram in Figure 4, out of total production time of an item on CNC machine, 95% is spent on transport and waiting time in the preparatory phase of processing, while 3.5% of production time represents an auxiliary processing time used for precise processing. Only 1.5% of total time is spent on the main processing phase which has the biggest contribution to the production of an item or a part of an item on the machine.

IMPLEMENTATION OF EMCO COMPACT 5 CNC

EMCO COMPACT 5 CNC represents a generation of modern lathes, computer operated, so they belong to one of the first generations on which these systems are implemented. Figure 6. shows the processing of an axis on CNC lathe.

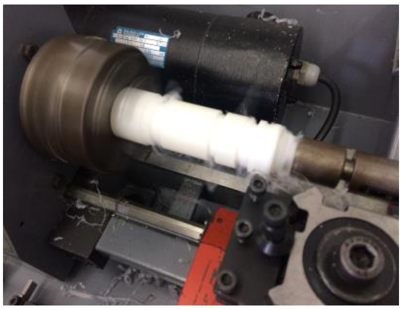

Figure 6. Processing of an axis on CNC lathe

Figure 7. shows a final product produced on CNC lathe.

Figure 7. Axis

CONCLUSION

The aim of this paper is to present a global impact of automated systems on the technologies in the cutting process. Modern Flexible Systems represent a basis of every successful automation. On the other hand, a human is the most important factor of integrated systems. Nowadays, in the 21st century, the world and European markets require fast production, quality and punctuality, and all of this should be united in order to make a good product which will satisfy modern customers. By accepting the concept of advanced and flexible production systems, a company can, along with other advantages, give optimum services to its customers and also minimize costs and earn profit. Besides paying attention to customers and the market, it is necessary to observe how products are made and how complex the production is. Traditional production technologies were exceptionaly reliable but mass production on these systems was almost impossible, in other words, it was time and volume limited.
To conclude, it ought to be stressed that flexible automated systems contribute to enlargement of production by means of reducing processing time, from the start till a final control of output, accompanied by high quality which make products competitive on the market.

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THE ROLE OF THE CAD/CAM SYSTEM IN THE PRODUCTION PROCESS

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Abstract: The paper deals with the implementation of software tools in machine parts and elements design. Information society has accelerated the development of technology, especially in the sphere of technical systems computerizing. This notion can be also called system automation, but when speaking about mechanical engineering project, the most frequent application of IT can be found in tools for modeling technical elements, sometimes even the whole systems, simulation of their functioning and testing of the modeled elements before their application in the real systems. The aforementioned aspects represent, in fact, the greatest advantage of modern technologies. A possibility to test the modeled elements enables the reduction of errors in the process of design and production of these elements. In this way, a quality of production is increased, the costs reduced and there are fewer delays. One of these advantages is also easier design, faster making of 2D models, a possibility of 3D model making, which in great extent helps technicians to make the imagined elements because they can rely on a clear picture of 2D models in 3D environment. One of the best known and most applicable software tools belongs to CAD program, AutoCAD.
Key words: software tools, automation, design, 2D model, 3D environment, Auto CAD.

INTRODUCTION

The development of modern Information Technologies in the first decade of the 21st century reached a high level and also initiated a development of other technologies in different industrial branches. One of the first segments which felt this development by an indirect impact of IT was electronics. Electronics is nowadays a consisting part of all industrial branches, going from mechanical engineering, through electrical engineering to civil building. The development of IT and their influence on industrial processes in the field of mechanical engineering is mostly reflected in the system automation itself, robotics and the implementation of software tools in project mechanical engineering. It is well known that designers have used computers for their calculations for a long time. The first results were obtained in 1960 in avio and car industry in the fields of 3D surface modeling and NC programming. In the modern Information era a need for the development of new technologies in different industrial branches appeared. For a meaningful introduction of modern concepts in design, such as in simultaneous or competitive engineering, the assumption is to give a designer in an early phase all possibilities and requirements for a new product production [1]. Modern production cannot be imagined without the use of modern tools such as program packages for 3D design and also the devices for fast production of prototypes. Computer aided production is named in short CAD/CAM systems.

The technology which stands behind the short terms CAD and CAM was still known in 1965. The first one stands for (CAD) Computer-Aided Drafting or Computer-Aided Design and the second for (CAM) Computer-Aided Manufacturing. CAD involves all tasks included in the process of creating data about a product, such as technological plans, listing of product parts and graphic models of a product. CAM implies the making of technological and management data in the production such as: processing technology, tightening plans, lists of tools and processing parameters, creation and validation of NC program [2].

Design making by application of 2D technology is becoming history because the use of 3D models is dominating. The use of 3D modeling in design considerably improves the quality of design, first of all because it is a more complete procedure than 2D. As a result, many human errors present in 2D design can be avoided here [3].

THE IMPLEMENTATION OF AUTOCAD IN MAKING THE PARTS OF A TECHNICAL SYSTEM

Today’s production and the sector for design and construction cannot be imagined without the use of software tools for modeling and design. The most popular software is AutoCAD, because it can be used in different professions and also because of its special tools and additional modules which are used in calculations and drawing. The most significant modules used in AutoCAD environment are best for: design and construction in mechanical engineering, construction of mechanical profiles, drawing spatial and isometric projections (three-dimensional - 3D) based on orthogonal (two-dimensional - 2D), parameter design of standard machine elements, creating database for standard machine elements, kinematic analysis of machine elements and mechanisms, designing tools for casting, etc.
Nowadays, the production process begins and ends by implementing IT, in other words, from the very design of parts to a final control of a product. In Figure 1., there is a schematic diagram of a modern production system.

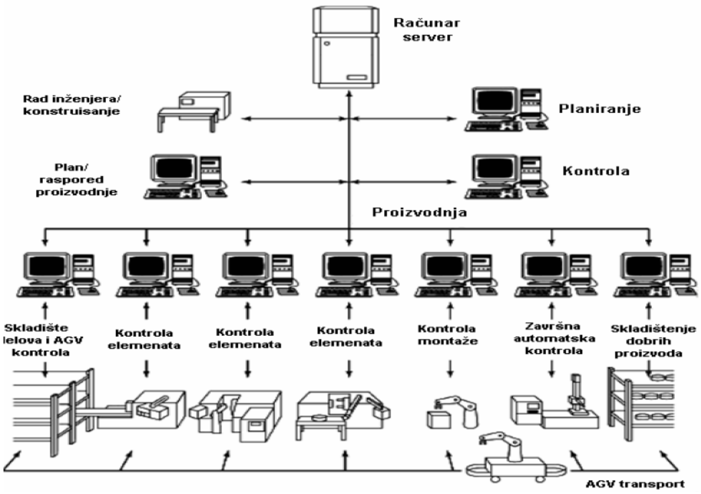

Figure 1. Schematic diagram of a production system

When speaking about a concrete application of AutoCAD software it should be said that it is most often used in making of 2D model, technical drawings and 2D models in three-dimensional (3D) environment. From the aspect of complexity and time, AutoCAD makes the production easier to engineers in the part of design because due to its software options the making of a model is shorter and less complex in comparison to hand-mechanical drawing of a model. Besides these advantages, 3D modeling additionally makes a model making easier because it gives a real picture of 2D model in the environment.
At designing 2D model in AutoCAD environment it is necessary to set some basic steps in order to understand the work technically:

1. Setting a Layer (selection of lines according to technical rules),
2. Drawing 2D model (technical drawing with elevations),
3. Modeling in 3D environment (UCS palette, assigning material, etc....)[4][5].

In Figure 2. a selection of Layer for making 2D model is shown..

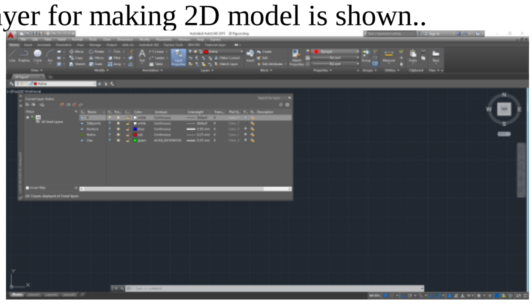

Figure 2. Selection of Layer

Figure 3. presents a making of 2D model in the form of a technical drawing

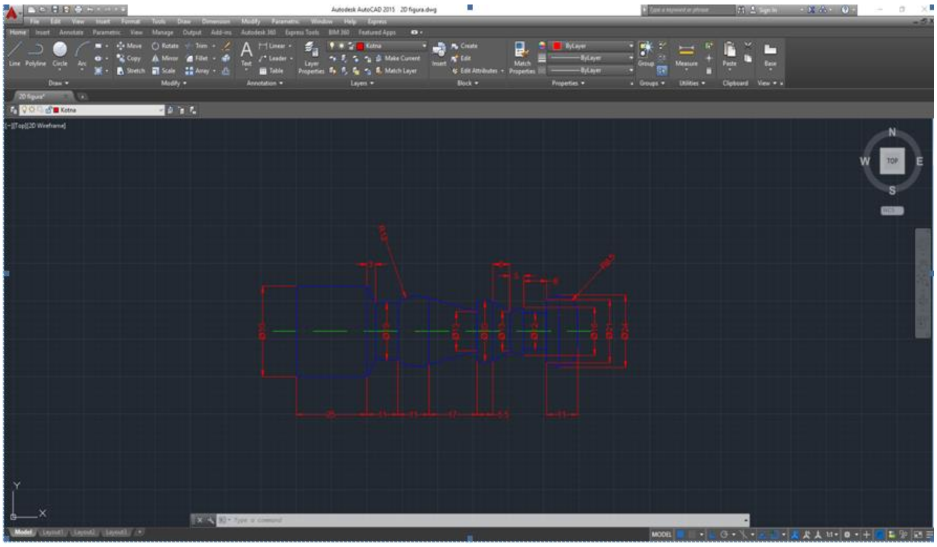

Figure 3. 2D model making

In Figure 3 there is a complete 2D model with contour lines, angular lines and axle lines which are according to their specific characteristics created in Layers.

After finishing 2D model, 3D model is created. A function Revolve is used for modeling a concrete model. It is necessary to make Region if we want the function Revolve to be feasible. Then we have to determine the axle around which a finished 3D model will be made by the function Revolve. Since lighting is included, see Figure 4, there is a need to put a pad under the object with a function Box. For lighting, an option Point Light is used with 4 sources of light set at 4 positions in order to present 3D model as better as possible. After determining lights positions, Render of a model is made in order to present a model in real environment. In this case, the pad is given the appearance of wood and the object looks as if it is made of PVC material.

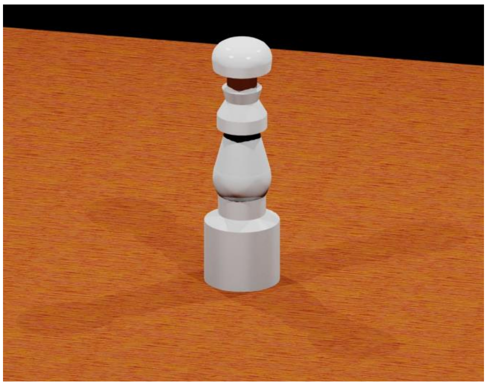

Figure 4. Presentation of 2D model in 3D environment

THE ROLE OF SOLIDWORKS IN DESIGN

SolidWorks is state of the art technology in CAD software. The program SolidWorks represents the objects in virtual environment, imitating the reality, so the objects have volume, surface, edges…This approach opens the door to new possibilities in design, accelerates a product development and reduces errors.. The final outcome is to produce high quality products [6].

Figure 5. presents 2D model of a shaft.

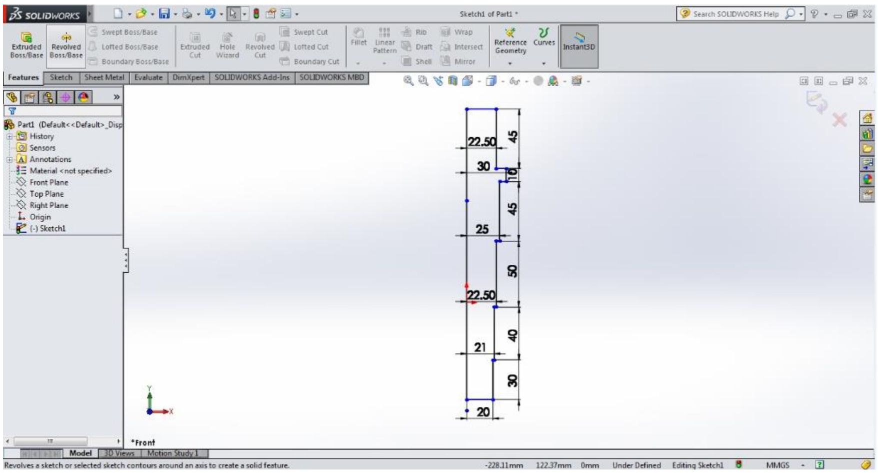

Figure 5. 2D model in SolidWorks program

A shaft has a cylindric shape, so it is needed to define the axes of rotation first and then to map the first part of the shaft over the axes. For this reason, a front surface is selected and then a coordinate system defined by clicking the option Sketch. Along Y axes a symmetry is designed and the object is closed by contour lines in half of real dimensions. Finally, Revolve option which is located in Features card is used and 3D model of a cylindric shaped shaft is made.
Figures 6 and 7 present 3D appearance of a modeled object.

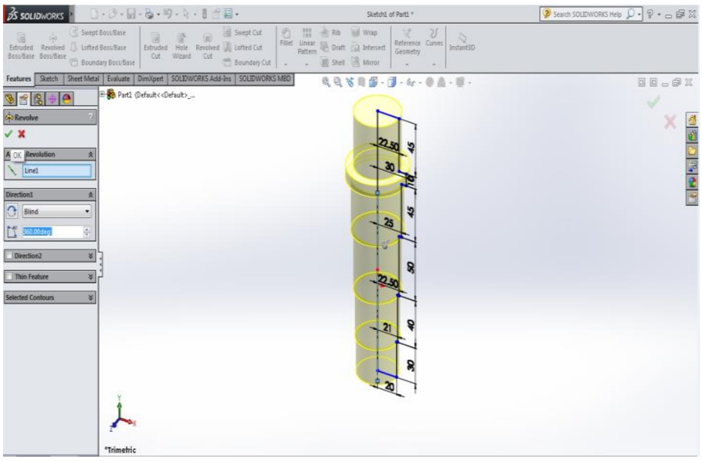

Figure 6. 3D model with angles

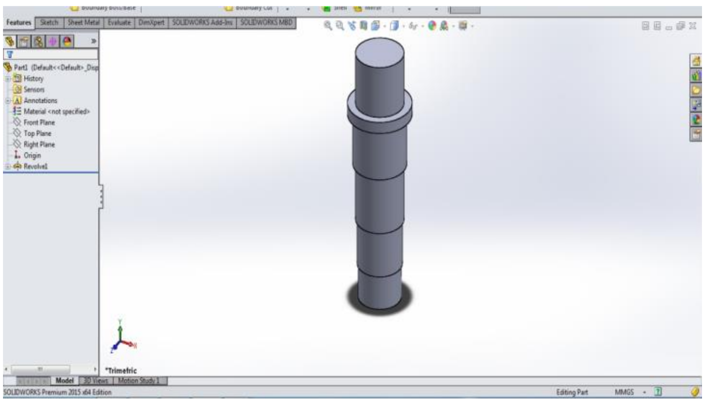

Figure 7. Completed 3D model

For cutting a wedge on the shaft it is necessary to define a new surface. By selecting a new surface a new coordinate system is defined and a sketch of a wedge is drawn with assigned dimensions. An option for cutting a wedge is used on Feature card, Extrude Cut option. A wedge pocket is cut at a defined depth depending on the case, see Figure 8.

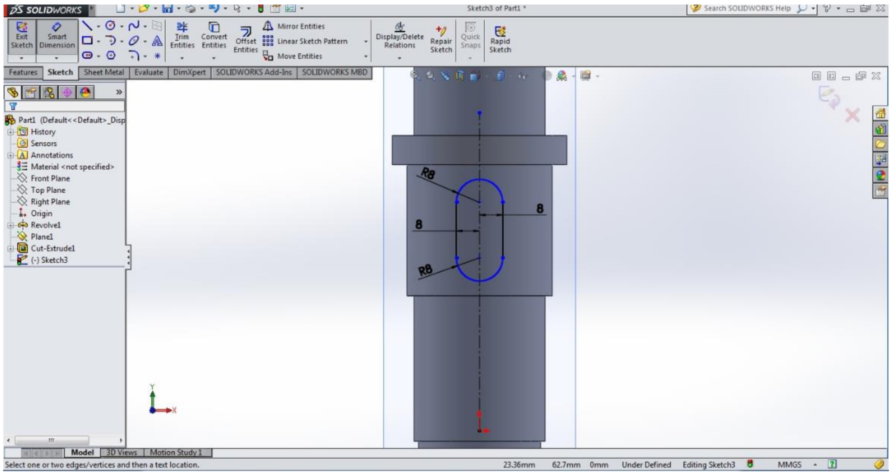

Figure 8. Cutting a wedge pocket

CONCLUSION

The purpose of this paper is reflected in the presentation of software tools application in the field of machine parts design. New technologies bring numerous advantages in the phase of production preparation because they enable fast and easy way of constructing 2D models of various objects but the greatest advantage is a possibility to represent 2D model in 3D environment which contributes to reducing complexity in product making. The aspect of time saving is also significant because by using software tools for creating 2D model the time is reduced for more than 50% in comparison to mechanical methods.

A need for shorter terms of development and production of new products along with costs reduce and parallel increase of total complexity of a product (Figure 4), forced production companies to find out new useful ways of production which as a final result brought significant changes in the very comprehension of the process of production and opened the door to numerous applications of the process, originally strictly intended for the production of prototypes. These new concepts of the production of prototypes based on completely new approach to the production of physical parts eliminated considerably a number of obstacles related to geometric limitations of the produced parts, reduced time of production which, for the first time, didn't depend on geometric complexity of products, reduced costs of the production of prototypes and caused the development of totally new production concepts known in modern literature as fast production [7].

Figure 9. shows a diagram of development flow and implementation of new technologies.

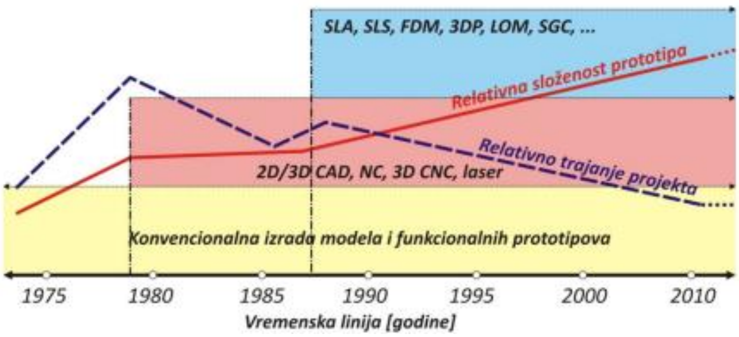

Figure 9. Presentation of modern technologies implementation

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BIONIC DESIGN – IMPLEMENTATION AND EXAMPLES

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Abstract: Bionic design is a science discipline which has one major purpose and it is to create new objects and products which are inspired by the nature. Also, this design improves the products which already exist. With this type of design, we are finding shapes and structures in the nature and with methods of bionic design we are implementing that shapes and structures in design of some products. The nature has the most perfect solutions for solving our construction problems with products. This paper would also present the beginning of bionic design as well as its own gradual progress in all spheres of everyday life. Everything that we said would be presented through the some typical examples.
Key words: Bionic design, methods, examples.

1. INTRODUCTION

At the very beginning you should become familiar with the concept of design. Basically the design means drawing, draft, sample or project. The design is a science discipline because it scientifically researches and demonstrates the phenomena, laws, methods and processes in the creation and development of products. In its development, design uses the achievements of various sciences and because of that it is interdisciplinary. It covers all aspects of the human environment, which are conditioned by industrial production.
Indication of bionic design appeared in the 16th century in the works of Leonardo da Vinci, but whole branch of industrial design called bionic design was born in the sixties in the United States.
Bionic design represents a scientific discipline which has one goal and it is to create new objects inspired by nature and forms found in nature. The term is derived from the Greek words "bios," meaning life, the suffix "-onic" from the English word "electronic", which means the electronic and the Greek word "mimesis", meaning to imitate.
Bionics is a branch of science that systematically analyzes the rules of design and growth, and also examines how these can be applied in the technological innovation. The objective of studying the biological processes is that they can be explained, abstracted and implemented in technical applications. Natural structures are extremely durable and reliable, and they are produced with minimal consumption of materials. As I mention, there are also important principles and methods of sorting and control information of the living system for creating analogy models in order to optimize a product in the functional and ecological sense. Bionic design needs to formulate a theory that would explain relationships between the nature and technology and thus to develop a methodology that will facilitate the design process. The essence of the bionic design is to create new ideas and to transform them into physical or intangible concepts.

2. METHODS OF BIONIC DESIGN

The nature-inspired design methods aims to offer designers an organized process in order to achieve a model applicable in design, but that model must be inspired by the relationships of shapes and functions in the nature because that is what bionic design represent. Despite the success achieved in many cases by applying this approach in design, the bionic design method still has room for improvement in order to become more systematic. There are five methods of the bionic design. Each method contains the stages by which the product is introduced into the area of bionic design.

Alborg method - emphasizes the importance of economic and environmental factors in the development and evaluation of projects by designers. It also shows little support for the organization's problems.

Table 1. Alborg method with its phases and descriptions for each one

Phase	Description
1. Analysis	Choice and analysis of a natural system. The purpose of this phase is to understand the form, structure and functional principles of the nature system.
2. Transformation	Extrapolation of mathematical, geometrical and statistical principles through a process of abstraction and simplification. Transformation, by the analysis of the analogy, of the characteristics of the biological system into technical and mechanical terms.
3. Implementation	Implementation of the principles of the relationship between form and structure found in the natural system analysis, for the development of new products.
4. Product development	Development and evaluation of the new product taking the environmental and economic factors for all life stages of the product into account.

The bio-mimicry design method - This method provides a detailed description of the methods involved in the collection and analysis of samples from the nature. A complete list of working principles of natural systems is also prescribed.

Table 2. The bio-mimicry design method- phases and descriptions

Phase	Description
1. Identification of need	Identification of an unmet need in a satisfactory manner so that it would allow the satisfaction of a particular problem for subsequent analysis of the environment in search of potential solutions.
2. Selection and sampling	Practical process step involves the selection of samples in the nature that fit a problem and a need. It involves the search for samples in the nature and knowledge about habitats of the samples which are collected, and also of the equipment which can be used for the collection.
3. Observation of the sample	Observation and analysis of the components of the morphological structure, functions and processes, distributions in time and space, and relationship with the environment. Classification of the sample.
4. Analogy of the natural system with the product	Through the information of functional analysis, morphology and structure, a designer has the capacity to consider the possibility and feasibility of application of an analogy between the studied sample and the product which he/she want to design.
5. Design implementation	Considering the feasibility of application of the sample characteristics to the design and from the functional, formal and structural analysis, as well as the needs and requirements of the proposed product, an analysis of the system is held at this stage.

The spiral design method- this method emphasizes on the product life cycle, considering issues such as manufacturing processes, packaging and recycling products in development. In this process, iterations are assumed and it is also recommended to evaluate the results in each step.

Table 3. The spiral design method – phases and descriptions

Phase	Description
1. Identify	Development of the Design Brief for a human need with the details and specifications of the problem to be solved.
2. Interpret	Biological view of a problem. Questioning the Design Brief from the perspective of nature. Translation of the functions of a project into tasks performed in the nature.

3. Discover	Find the best natural models to answer / address the posed challenges.
4. Abstract	Select the "champions" with the strategies most relevant to a particular challenge of a project.
5. Emulate	Developing ideas and solutions based on natural models to mimic aspects of form, function and ecosystem as much as possible.
6. Evaluate	Evaluate the design solution considering the principles of life. Identify ways to improve a design and bring forward questions to explore issues such as those related to packaging, marketing, transportation, new products, additions and refinements.
7. Identify	Develop and refine design briefs based on lessons learned from evaluation of life's principles.

Bio-inspired design method- for this method, the process of defining problems and searching for biological solutions is supported by techniques, suggestions and practical examples.

Table 4. Bio-inspired design method- phases and descriptions

Phase	Description
1. Problem definition	Selection of a problem to solve and performing further definition of it through functional decomposition and optimization.
2. Reframe the problem	Redefining the problem using broadly applicable biological terms. Asking the question: "How do biological solutions perform this function?"
3. Biological solution search	Find solutions that are relevant to a biological problem with techniques such as changing constraints, analysis of natural champions of adaptation, variation within the family of solutions and multi-functionality.
4. Define the biological solution	Identify the structures and surface mechanisms of the biological system related to the recast function.
5. Principle extraction	Extraction of the important principles of a solution in the form of a neutral solution, requiring a description that removes, as much as possible, the various structural and environmental constraints.
6. Principle application	Translation of the bio-inspired solution principle extracted into a new area, involving an interpretation of a domain space (e.g., biology) to another, (e.g., mechanics) by introducing new constraints.

Inverse design method - this method supports the iterative formulations of design principle, and all of that is connected and inspired by nature.

Table 5. Inverse design method- phases and descriptions

Phase	Description
1. Biological solution identification	From the observation of natural phenomena on a macro scale or a micro level, a potential solution to apply is sought to transfer to a human problem.
2. Define the biological solution	The components or systems involved in the phenomenon in question are identified in order to outline the biological solution in functional notation.
3. Principle extraction	From the analysis of the biological solution in schematic notation, the fundamental principle of the solution is extracted.
4. Reframe the solution	In this case, reframing forces designers to think in terms of how humans might view the usefulness of the achieved biological function.

5. Problem search	Whereas search in the biological domain includes search through some finite space of documented biological solutions, the search may include defining new problems.
6. Problem definition	By analogy with the definition of the solution in schematic notation, a problem is outlined similarly. The aim is to establish a parallel between the systems and components of the biological solution and the problem.
7. Principle application	Once the solution principle is established, it is transformed into a working principle of the technological concept that is needed. This activity will culminate in the embodiment of a bio-inspired solution of a technological product or system.

The application of bionic principles in a design project can be accomplished by following any of two opposing directions: finding a solution to a problem in the nature, or looking for a problem for which a solution has been found in the nature. The former approach starts with the identification of a problem (human applications, such as developing or improving products or services) or the need of a project, followed by looking for inspiration from the nature or an analogy to foster a solution to a problem (a bionic solution proposal). This approach is well suited to designers seeking inspiration for the development of a particular product. The other approach is based on the observation of the nature and its structures in order to collect useful information (bionic inspiration based solution) for human applications (design problems to be sought).

3. BIONIC DESIGN – EXAMPLES

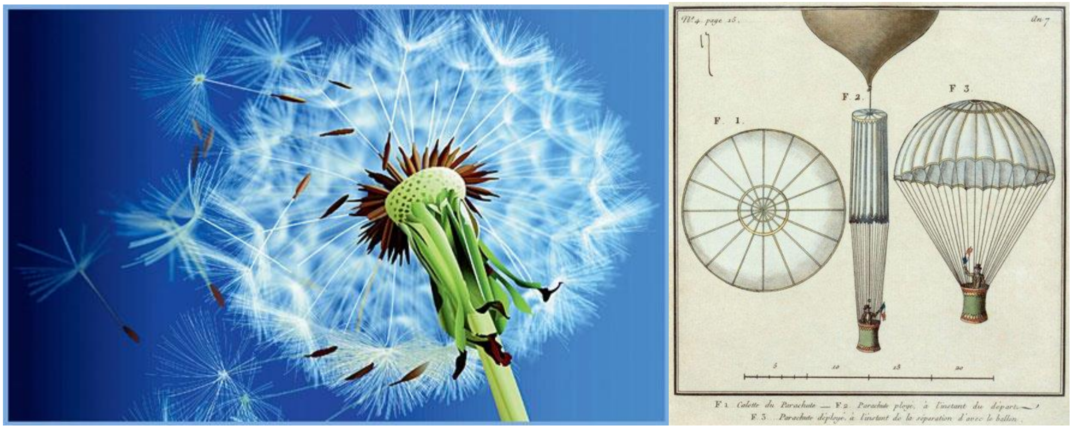
The beginning of the bionic design has been seen in the earliest work of Leonardo da Vinci. He was thinking how to make some kind of flying machine and his inspiration was found in the phenomenon of the maple fruits when they fell from the tree. He was watching it and saw that the maple fruit fell from the air to the ground in a typical rotating movement that slows down their fall.

Picture 1. Draft of Leonardo`s flying machine and inspiration for that

The example how bionic design can be implemented to increase production of energy is presented on picture. Those solar panels, designed in shape of trees, present uses of mathematical principles of nature growth. This presents construction of small solar cells stepwise organized at specific intervals and based on Fibonacci formulas.

Picture 2. Solar panels stepwise arranged by the Fibonacci series

English botanist Sir George Cayley (1773 – 1857) was the one of founders of science of flying. He developed a glider and parachute while observing seeds of dandelion and the way in which they fly through the air. He developed concept of stable parachute whose brunt was placed low while dome was placed on the top of parachute.



Picture 3. Draft of parachute which design is based on seeds of dandelion

Raoul France discovered that seeds of poppy spread uniformly through small holes, and based on which he invented salt cellar.

Picture 4. Bionic product salt cellar

George de Mestral was inspired with burdock, and in 1948 while observing yield of burdock he invented the Velcro. By observing with microscope, he discovered that ends of burdock's needles are bent into a hook, which can easily hook for fur or similar materials.

Picture 5. Bionic product Velcro

The fastest train in the world is Japanese Shinkansen bullet train, which reaches a speed of about 300 km/h. As for the problems with noise, they were solved by designing the front part modelled on the aerodynamic shapes of the beak of a kingfisher bird. It enables reduces of the cause of noise problems, but also reduce of electricity consumption for 15 percentages while incising speed for 10 percentages.

Picture 6. Bionic product Japanese Shinkansen bullet train

4. CONCLUSION

Bionic design is wide and interesting discipline which provides innovative ideas and solutions inspired with the nature. The nature by itself gives us great aesthetic range, as well as functional and mechanical solutions which can be used in the process of product design.

Bionic is a science field that systematically analyse rules of the natural designs and natural growth. It observes uses of that rules on technological innovations. One of the objectives of this branch is to show that bionic design can be used as instrument for increasing quality of education from the aspect of industrial design.

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DESIGN AND SELECTION OF MATERIALS FOR THE MANUFACTURE OF PACKAGING IN ORDER OF ENVIRONMENT PROTECTION

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Abstract: Increased purchasing power and consumption leads to a demand for a larger amount of resources. At the same time, the life expectancy of the product is reduced and all this together causes a destabilization in nature, and eventually leads to the disappearance of certain resources. For this reason, it is necessary to devote more attention to the characteristics of the materials used to manufacture the product. In the material selection process, it is also necessary to consider their impact on the environment. When it comes to the protection of the environment, design takes a significant place. Design helps to guide consumers' habits in a particular direction, in order to increase the use of those materials where the negative impacts on the ecosystem are not so much expressed.
Key words: material, environment, design, packaging

INTRODUCTION

Consequences that are caused by non-rational using of natural resources and pollution of the environment, for decades have been a major problem with which humanity is faced on a daily basis. The subject of environmental protection is becoming more and more present in the numerous activities of different nature. Thanks to the influence of design on the attitudes of consumers, by directing their activities, it becomes possible for individuals to contribute to the preservation of the environment.
The paper consists of presenting the task of packaging as well as the direction in which the design in the 21st century is developed. Also there are introductions of several alternative materials that can be used to replace conventional materials when creating packaging, whose application reduces the negative impact of waste on the environment.

PACKAGING

The task of packaging is to protect packaged products during transport, to preserve their quality, but also to attract attention and encourage purchase. There is a constant seeking present for discovering new materials and solutions that will be able to satisfy the demands of society more successfully, and for this reason there is a constant appearance of new materials replacing others on the market. Conventional materials, such as paper, glass, metal, polymeric materials and similar, take the leading place in the creation of the products. However, there is a need to increase the use of the newly discovered material in order to protect the environment.

Packaging design in the 21st century

When choosing a material for packaging, designers, consciously or unconsciously define the impact of the product on environmental. With a more stringent requirement, the community wants to control the discharge of polluting material in the environment, and also represents the basis from which the fight against the destruction of nature begins. In addition to ensuring good product placement, the role of design in the 21st century is also, to take care of the consequences that the product will have on the ecosystem. While the economic sustainability primarily concerned with maintaining the flow of income over time, environmental sustainability depends on reproducibility-the ability of ecosystem recovery which is affected by economic exploitation or natural phenomena such as diseases or extreme weather conditions [1]. In order to preserve the balance between production, consumption and use of resources, it is necessary that the industry change its attitude towards resources. Production is based on converting the inputs, i.e. the raw materials, and energy, in outputs, i.e. in finished products. It is necessary to close this linear process by making the last step at the same time represents the first, or with other words, that the end product becomes a material that will be used as a raw material for making other products. Savings through replacement of primary resources with secondary, is presented in table 1.

Table 1. Savings achieved by replacing the primary raw materials with secondary ones (%) [2]

	Paper	Glass	Steel	Aluminium
Energy	23-74	4-31	47-74	90-97
Air pollution	74	20	85	95
Water pollution	35	/	76	97
Waste from the mine	/	80	97	/
Water waste	58	50	40	/

We live in a consumer economy, so, the more we spend, the more we think that we are also economically more developed. The consumer economy is based not only on spending, but also on the constant increase in the consumption rate [3].

ALTERNATIVE MATERIALS FOR THE PRODUCTION OF PACKAGING

Innovative packaging made of calcium carbonate by the company named Ecolean

The main ingredient of this packaging is calcium carbonate, which is at the beginning of the production process is in powder form. By adding binders, in this case, polyolefin the material gets a form that can be easily formed and shaped. The weight of the packaging which can fill up with fluid of 1000 ml equals 14.3 g, while the weight of the packaging made of other materials is almost twice as high. The thickness of the empty packaging is only 0.5mm, while the amount of water needed for making Ecolean packaging is only one third of the quantity used in the manufacture of other packaging, while the CO2 emissions into the atmosphere during production, is reduced by 30% [4]. The small volume of packaging as waste, at the same time allows transportation and storage of a large number of packaging. Figure 1. represents the mentioned packaging material.

Figure 1. Innovative packaging by the company named Ecolean [5]

Agriplast

To obtain this unique material, used is grass as a source of cellulose, which replaces a certain percentage of crude oil. In the mixture of grass, oil or granules of plastic are added, which can be also replaced by recycled plastic parts. The contribution of grass can be from 30 to 75%, depending on the characteristics of the materials that wants to be achieved [6]. Thanks to the use of this method, there is a reduced need for oil as the main resource. On Figure 2.they are presented examples of products that can be created from Argiplast.

Figure 2. Products from Agriplast [7]

Mycofoam as an alternative protection during the transportation

For the production of Mycofoam, used are mushrooms, or more specifically the roots, called mycelium and corn stems, which is an agricultural by-product. In the process of the growth of the mushrooms, the mass is formed into the desired shape, and it only takes a few days to get the product finished. Thermal treatment and drying stops the growth process [8]. Products from this materials are used to manufacture packaging that protects the product during the transport, but many designers have discovered its characteristics, and use them for making decorative objects. Figure 3. presents the appearance of Mycofoam.

Figure 3. Mycofoam [9]

Milk as an alternative raw material

At the end of the production of milk and cheese, a by-product is produced that can be used for the production of materials that has the potential to replace a plastic foil that is often used as a packaging material. To create this material used is casein, the main protein found in milk. After treatment of drying, adding water, natural colours and other substances, it will be possible to form the mass into thin strips which will be is grinded into granules [10]. Figure 4 shows the foil produced in this way. Many people are worried about the hypothesis that milk production will have to increase. But for the production of this material it is possible to use only milk that for some reason cannot be placed on the market or due to unsatisfactory characteristics and quality are withdrawn from sales.

Figure 4. Examples of foil made of milk [11]

THE INFLUENCE OF PACKAGING ON THE ENVIRONMENT

The lifetime of the products became shorter, which led to the goods losing their value faster and there is a need to be replaced with new ones. Higher consumption leads to spending a larger amount of natural resources, which slows down the process of renewal.
By considering the impact of packaging waste on the environment, one of the main problems is the incomplete utilization of capacity of the packaging. Some product's packaging, as in the figure 5. is showed, are more than 50% filled with air. For certain products, the air inside the packaging serves to protect it from external influences, but we can notice that the packaging size of those products where such a danger in the loss of physical, external or internal quality does not exist, is also greater than what would be necessary.

Figure 5. X-ray images of food packages [12]

The amount of waste that is produced is causing drastic consequences on the ecosystem, as it is evidenced by the fact that every hour 675 tons of wastes are unloaded in the oceans, of which 80% is plastic waste. This led to the fact that there is already six times more plastic waste in the oceans than plankton [13]. The greatest danger in this situation is that a large part of the waste that is in the water cannot be completely degraded in a natural way, but with the water streams they fall apart into smaller and smaller pieces. Numerous living beings are affected by these microparticles, just as those who are living in the water, but those animals and humans who are also using them as a food resource. The danger is that the particles of the plastic will get into the organism of fish or other animals, which leads to the reduction of the available space for food in the stomach, after which they will not be able to supply their organisms with sufficient amount of food needed to survive. But also, beside the risk of injury certain wastes release substances that are toxic not only for the wildlife, but the substances can also cause disturbance in the growth of both marine and terrestrial plants.

CONCLUSION

Although recycling extends the lifetime of the resources, it is not possible to rely solely on this kind of solution. It is necessary to increase the application of renewable resources in the production, in order to preserve a balance between spending and the time it takes to restore the resources in a certain amount in a natural way. Scientists around the world are working on identifying alternative materials in order to achieve this balance.

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DIESEL ELECTRIC AGGREGATES AS SECONDARY ELECTRIC POWER SOURCES

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Abstract: The Authors of this paper focused their attention on the issues of using and maintenance diesel electric aggregates in case of *Telekom Srbija* telecommunication company. Every day we witness a poor quality of the national electrical power grid, with frequent voltage drops, restrictions in supply etc. As big systems such as *Telekom Srbija* are of great importance for both the country and population, secondary power sources are required to appropriatelly compensate transient breaks in electical power supply from the national grid. The most frequently used devices for this purpose are diesel electric aggregates (DEA).
Key words: start battery, diesel electric aggregate, electric current, electric power (energy).

INTRODUCTION

More and more the modern world is becoming dependent on electric energy, and therefore its reliable and continuous supply plays a vital part in the context of functioning and normal operation of a great deal of public buildings and institutions, such as hospitals, banks, telecommunication companies, factories, computer centers, shopping malls, etc. Normal functioning of them all strongly depends on continuos and stable electric energy supply, which they require at any moment [1].Diesel electric aggregate installations serve as a backup power source for equipment used in case power supply from the grid is interrupted. Diesel electric aggregates are machines which convert mechanical into electric energy. They are normally intended for such places where connecting of a place to a power grid (as the primary power source) is either impossibile or costly, and their exploitation as a backup power source is very intesive [2]. Diesel electric aggregates can be stationary or mobile i.e. portable. Stationary diesel electric aggregates are machines intended for fixed installation and usually situated in a separate room within the building they supply electric energy to. Such a room must be specially adapted to their technology and operating conditions in respect of construction characteristics, sanitary and technical conditions, and fire protection measures [3].
Portable diesel electric aggregates are movable machines which can be mounted on vehicles or hand-carried. Such aggregates are transported in accordance with the need for them, to any location within the grid. The most important part of any aggregate is its batteries. Maintenance of batteries and measuring voltage on their connections are of essential importance in the context of safe and reliable operation of a diesel electric argregate. Therefore this paper will explain how to deal with batteries, with special focus on maintenance and voltage measurement. Voltage measurement represents a key segment because its a leading point to eleminating most errors and tight spots, and thus securing conditions for optimal performance of a diesel electric aggregate.

THE IMPLEMENTATION OF DIESEL ELECTRIC AGGREGATE

Diesel electric aggregates are integral part of numerous applications, and in various types of electrical installations they come either as backup or as independent power sources, but also as power sources operating in conjunction with electric power grid.
DEA is basically a synchronous electric generator run by a dizel motor with internal combustion. Synchronous generators used for this purpose are normally three-phased, self-excited, and brushless. Apart from the synchronous generator and diesel motor, other parts of one such a complex electromechanical system are excitaton controllers (output voltage) and frequency regulators (rotation speed). An outstandingly important part of one such system is the accumulator block (DC source) which generates energy required for the initial start of the diesel motor. DEA is normally designed in

accordance with the maximum power criterium (Total sum of powers of all consumers connected to DEA) and depending on allowed voltage drop between its connections [4].
DEAs are usually manufactured in the power range from 1 kVA to 5 MVA, but there may be exceptions. High power DEAs are essentially small power plants. They occasionally serve not only as backup power supply, but as support to the electric power grid in the event of peak demand for electricity [2].
DEAs are used in many industries, with countless applications in construction machines and equioment, means of transportation (ships and diesel engines in particular), etc. One of their key applications is backup power supply in hospitals, schools, hotels and other similar places. Average life of a diesel electric agregate is approximately 50000 working hours, but can expand to 100000 working hours provided it is properly exploited and planned for service after each 200 ÷ 300 hours of continuous operation [5].
Figure 1. shows the optimal operation of one 80kW diesel electric aggregat [6].

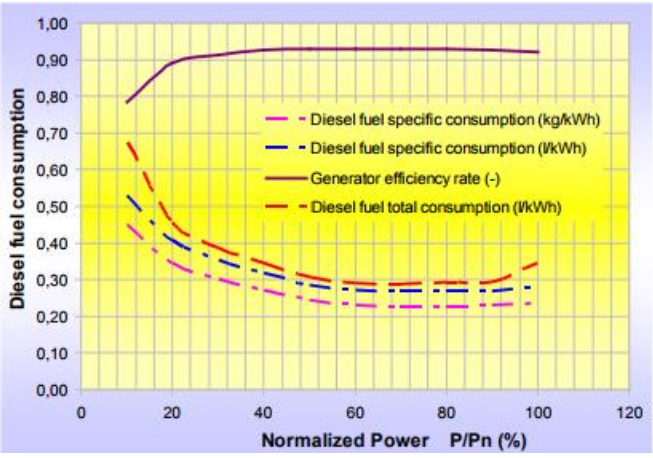

Figure 1. Optimal operation of an 80kW diesel electric aggregate

Figure .1 clearly indicates that the optimal operating mode of the motor, when the aggregate generates electric energy, is obtained with the constant rotation speed of approximatelly 1500rpm, which corresponds to 70-90% span of the nominal power of 80 kW. In the synchronous operating mode sufficient quantities of electric energy are generated with minimum consumption of diesel fuel.

Figure 2. shows the schematics of a secondary power supply system with diesel electric aggregate.

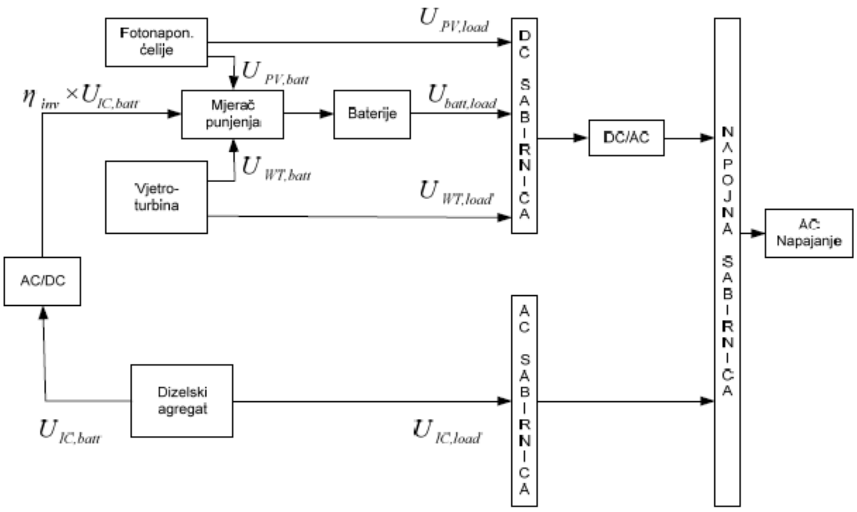

Figure 2. Secondary power supply system with diesel electric aggregate

DEA power can be obtained using apparent power, S (kVA), required for supplying all loads that need to work in case of any electric power grid shutdown. The following information is required in orded to determine DEA power:

- true powers of all loads, P (kW),
- average power factor (cosø),
- electric power efficiency (η). [8]

The true power of a specified load (load “i” in general case) can be obtained from equation 1.

$$Si = P_i/n_i * cos\varnothing \text{ (kVA)} \qquad (1).$$

After obtaining the apparent power, it is necessary to calculate power losses which inevitably occur during operation, and also the voltage drop in the system.

$$k = (Sp/Sa)*100\% \qquad (2).$$

According to equation 2, the voltage drop can be obtained as apparent-to-assumed DEA power ratio, expressed percentually.

Figure 3. shows voltage drops during DEA operation [8].

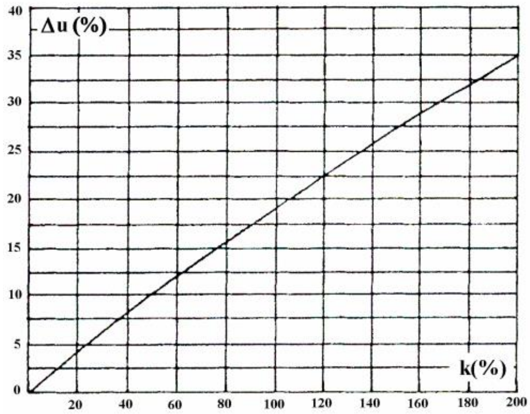

Figure 3. Electric power efficiency-to-voltage drop diagram

IMPACT OF START BATTERIES (ACCUMULATOR) ON DEA OPERATION

One DEA system consists of a plenty of parts each impacting its operation, however two essential parts of such systems are the aggregate itself and start batteries (accumulator) which serve to convert stored chemical energy into electric energy, and to distribute it. Some explosive gases are often created in batteries during this conversion process. Batterias are filled with sulfur acid, an extremely hazardous chemical compound. Complying with all HSE standards and wearing protective equipment is obligatory when dealing with sulfur acid. Metal connectors on a battery are on some potential and there is always risk of their shortcut. Electrostatic discharges should also be avoided at all cost. Inadequate installation and failing to comply with the installation and user's manuals may have negative impact on the life of batteries and may void warranty on them.

As shown in figure 1, electric energy generated by all the sources can be either directly supplied to the consumer or used to charge the batteries [7].

This interconnection can be expressed with the following formulas:

$$U_{ic} = U_{ic,load} + U_{ic,\, batt.} \qquad (3).$$

The real diesel fuel consumption - to - generated electric energy characteristic is linear as stated in equation 4. F_0 and F_1 are two parameters necessary as entry values for the model in question.

$$F=F_0+F_1*U_{ic} \tag{4.}$$

According to equation 2, diesel fuel consumption is directly proportional to increased diesel fuel consumption (l/h) multiplied by hourly generated amount of electric energy (kW/h) and normal diesel fuel consumption, F_0.

Battery installation

When working with batteries, safety measures in accordance with standard EN 50272-2 must be taken. This standard is applicable on stationary batteries and battery blocks up to 1500V nominal output DC voltage and prescribes principal safety measures in case of electric hazards, emissions of gases, spilled electrolyte etc. The standard also presribes safety measures in respect of installation, exploitation, inspection, maintenance and disposing of batteries, and covers lead and nickel-cadmium type batteries. [9].

When analyzing battery life, its operating temperature is a factor of great importance. Therefore it is absolutely recommendable to follow the guidelines underneath:

- Acceptable operating temperature range is 0-50 ^{0}C.
- Recommended operating temperature range is 10-30 ^{0}C.
- Technical specification is given for the operating temperature of 20^{0}C.
- Increased operating temperature reduces life of a battery.
- Low temperatures reduce baterry capacity.

Battery maintenance

Maintenance practices directly impact battery life. As the quality of DEA operation greatly depends on batteries, preventive maintenance is the preferable maintenance method and should include the following:

- refilling electrolyte up to the nominal level,
- cleaning,
- closing cells with caps,
- monitoring.

CONCLUSION

Modern concepts in industry and the principles of functioning of electric energy production and distribution systems require almost flawless and continuous production of electric energy. In achieving this goal, fuels play great part because they provide energy necessary for any industrial process. Most consumers still spend energy from non-renewable sources and in case of electric power systems, some inherent problems such as voltage drops in the grid, restrictions in supply, or simply insufficient quality of energy itself may occur as a consequence, which further produces many negative impacts on machines and equipment used in industrial processes. For the reasons above, companies with extremely high electric energy consumption often decide to invest in secondary electric power sources, the most common of which is DEA. The main advantage of DEA is their mobility, which means they can be transported between different locations. This type of secondary electric power source can supply industrial facilities with electric energy for certain period of time depending on capacity. From economic standpoint, investing in such machines pays off long-term because their price is much cheaper comparing to process shutdowns and losses due to interruptions in power supply. New DEA models are being developed as automated autonomous systems with high efficiency. For instance, advanced DEAs running on bio-diesel or gas not only introduce high power efficiency and low noise operation, but also satisfy all requirements imposed by strict ecological regulations.

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REPRESENTATION OF ENERGY MANAGEMENT IN ENTERPRISES OPERATING ON TERRITORY OF THE CENTRAL BANAT

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Abstract: Today, it is necessary to manage energy in an adequate manner in all production processes in the company. Energy efficiency is becoming an impresivable one today. By applying the company's energy efficiency systems, they provide constant energy supplies with low costs and environmental protection. In this way, the application of energy management helps companies to become competitive on the market. The paper presents a survey on the application of energy management in enterprises in the territory of Central Banat.
Key words: energy management, energy efficiency, competitiveness, energy management.

INTRODUCTION

The imperative of the modern economy becomes a rational use of natural non-renewable resources and environmental protection. Our country has remarkable energy potential in renewable energy sources, but it has not been sufficiently utilized. By saving traditional forms of energy with the intensive use of alternative energy sources, a high degree of energy efficiency can be ensured. Resources are limited and care must be taken of their use [1]. There is an increasing need to manage energy resources in an adequate way in one continuity. Natural resources are getting smaller. The Republic of Serbia needs to understand the problem of missing energy much more seriously [2]. Efficient energy management companies deliver a new number of clients with their learning on specific projects. In this way, companies achieve greater efficiency and business efficiency with maximization of profit [3].

ENERGY MANAGMENT

It is very important to raise awareness about the importance of environmental protection, but it is also a long and slow process. Preservation of natural resources is one of the important aspects in each industrial branch. In this regard, a number of acts on a global level have been adopted and implemented in national legislation. Public awareness of the importance of the energy sector in our country is very low. It is considered that the legal system in Serbia does not provide enough guidance on how to treat energy as a public good. In many richer countries of the world, solar facilities and plants are constantly developing and developing. Solar energy represents a great hope for the future. Many scientists believe that the solar energy is trying. A general energy policy should be based on the use of solar energy and other alternative energy sources. In Italy, electricity distributions offer long-term loans for financing solar facilities in order to achieve energy efficiency. Based on numerous literary sources in the field of energy management, it became clear that the relation of the comprehensive issue of sustainable development, climate change and the utilization of energy resources is in a very close relationship. In order to increase efficiency in energy systems, many state strategies are introduced. One of them involves the replacement of existing energy sources with renewable energy sources. Organizational culture of enterprises is a very important role when discussing the needs for energy management of the organization. In one continuous process, it is necessary to create a plan for the launch of energy efficiency programs, and the success of the implementation depends on the organizational climate that is nourished in the company. ISO 5001 supports organizations in all sectors to more efficiently use energy through the development of an energy management system.

ENERGETIC EFFICIENCY

One of the tasks of energy efficiency is more economical production and reduction of energy losses, efficient distribution to consumers and the choice of optimal mode of transport. Also, one of the main goals of this topic is to reduce negative and harmful environmental impacts with less energy losses and increased efficiency [4]. In addition to the ecological, the use of alternative energy sources has an economic significance. It can contribute to reducing fossil fuel imports, developing local industry and creating new jobs, but also allowing household savings. Energy efficiency is a very efficient way of saving resources and making them more efficient. It implies a set of measures and actions in all areas of life with the ultimate goal of minimizing energy consumption, with the condition that the level of work and life remains the same or improves. Continuous population growth as well as the growth of living standards condition the increased need for energy resources. Figure 1 shows the increase in the number of inhabitants in the world in the 1960-2000 period years. It is not mere energy saving that implies renunciation, but its effective use that contributes to improving the quality of life and work, as well as greater competitiveness of production. Successful implementation of eco-management, i.e. the concept of sustainable development will enable unhindered industrial growth, the quality of the environment, the health, and the harmonious life of today's and future generations [5].

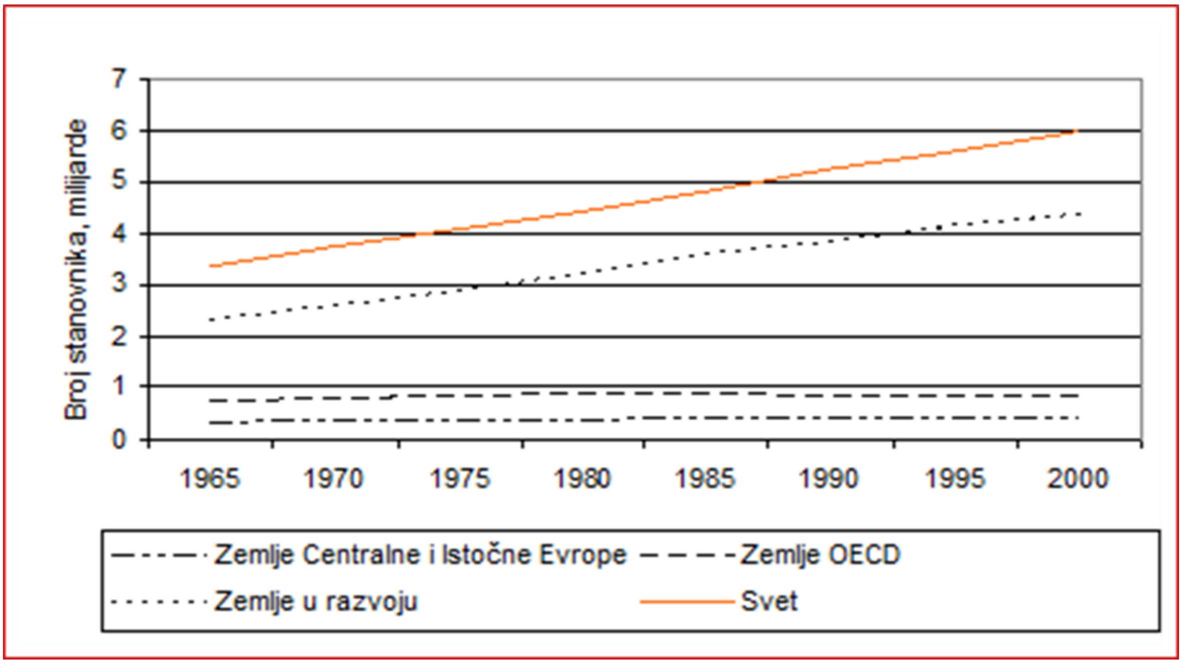

Figure 1. Population increase in the world in the period 1960-2000. years [2].

Under conditions where non-renewable energy sources are getting smaller and their negative impact on the environment becomes more and more important, the attention of the expert, political and the general public must be focused on the potentials of renewable energy sources. Starting from the point of view that energy is an indispensable necessity for the economy, as well as every citizen, but the pioneer of development in the technological, scientific, educational and economic sense, the need for organizing, developing, using and managing this extremely important resource is put under the necessary care and control [6]. Further improvement of energy efficiency is a key task and the goal is to achieve an improvement of 20% in energy efficiency by 2020 at the level of the European Union. The Directive foresees that each country of the European Union will prepare NAPOIE in accordance with the adopted template for the preparation of the documen- tation (Decision 2009/548 / E3) [7].
Our country has remarkable energy potential in renewable energy sources, but it has not been sufficiently utilized. By saving traditional forms of energy with the intensive use of alternative energy sources, a high degree of energy efficiency can be ensured.

THE NEED FOR ENERGY THROUGH THROUGH ENERGY TRENDS TWENTY FIRST CENTURY

The rapid development of new technologies of the 21st century has developed the increasing need of man for energy. It is necessary to develop new and upgrade existing plants in order to reach higher energy capacities. Most of the population is concentrated in cities where energy consumption is significantly higher than rural areas. Companies increasingly introduce energy policy in their business. Their policy is based on the construction of plants based on alternative energy sources, with the use of resources in the most efficient way. Society needs large amounts of energy resources today in order to sustain life on the planet. Industry is increasingly involved in the launch of machines and large plants, using both enormous amounts of energy in food and other industries. Figure 2 shows the global energy consumption in the period 1850-2000. years.

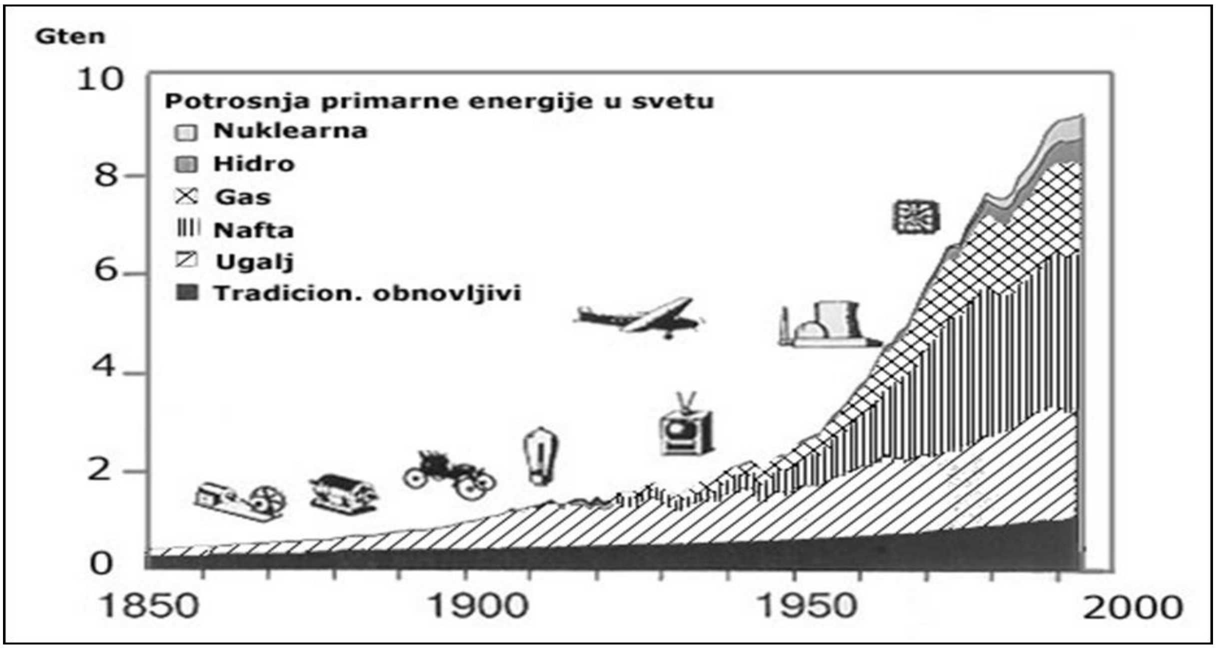

Figure 2. Global energy consumption in the period 1850-2000 years[2].

Problem and subject of research

This area in the territory of the city of Zrenjanin is not very potent, research has not been done on this topic to a sufficient extent. There is not much information or data on the representation of energy management in the territory of the Central Banat. Because of this, the employees themselves do not have a clear picture of the advantages of introducing energy management in companies specifically in the territory where the research work has been done.

Research Area

The research was conducted in the territory of the city of Zrenjanin, the administrative center of the Central Banat District, which has a population of 76,511 in the territory of the city, and 123,362 in the municipality. The total area of the municipality is 1324km^2[8].

Method of research

The research involved two groups of opponents. The first group of respondents consisted of employees in the sector of management and environmental protection while the other group of respondents comprised the management of the company. Data collection was carried out in two ways. The first way involved an employee interview while the other way of collecting data was a questionnaire survey, where it was pointed out that the questionnaire was anonymous and that the obtained results would be used exclusively for research work in this territory.

Table 1. Structure of respodents and groups of qualifications

Qualification	Obtuseness(%)	1	2
IIIskilled worker	- 10%	8	5
IVsecondary education(4 years)	- 17%	6	8
Thehighly skilled worker	- 17%	10	3
VI(VI1 andVI2) higher education(and university level)	- 10%	9	10
Education	- 36%	13	9

Table 2. Structure of respondents

YEARS OF SERVICE	Number of respondents		
	1	2	Total
to 5 years	12	9	21
from 6 to 10 years	10	12	22
from 11 to 15 years	5	3	8
from 16 to 20 years	8	4	12
from 21 to 25 years	3	1	4
over 25 years	7	10	17

Research hypotheses

Principal hypothesis: There is a connection between the size of the company and the representation of the application of energy management.

Hypothesis No.1 In enterprises operating in the food industry as well as chemical, the greatest intensity is the application of energy management.

Hypothesis No.2 The application of energy management is most represented in the enterprises of production activities.

The aim of the research

The aim of the research is to demonstrate the importance of energy management in companies in the Central Banat Territory. The future brings the need for constant monitoring of resource consumption. Modern technologies bring greater use of energy resources and in this connection the necessity of energy savings with adequate management in all processes in the company arises. The research was carried out in the territory of the city of Zrenjanin and the representation of energy management in this area was measured.

Research results

The research involved two groups of respondents. One group of respondents covered the employees in the management and environmental sector while the other group of respondents comprised the management of the company. The survey showed that the greatest use of energy management is represented in medium-sized enterprises, followed by small and large enterprises. The research is brazen by the assumption that the biggest application of energy management in large enterprises. The obtained results show that the main assumptions of this research are denied. In large enterprises, the smallest intensity is the application of energy management (Figure 3). The research also showed that the greatest use of energy management in service activities is while the application of manufacturing activities is considerably lower (Figure 4). The greatest representation of the application of energy management is present in the food industry and the wood processing industry (Figure 5). With the application of energy management, increased efficiency and ease of business operations are achieved.

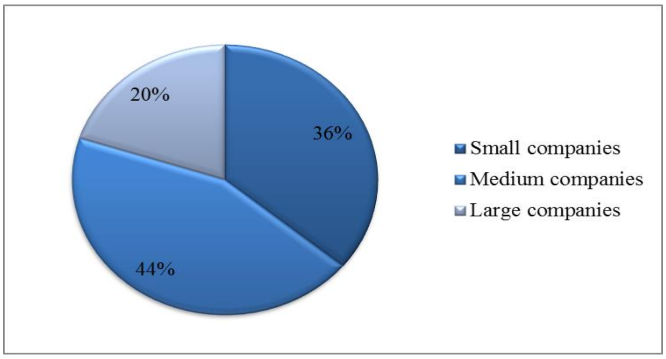

Figure 1. Application of energy management based on company size

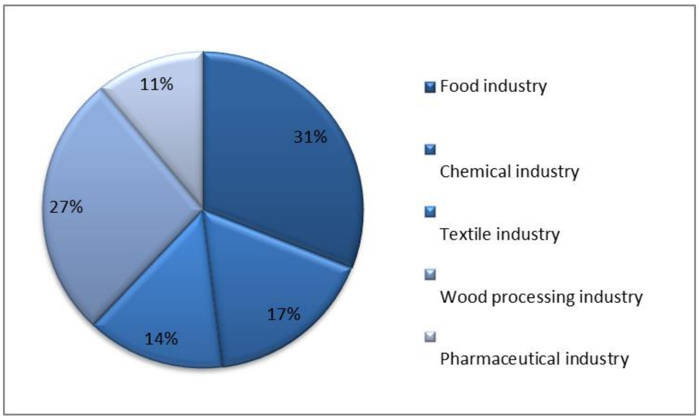

Figure 2. Representation of the application of energy management to the industry branch

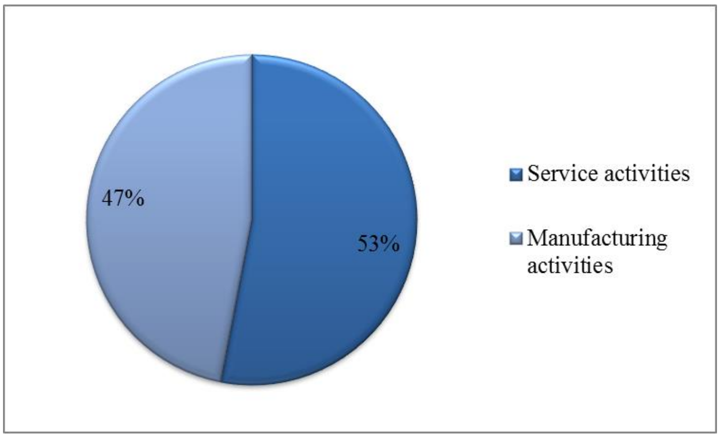

Figure 3. Percentage of the participation of energymanagement

CONCLUSION

The energy efficiency area in the companies in Central Banat is very small and is represented. Companies in this territory do not have a separate sector dealing with energy resources management. The management believes that the application of energy management requires high financial resources. The fact is that the future requires increased use for energy resources and therefore the need for adequate management is required. Adequate management of these resources can be achieved only by applying the energy management system in enterprises.

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SAFETY AND HEALTH AT WORK IN THE REPUBLIC OF SERBIA

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Abstract: The work we do affects our health not only in the workplace, but also during the rest of the day, weekends and during holidays, and even years after we stopped working. The consequences of dangerous working conditions are fierce. More than one hundred thousand workers die every year from known workplace illnesses, and many suffer more from other diseases that are not yet directly related to the workplace. The worker must know where he is going, what are the working conditions, and the employer must train him for safe work. Where and how we work constantly affects our health, in visible and invisible ways. The aim of this paper is to point out the significance of the issues of protecting people at work. Health and safety are a priority for every work environment, and the increase in comfort improves employee protection and thus contributes to increased productivity and compliance with security measures. In addition to protecting people, the environment should be protected.
Key words: work environment, health, safety

INTRODUCTION

The occupational health and safety system is based on the application of the principles of prevention from injury at work, illness or damage to the health of an employee that is carried out before starting work in the workplace and in the work environment. The precondition for successful implementation and implementation of measures for safe and healthy work at the workplace and in the workplace with the employer is the assessment of the risk of injury at work or damage to health, or sickness of an employee.
The assessment of the risk of injuries at work or damage to health, or an employee's illness, is based on determining the hazards and hazards in the workplace and in the workplace that may cause injury to work and / or professional illness and the likelihood of their occurrence.
The employer's obligation is to evaluate the risks from the aspect of safety and health of employees in relation to the nature of the activity performed by the company or institution, taking into account, inter alia, the choice of funds for work, working conditions, means and equipment of personal protection at work, materials used in the work process, workplace and work environment adaptation to employees, etc.
Based on the results of the performed risk assessment of occupational injuries and / or occupational diseases, the employer is obliged to provide improvement or bringing it to the prescribed level of occupational safety and health at work as well as in the working environment of his / her company or institution, which is achieved by undertaking appropriate preventive measures or change of working or production procedures, if necessary.

ACT ON RISK ASSESSMENT

The employer is obliged to pass a Risk Assessment Act in writing for all work places in the work environment and to determine the method and measures for their elimination, and is obliged to change the Risk Assessment Act in the event of any new danger and change in the level of risk in the process work. The Risk Assessment Act is based on identifying all possible types of hazards and adverse effects in a random place in the work environment, on the basis of which the assessment of the risk of injury and damage to the health of an employee is carried out. The manner and procedure for assessing risks at random locations and in the workplace is prescribed by the Minister in charge of labor.
The employer is obliged by the act on risk assessment, based on the assessment of the occupational medicine service, to determine the special health conditions that must be fulfilled by employees for performing certain jobs at the workplace in the workplace or for the use of certain equipment for work [1].

An employer can perform risk assessment on his own, if he has up to ten employees and is not obliged to pass a professional exam, in the following activities:

- Financial-technical and business services;
- Craft and personal services;
- Education, science and information,
- Catering and tourism,
- Shops,
- Health and social care;
- In housing and communal activities.

For the performance of occupational safety and health at work, the employer may appoint one or more of his employees or engage a legal entity, that is, entrepreneurs who have a license, or pass a professional examination in accordance with this law.

RESULTS OF BREAKDOWN ON WORK

Injury at work, which is defined in Article 22 of the Law on Pension and Disability Insurance, is considered to be a violation of an insured person that occurs in spatial, temporal and causal connection with the performance of the work on the basis of which he is insured, caused by immediate and short-term mechanical, physical or chemical effect, sudden changes in body position, sudden body burden or other changes in the physiological state of the body.

In the event of serious, fatal or collective injury at work or injuries due to which the employee is unable to work for more than three consecutive working days, the employer is obliged to report it to the competent labor inspection and to the competent body of internal affairs within 24 hours at the latest, since its creation. In obtaining a report on injury at work, the labor inspector is obliged to examine the situation on the spot and to take measures to eliminate the sources and causes that have contributed to injury to an employee [2].

Inspection inspections are carried out in connection with all reported work injuries that occurred during the performance of jobs in the workplace, while injuries that have occurred from house to work and vice versa do not control violations at work.

Table 1. Comparative analysis of performed inspection inspections for fatal injuries at work for the period 2013-2016. years [1]:

year	Number of inspections carried out in case of fatal, severe with fatal, collective, severe and minor injuries at work					
	Total	fatal	severe with fatal outcome	collective	heavy	easyer
2013.	1146	24	14	11	849	248
2014.	1100	21	17	19	904	139
2015.	947	24	14	18	780	111
2016.	900	29	13	20	774	64

Some persons who have suffered serious and serious injuries at work in terms of construction activity did not have concluded work contracts. They usually perform occasional and temporary (seasonal) jobs and start working without first getting to know the technology, while not taking sufficient care of their professional qualifications for performing these tasks, as well as their training for safe and healthy work. The consequences are due to the increased risk of injuries in persons working on "black", as is clearly stated by the data on injuries at work.

FIELD OF SAFETY AND HEALTH AT WORK

During 2016, the labor inspectorate carried out 14,156 inspections in the field of occupational safety and health, which included 178,919 employees. A total of 478 decisions were issued on workplace

ban, because of dangerous occurrences that could endanger the safety and health of employees, and made a 5331 solution to eliminate deficiencies in the field of safety and health at work [3].
900 inspections have been carried out in respect of reported injuries at work, of which 29 are supervised for fatal injuries at work, 13 surveillance of serious injuries at work with fatal outcomes, 20 surveillance for collective injuries at work, 774 surveillance for serious injuries at work and 64 supervision of light injuries at work[4].
The reason for these indicators is that employers do not fully implement the provisions of the Law on Safety and Health at Work and secondary legislation.
Due to violation of the provisions of the Labor Law, 4275 decisions were issued that ordered the removal of identified irregularities. The most commonly identified irregularities were related to the failure to pay salaries and benefits to employees within the prescribed deadlines and the non-conclusion of random engagement contracts with persons found at work. 813 decisions were made that ordered unregistered entities to enter the register of the Business Register Agency with a ban on performing activities until they did so.
3571 requests were submitted by the labor inspector for the initiation of misdemeanor proceedings, and 62 requests for initiation of criminal charges against the responsible persons [5].

DISCUSSION

The most frequent causes of injuries at work are given by analysis of the causes and circumstances that led to injuries at work, it was found that the most common causes are: unsafe work at altitude and incorrectly mounted scaffolds, unused use of prescribed means and equipment for personal protection at work, protection helmet and protective belt, work in improperly excavated excavations, non-implementation of basic principles of organization of works, deviation from the prescribed and established process of work, improper cooperation of participants in work, improper work with equipment for work, inability to work for safety work, incomplete implementation measures of occupational safety at work places, engagement of a significant number of unskilled persons working on "black".

CONCLUSION

Compliance with the provisions of the Occupational Health and Safety Act may be made ineffective in office work conditions, but it may mean a difference between life and death in the event that employees are not able to take care of each other in the event of an accident and provide mutual assistance. Security issues on construction sites have always been a topic that has been little talked about, and even less on this field, in our society. It was rarely an important individual, his safety and the ability to perform normal work. In the first place, what seemed to be the most important, which is a profit, bearing in mind that this practice was not ubiquitous and there were always exceptions. Investors, designers and contractors should first of all be well aware of the Regulation on Occupational Safety and Health at temporary or mobile construction sites and are consistently applied. Investors should hire coordinators because they are very useful, which is practically the protection of their interests. There is no need to be afraid of responsibility, because the consistent application of laws and by-laws, or measures of occupational safety and health, is part of the investment, not the cost.

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MANAGING ORGANIZATION BY KAIZEN METHOD

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Abstract: This paper gives an overview of the importance of organizational management and guiding through the kaizen method. The management of the company needs good knowledge of their organization in order to know how to manage and lead the organization. The Kaizen method allows the manager to do the right moves in managing the company in order to successfullysucceed in business. Managing and guidance of the kaizen method allows companies to survive and expand at the global market. Kaizen is a good example and the key to the success of Japanese companies.
Key words: Organization, Kaizen, Management, Competitiveness.

INTRODUCTION

The operations of all companies listed in today's business world where there is great competitiveness, must be operational, have good management and well organized in the company for long-term survival of the business market. It is necessary to understand the difference between management as a practice and as a scientific discipline. At the end of the eighteenth century in England, the period of industrialization was precisely related to the practical concept of management and the beginning of the very concept of management.

There is a need for managers who have to organize, motivate, lead and discipline people. Today, in the twenty-first century, we speak of managementas a scientific discipline that is more recent. Every company and even the best one has the opportunity to improve. That's exactly what Kaizen is doing. It represents a gradual and continuous improvement of the way an organization works, the quality of products and services, processes, corporate culture, human resources, relationships with customers and suppliers, and everything that concerns the business of one company. This affects not only the internal factors, but also the external factors.

LEADERSHIP AND MANAGING ORGANIZATIONS

Enormous and rapid development of management in factories and production companies is achieving tremendous results. On the basis of modern control systems, "factories without people" are created in which the management system works perfectly [1].The functions of management appear in companies of all shapes and goals were those of economic and non-industrial branches. In companies, management is defined or directed to coordinate actions at all stages of the process where the reproduction takes place. In non-commercial companies (cultural, educational, health, social, etc.) there is a coordination of actions in order to achieve their specific goals for such types of companies.

Management can be defined as the basic function of each enterprise as an organizational phenomenon. It is a universal process in coordinating and directing all organizational resources to achieve the definitions of objectives [8]. Corporate governance is a continuous process that drives and directs business activity to achieve the purpose of doing business [10].

Since a knowledge society must inevitably be a society of an organization, its central and important organ is management [4]. Management is seen, on the one hand, as the management and management skills of organizational systems as well as the bearers of this function, and, on the other hand, as a theory that studies this phenomenon and contributes to its improvement.

Leaders who are completely disorganized and unable to run their own groups can appear, while managers can only exist where the organizational structures play their roles. Separation of leadership from management has significant analytical advantages for a different understanding. Management manifests itself as a set of ways of consciously directing the joint activities of organized people together to achieve the goals of management [9].

Leadership and motivation are closely linked. Understanding motivation can better assess what people want and why they act in the way they act. Also, as mentioned in the previous chapter, leaders not only react to the motivation of their subordinates, but they can also be encouraged or hindered by the organizational climate they create. Both of these factors are also important for leadership and management [8].

Leaders usually focus on the future, they are those who inspire their members in the organization and create the image of both organizations and companies. The changes are under the strong influence of technological progress and the process of global market unification. These changes are permanent and business organizations have to make models of behaviour in relation to the observed and anticipated changes[5].

KAIZEN METHOD

The value of the concept of kaizen

There are many references that deal with the successful application of the Kaizen concept in various industries. Introducing Kaizen method resulted in significant performance improvements in two observed companies such as 30% financial growth and 81% productivity improvement [2]. Another research has reported the results of a multiple case study, showing and providing empirical evidence grounded in the application of process innovation and the impact this has on the management of the organization. In this study, the authors found that the application of Kaizen is leading to continuous improvement [11].

A case study showed that a company managed to reduce its operational cost and production lead time significantly by applying Kaizen. A total of RM 31,661.22 per year of saving was targeted to be achieved through the long-term commitment from the kaizen team and also top management [3]. Kaizen philosophy was applied in a small-sized custom-made furniture industry for continuous improvement and to develop the products with higher quality, lower cost, and higher productivity in meeting the customer requirements. [7].

Kaizen Management is a concept of successful business. This business concept increases productivity in the workplace, with the worker maximally dedicated to his workplace. No one knows better his job than the employee himself, and he performs his work task. By this approach, the worker is able to give and initiate improvements in work and working conditions. An example of the Japanese automotive industry that has applied this management concept, a steady advancement is Toyota's world leader in the auto industry. They argued that this change would positively affect productivity and production in the company itself, increase productivity by 50%.

Kaizen focuses on small steps, which lead to great improvements. No idea is considered to be too small, and each, even the smallest change, contributes to the companiesimprovement. Kaizen solutions generally do not require large financial investments, they are not risky, and therefore it is expected that it is becoming more and more present.

The philosophy that emerged from Japan is being successfully applied in the world. For this the most credits has MasakiImaj (MasaakiImai), father of the Kaizen Philosophy, founder and director of the Kaizen Institute (KaizenInstituteConsultingGroup). Masaki is also the author of the book Kaizen - the Key to Japanese Business Success, the first book in this field, which has popularized this term in the world. The institute was founded in 1986 with the goal of helping companies in the world to get to know the concepts, systems and goals of Japanese business philosophy. Kaizen Management is an element of comprehensive quality management control, and relates to continuous long-term approach to change, while respecting human needs and quality [6].

Model and solutions of the kaizen concept

The Kaizen model adopts certain solutions with its mode of operation. The goal of the solution is to improve all the processes in the company, to improve the environment for the work of employees, and on the other hand to eliminate all unnecessary things. Also, by solutions kaizen tries to eliminate the possibility of error, or to minimize any errors. The more recognizable feature of this model is the positive impact on work and the simplicity of work, without major financial investments.

The struggle of companies to survive and maintain competitiveness and customers, to conquer new markets and potential clients, is in the strategy of a large number of companies. The Kaizen model is a consumer-oriented strategy, known as an umbrella concept. This concept is rapidly spreading to the world economy by applying the unity of Japanese solutions.

Figure 1. Kaizen umbrella

What is known about kaizen and its famous model for improving the company's business and productivity, is that, many of the companies in Japan have realized that they have to apply it to maintain and increase product growth and to make steady progress, for example, Japan's Toyota and many others who have understood and accepted the changes on which the kaizen rests.

Some of these benefits are:

- Excellent method for eliminating waste,
- Creating a new corporate culture,
- Easier recognition of space / place for improvement,
- The result visible to everyone - both employees and clients,
- Introduction of the order in all sectors of the company.

5S - meaning and steps:

- SEIRI (SORT) - Separate and remove all unnecessary things,
- SEITON (STRAIGHTEN) - Compile all necessary things so that they can easily access them,
- SEISOU (SCRUB) - Clean all tools, work desks, offices, remove stains and eliminate sources of impurities,
- SEIKETSU (STANDARDIZE) - Standardize the previous three steps to ensure continuous improvement,
- SHITSUKE (SUSTAIN/ SELF discipline) - Continue to work according to 5S principles / rules every day.

Other methods of Kaizen that provide certain solutions are: cellular production, single-channel flow, Kanban (Information System), SMED (SMED(SingleMinuteEchangeofDie), TQC (Total Quality Management), TPM (Total Productive Maintenance).

CONCLUSION

The first most visible results were found in production. Also, besides the minimum financial resources involved in introducing the Kaizen model, it is equivalent the reducing of the company-wide costs. Also, this method has shown the simple fact that nothing is perfect and that everything should be constantly and gradually improved.

Kaizen's business philosophy, by which management manages to achieve better, or more efficient results, is primarily reflected in improving the soft quality of products, reducing the time of production of products and the way of production, thus increasing productivity in the company.
Globally, the popularity of this way of managing the company is noticed. This popularity of the Kaizen management model in the organization is achieved thanks to the simplicity and effectiveness of the results it accomplishes. This model has no restrictions on the company's activity and size. Its successful implementation can be found in a variety of activities around the world.
The exceptionally important advantage of this model, in contrast to other organizational management models, is that this is an evolutionary process of change. On the one hand, the implementation starts very easily and quickly, gives instant and visible results. On the other hand, it is planned and adapted in the long run, leaving space for continuous improvement, and there is no fear of possible outdating ofthe way of managing. It can simply be said that this is a living method that is constantly being taught and improved.

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IMPROVING ERGONOMY AND MANAGING QUALITY IN THE FUNCTION OF EFFICIENCY INCREASING AND REDUCTION OF COSTS

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Abstract: Managers usually connect ergonomics with protection and safety at work and similar laws, and not with business performances. Maybe that is why it seems that the decision makers in many companies are not positively motivated to apply ergonomics, and for that reason, it is shown in this work how the improvement of ergonomics can cause the improvement of the company's business performances as well. A case study of the company in the retail sector is represented below, as well as the analysis which shows how the improvement of ergonomics can contribute to the efficiency improvement and then to the cost reduce.
Key words: organizational ergonomics, quality management, efficiency

INTRODUCTION

Human factor and ergonomics apply scientific information about human knowledge and behaviour, in order to support the design of products and systems that improve their well-being and performance. These factors and ergonomic professionals are researching the interaction of the human system on the individual, group and organizational level. The goal is to design products that enhance social, technical and organizational aspects of the system. Human factor and ergonomics are used for improving safety and productivity, especially in complex socio-techical systems (Hassall, Maureen and Xiao, Tania, 2015). The definitons of ergonomics and quality are overlapping considerably. Deficiencies in quality management, human errors and ergonomic issues often have the same cause, which can, in many cases, be monitored by the design of business, work place and environment, e.g. noise, light, position, load, pace and work content. Besides, the possibility of achieving high standard at work is an important precondition for satisfaction and well-being. Contradictions between these two fields are identified in terms of concepts, such as standardization, reducing variability and copying the best practices, which demands further research. Implementing the knowledge of ergonomics, especially in the field of design of work and human abilities, is of crucial importance for human and system performance. Ergonomics and quality management together have a great potential for improving work conditions and quality results, by satisfying the majority of interested sides (Eklund, J., 1997). The growth of products and services is a result of interactions between people working outside of the organizational, geographical, cultural and time limits. This has a significant implication on the human factor and ergonomics (HFE), especially on the systems being designed (Carayon, P., 2006). Today, many companies are going through some organizational tranformations so they could satisfy the changeable market demands. Therefore, in order to become more competitive, the supply chains (SC) are adopting new management paradigms so they could improve their performance. The implementation of new production paradigms demands a special concern about issues, regarding the human factor, in order to avoid problems with health, workers' safety and potential company loss (Figueira, S., Machado, V. C., & Nunes, I. L., 2012).

SUBJECT AND ISSUE OF THE RESEARCH

The issue of the research in this work is searching for the answer if the impovement of work ergonomics can have an influence on increasing quality and efficiency and, at the same time, on decreasing work costs. One specific issue is reflected in the fact whether quality checking of pneumatics can lead to the improvement in all of the above mentioned fields. The subject of the research in this work represents an analysis of the operation of forklifts in the company Mercator-S, by measuring the costs and work efficiency of forklifts in warehouses and through the procedure of necessary checks of the pneumatics and of the pattern depth.

RESEARCH GOAL

The scientific goal of this research is to recognize if and how the ergonomics can affect the improvement of quality, which has a significant influence on the increase of work efficiency and cost reduce, while the recognition of all the things that, in practice, contribute to the logistics development, optimal management of supplies and internal transport represent the social goal of the research.

METHOD AND ORGANIZATION OF THE RESEARCH

When choosing a method and organization of this research, it has been determined that all the necessary data can be received from the previous reports and that it can show if the improvement of ergonomics has contributed to the higher efficiency and/or to the decrease of the total costs of pneumatics maintenance. All the information is analyzed by applying the base index, so the numbers received for the years 2015 and 2016 are compared necessarily to the ones from 2014 which is, in this case, considered as a base. The total number of these vehicles has increased year by year, but the cost unit per vehicle or per kilometer traveled could show clearly if there was a cost reduce. In 2014 the rolling stock counted 120 forklifts, in 2015 – 133, while in 2016 there were 144 vehicles available. Apart from the semestral change of the total cost, the calculation method „Like for Like“ has been applied, where the total cost has been monitored in a way that the total growth of the number of vehicles does not affect the total cost value. In other words, everything has been calculated regarding the number of 120 vehicles, as in 2014.

THEORETICAL RESEARCH AND RESEARCH QUESTIONS

The integration of initiatives for quality management, especially quality management (TQM) and ergonomics, drew all the greater attention of scientists and practitioners (Taveira, A. D., James, C. A., Karsh, B. T., & Sainfort, F., 2003). According to Eklund, J. A. (1999), it is shown in many studies that the ergonomics has an influence on human performance. Lin, L., Drury, C. G., & Kim, S. W. (2001) indicated in their study a direct effect of the ergonomic variables on the quality results. Also the author Lewandowski, J. (2016) gives in his work basic principles of a new approach to the ergonomic aspects in the total quality management of companies. This approach regards a complete view on the ergonomic issues of the company. That is why the ergonomics has the potential to become a driving force for the development of new quality management strategies. Lee, K. S. (2005) also described in his scientific work how and why ergonomics should be promoted in the total quality management (TQM). He determined that the application of ergonomics in the TQM would be efficient in the improvement of workplaces and would result in productivity increase, cost savings and improved safety. Also, the authors González, B. A., Adenso-Díaz, B., & Torre, P. G. (2003) claim that the ergonomics and quality are important management aspects. In their work, they established a positive connection between the decrease of ergonomic problems and better quality records. Successful interventions of PE demand appropriate ergonomic training, clear responsibilities and the involvement of the right kind of people (Van Eerd, D., Cole, D., Irvin, E., Mahood, Q., Keown, K., Theberge, N., ... & Cullen, K., 2010). In a large number of business settings, ergonomics and quality initiative are being undertaken. For that reason, Drury, C. G. (1997) came to a conclusion in his work that the interaction between ergonomics and quality movement can bring benefits from both. The authors Yeow, P. H., & Sen, R. N. (2003) carried out an ergonomic study in order to improve work stations for electric tests in the factory of printed circuits (PCA) in the developing industry (IDC). The results were: average savings of annual reimbursement costs (from 574.560 US $), reduction of the refusal rate, monthly income increase, improvement of productivity, quality, working conditions of operators, health and safety at work (OHS) and the clients' satisfaction.

Creating new values should represent an operational priority in all sectors of the company. The operation and goals should be directed at increasing efficiency and decreasing costs on all levels (Nikolayevna V., 2015. pp.117). Managers usually connect ergonomics with protection and safety at work and similar laws, and not with business performances. Maybe that is why it seems that the decision makers in many companies are not positively motivated to apply ergonomics for the sake of health and safety. It is necessary that the ergonomics becomes an integral part of formulation and implementation of strategy in order for its role to be more important in the business world (Dul, J., & Neumann, W. P., 2009).

In this particular case, work ergonomics is essential because it has an influence on the job satisfaction and especially on its one part, regarding more pleasant working conditions. This is really important if you take into account the fact that people are often dissatisified with poor working conditions that interfere with them to achieve the expected results (Janićijević, N., 2008).

Precisely because of all of the above mentioned, in this work we decided to give answers to the following research questions:

- IP1: If the control and timely pressure supplementation of pneumatics improve the ergonomics and create better working conditions for the forkilft drivers, do they also influence higher working efficiency?
- IP2: If checking the pattern depth on pneumatics has an influence on more pleasant working conditions, does it also affect the exploitation age of tires?
- IP3: If the timely pressure supplementation and checking the pattern depth on pneumatics cause higher efficiency, do they also influence the cost reduce of the forklift tires?

CASE STUDY OF THE COMPANY MERCATOR-S

Until the moment of their integration, IDEA and Mercator-S were two separate companies whose logistic sectors had a daily task to supply their stores with goods. At the time, IDEA supplied 191 and Mercator-S its 126 stores. After the integration, i.e., merging the companies, which finished in November 2014, the company Mercator-S had 317 stores on the market that were supposed to be supplied. The portfolio of the retail network before and after the integration is shown in the Figure 1. (Figure 1.). Because of the optimization of the storage space, there was a great need for the rationalizaton of costs, as well as for the efficiency increase and the forklifts were one of the segments to which special attention was paid.

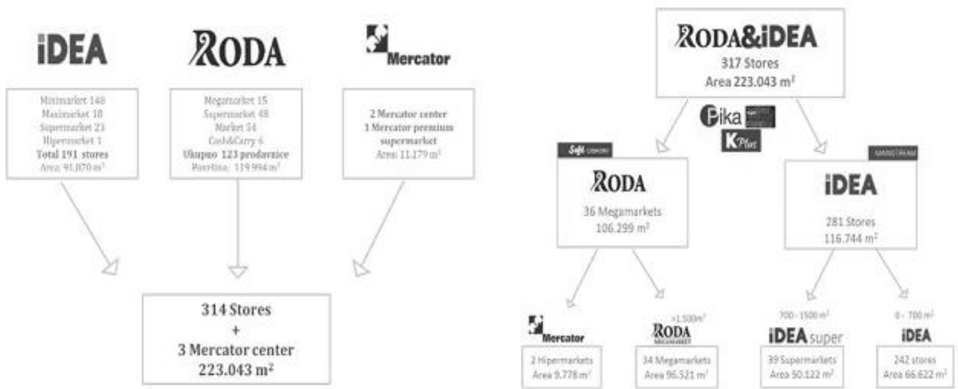

Figure 1 - Portfolio of the retail network before and after integration
Source: Mercator-S (2017).

A need for better usage of the expensive storage space appeared because of the work rationalization and cost optimization. In order to make storage transport more efficient, the company Mercator-S decided to introduce an extraordinary procedure of quality checks, apart from the regular ones. All drivers of forklifts situated in the warehouses got the task to check the pressure in pneumatics every

15 minutes and to change the pattern depth on them. If the pressure in pneumatics is lower than it is required, it comes to the supplementation of pressure, and when the tire pattern reduces as well and does not fulfill the required standard, the rotation of pneumatics is carried out.
The rotation of tires represents moving of pneumatics from one axle to the other, in order to accomplish their even wear and durability of the vehicles' performances. It depends on the vehicle type and on the drive. The distribution of mass between the front and the rear axle is different for all vehicles. Also, tire wear on different axles is uneven, because usually the drive is either on the front or on the rear axle, except for the vehicles with an all-wheel drive. So, it means that the tires are wearing unevenly, depending on the drive. In order to prove that the rotation of pneumatics and checking of the pressure in them can give some results, a case study has been done in the company Mercator-S. Movement of the total cost, number of kilometres traveled and number of vehicles will definitely show that the above mentioned activities are giving results.
In the Figure 2. (Figure 2.) can be seen the movement of the total cost in the last three years and, by applying the base index method, it is obvious that the level of costs is decreasing considerably. A semestral cost change indicated that, despite of the increasing number of vehicles, the total level of costs regarding the pneumatics maintenance, both in 2015 and 2016, is significantly lower, compared to the observed 2014. Apart from the semestral change of the total cost, a calculation method „Like for Like" has also been applied, in a way that the total growth of the number of vehicles has not affected the total value of the cost, i.e., everything has been calculated regarding the number of 120 vehicles, as in 2014. According to that criteria, the costs of pneumatics maintenance were lower by 20% in 2015 and by 40% in 2016, in comparison with 2014, which is considered as a base year in this analysis.

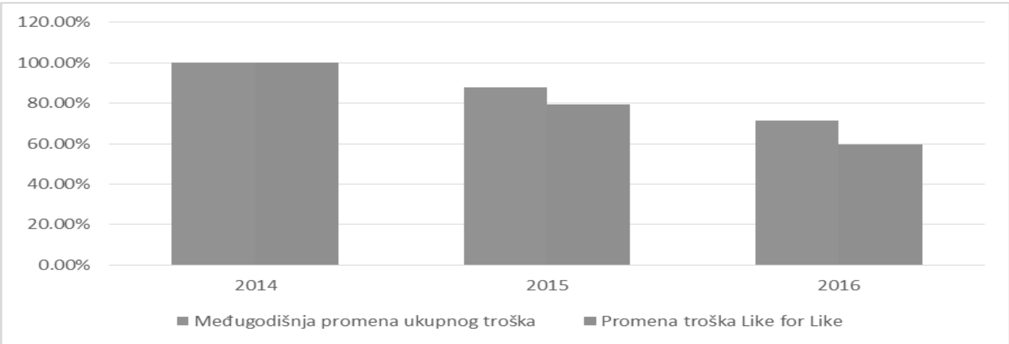

Figure 2 - Total cost of forklift trucks in warehouses
Source: Mercator-S (2017).

However, apart from the above mentioned analysis that, according to its total results, proved the claim about the cost reduce, one more analysis has been carried out. In the Figure 3. (Figure 3.), it can be seen a ratio of the total number of kilometres traveled, number of vehicles and of the cost per kilometer traveled. In that picture, by applying the base index, it is clear that the number of vehicles, as well as the number of kilometres traveled in 2015 and 2016 was growing, compared to the 2014, while the cost per one kilometer traveled recorded a significant decline. The cost per one kilometer in 2016 was lower by 46%, in comparison to the same indicator in 2014.

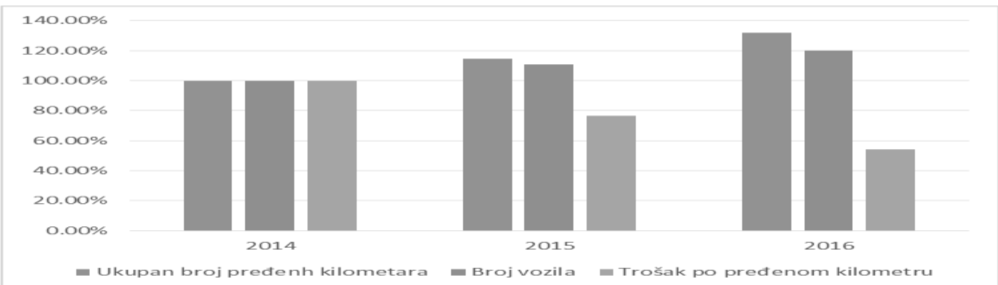

Figure 3 - Cost per kilometer traveled
Source: Mercator-S (2017).

From all of the above mentioned, it is proved that the quality control of pneumatics can have a great influence on reducing the costs of their maintenance. Besides, this quality control measurement has affected the efficiency of vehicles as well. In the Picture 4. (Picture 4.), one can see a number of kilometres traveled per vehicle in 2015, which has been increased by slightly more than 3%, and by more than 10% in 2016, compared to 2014 and despite the cost reduce.

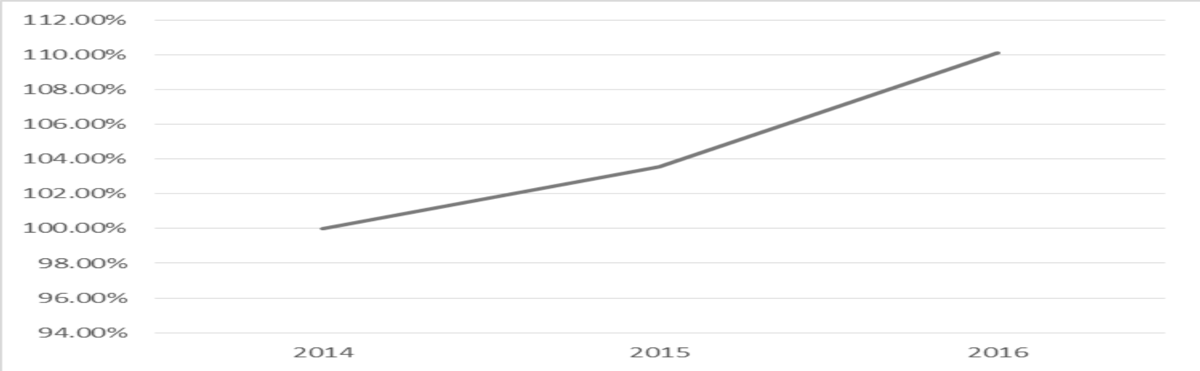

Figure 4 - Number of kilometers traveled per vehicle
Source: Mercator-S (2017).

CONCLUSION

In the case study of the company Mercator-S it is clearly seen that the improvement of the work ergonomics and efficiency has influenced significantly the company’s economic performances, i.e., the cost reduce. Here, in order to improve work ergonomics and increase efficiency, quality management has been carried out. The goal of introducing new procedures was to decrease costs and increase efficiency, which has been proved in this study. According to all of the above mentioned, it can be concluded that the work ergonomics is important because of several reasons:

1. Work ergonomics contributes to the efficiency improvement, as confirmed in the Chart 4.
2. Work ergonomics and efficiency increase contribute to the cost reduce, as shown in the Charts 2. and 3.

These data are a clear indicator that better work ergonomics definitely affects the increase of business performances of the company, that can be achieved, at least in the logistics and transport field, by various quality control measurements, that must be applied in this domain.

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IMPROVING PROJECT MANAGEMENT WITH THE ISO 21500:2012 STANDARD

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Abstract: This paper analyzes the main concepts of project management with the goal to identify other factors which may influence project success. Furthermore, the review of the ISO 21500:2012 standard will be addressed. Similarly, the integration of the mentioned standard in a work environment will be presented. The research has the goal to "shed light" and to clarify the importance of project guidelines and standardized project guidelines. In addition, project management tools and techniques will be previewed as an inevitable part of project success.
Key words: project management, ISO 21500:2012, integration, project tools

INTRODUCTION

Projects can be observed as a set of unique procedures and processes which are coordinated and controlled. The goal of projects is achieving company objectives [14]. Organizations, groups or individuals realize projects in various scientific, business or private fields. Project management has a crucial role in timely project realization [10]. In addition, project management can be defined as an endeavor with a definitive and defined beginning and ending with the goal to create new, innovative products or services [10]. It is certain that in order to achieve business excellence, companies have to create a "fertile" environment for effective project management [2].
The analytical nature of this paper is complementary to the growing number of other research papers that review the "giant" names of project success like Pinto, Slevin and Prescott [11]. Furthermore, the project life cycle will be addressed in order to understand the fundamental "driving force" of undergoing projects. Likewise, project success factors such as scope, time, costs, quality, stakeholder needs and expectations will be analyzed. It is rather important to develop highly applicable knowledge of project control, thus enhancing the effectiveness of projects and project results.
In this paper, the implementation of the ISO 21500:2012 standard will be reviewed. The remarkable feature of this standard is that it provides clear and concise framework for improving overall project management in an organization. Furthermore, this paper outlines the key elements of this standard. In addition, the ISO 21500:2012 standard provides guidance on important project managerial tasks [14].
This paper examines the ISO 21500:2012 framework, the tools and techniques of project management and the process of integration the ISO 21500:2012 standard into a work environment. An extensive research of literature was conducted in order to provide and suggest propositions that "shed light" on the importance of effective project management. The paper includes three main sections. The first section provides information about the concept and framework of project management. Second, the paper moves on to the techniques and tools which are used in exemplary project management processes. The third section gives a glimpse of the integration process of the ISO 21500:2012 standard in a work environment.

1. PROJECT MANAGEMENT FRAMEWORK

In order to execute precise project procedures it is necessary to strategically define the internal and external environment [16]. This is achieved with thorough analysis, documentation and reporting. Success of a project can be noted as an important success factor that influences business performance. Organizations which started multiple projects simultaneously often need an effective project success management system [9].
The project management framework has to take into consideration all the factors and external and internal variables that can affect the success rate and the expected results of a project. Yet, there is a big number of organizations that foolishly assume that project success is not entirely manageable.

Therefore it is necessary to outline the framework and the flexibility of adequate and effective project management and project success management.
Research showed that 85% of employees who work on a project, constantly conduct additional research and information mining [16]. This is somewhat understandable taking into consideration the importance of project results, as they are strongly correlated with business performance. Innovative approach becomes a necessity as traditional business activities cannot achieve good business performance indices such as quality, product, sales and price [17].
In order to easily examine the project management framework the project success analysis framework will be shown on Figure 1 [16].

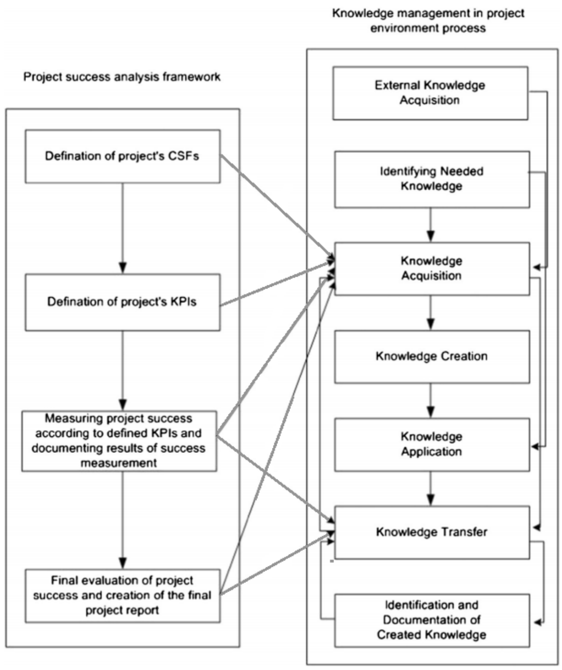

Figure 1. Project success analysis framework

Figure 1. shows that there are two main groups of factors in the framework. The first one is the project success framework and the second one is the knowledge management in project environment process. Furthermore, the project framework analysis includes the process of defining the company's success factors (CSF) and the key performance indicators (KPI). Additionally, mandatory measuring and documentation is required. The last activity is the evaluation of the project success and reporting.
Knowledge management in a project environment process includes knowledge gathering, defining needed knowledge, creating and using knowledge, transferring knowledge and identifying and documenting the results, and the gathered and newly acquired knowledge. This can simply be defined as intellectual capital management [6]. This framework is highly flexible and can be used for big variety of projects. It was noted that the usage of project management is very high in maintenance documentation of technical systems [1]. As indicated previously, the next section will overview project management tools and techniques.

2. PROJECT MANAGEMENT TOOLS AND TECHNIQUES

Project management is a process that incorporates various tools and techniques that help achieve goals and business objectives [5]. An interesting research suggested that there is a significant role of project management education, where employees are educated about the importance of effective project process control [11]. However, it is very time consuming to educate new workers on a project, as the senior project managers struggle to find time for the more important aspects of project overview and control [15].
An investigation showed that the main tools and techniques of project management include creating project teams, extensive project planning, Microsoft Project software, Gantt charts, critical path

methods, stage gate processes, earned value management, project charters and a vast number of other [10]. A more detailed presentation of project management tools and techniques is given in Table 1.

Table 1. Project management tools and techniques

Knowledge Area	**Tools and techniques**
Integration management	Project selection, project methodology, project charters, stakeholder analysis, work authorization process
Scope management	Project scope statements, record documentation, scope change analysis
Time management	Pivot and pie charts, Gantt charts, project network diagrams, PERT, milestone evaluation, Critical path analysis
Quality management	Ishikawa diagrams, quality audits, quality control charts and procedures, six sigma, TQM
Cost management	Return on investment analysis, payback analysis, business cases, case studies, project portfolio management and control, cost estimation software, financial reports
Communication management	Communication plan, project web sites, status reports, relationship control
Human resource management	Motivation and productivity techniques, conflict management, responsibility matrices, team contracts, resource histogram, intellectual capital management
Risk management	Risk plan, probability/impact matric risk ranking, Monte Carlo simulation

As Table 1. shows, it is clear that project management and control includes a wide set of functions which further define specific tools and techniques. Namely, depending on the project's type, size, function and final goal, the above noted tools and techniques can be moderately to severely modified, so it could accustom the specific needs of project managers and other team members [12]. Some of the main functions can be eliminated completely if the project is small or simple. Similarly, new functions and knowledge areas can be added such as documentation management and new innovation, product, service management [3]. Essentially, there are different type of management functions inside the whole project management process. To conclude this section, the following propositions are suggested:

Proposition 1: Project management success depends on the company' internal and external success factors and key performance indicators that define the activities of the company.

Proposition 2: Project management tools and techniques are highly flexible and modifiable, thus adapting to a wide variety of different project types, sizes and project goals.

The next section will describe the integration of the ISO 21500:2012 standard into a work environment.

3. INTEGRATING THE ISO 21500:2012 STANDARD INTO A WORK ENVIRONMENT

The integration process depends on the factors outside the organization and factors that are inside the organization [14]. Some of the main factors inside the organization are members of the project governance and the members of the project organization. Project governance includes the project steering committee or board and the project sponsor. Nonetheless, the project organization includes

the project team, project management team and the project manager. These are the internal members in project development.
Furthermore, the integration process involves many sectors and processes. Figure 2. shows that the organizational strategy is connected with the business case and the whole project environment [7]. Similarly, the project environment and project governance overview the three main processes: project management, product and support. In addition, benefits are the "mediator" between the organizational strategy and main operations. When implementing an ISO 21500:2012 standard, it is necessary to interpret all the functions and instructions in such a manner that the objectively defined processes can be used for a specific organization and specific project with specific goals [14]. A strong leadership is an imperative for successful implementation [8]. It can be discussed that without an effective and adequate project manager, the integration of a standard is very challenging, in some cases hardly possible.

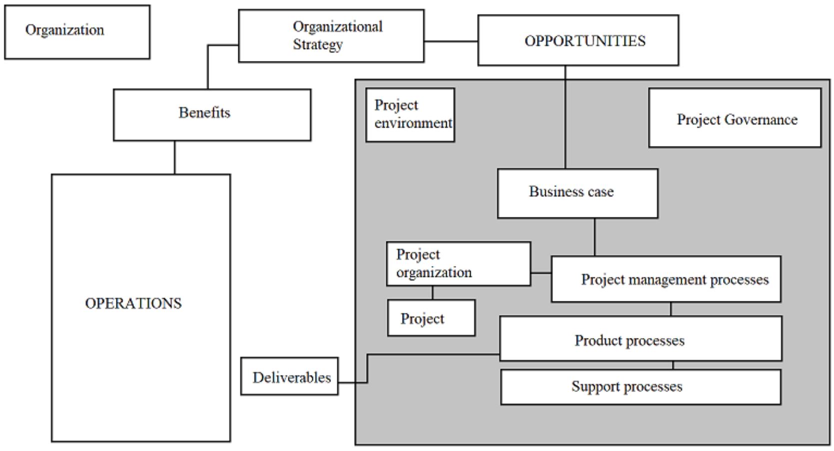

Figure 2. ISO 21500:2012 standard integration of processes

Every process in the integration process can be simply outlined in five groups: initiating, planning, implementing, controlling and closing [13]. Further, research showed that there are factors that influence project integration success and project success which need to be clarified in order to achieve the project goal [10]. Similarly, other research suggested that factors such as organizational culture, employee motivation, manager initiative and others, have a strong influence on the outcome of the new standard integration [4]. The major benefits of this standard are timely project execution, well defined processes and activities, higher productivity, lower execution costs, lower risk from failure [4]. As a closing part of this section the following propositions are noted:

Proposition 3: New project management standard integration requires a strong leadership that can withhold the pressure of deadlines, evaluation requirements and process control.

Proposition 4: Integrating project guidance standards requires the analysis of the company's processes and activities in order to modify and adapt the objective standard guidelines to a specific project environment.

4. CONCLUSION

The paper describes that there must be a sufficient amount of internal and external organization factors that comply with a project's requirements. This can be achieved in various ways. Following strict guidelines is helpful but not entirely effective. It is necessary to address factors such as culture, employee's motivation and intelligence. Without adapting the project's framework to the company's organizational strategy and activities, and vice-versa, there is little chance for success.

It can be argued that there is no sufficient information, as there are no identical organizations, just similar ones and therefore project management and project success is very subjective due to the uniqueness of the researched organizations.
Furthermore, this paper describes the necessity for a strong leading project manager, who can manage all the intricacies of the ISO 21500:2012 standard integration. This paper is designed as an analytical preview of project management as a driving force towards business excellence. This research will serve as a base for future studies that will involve project management and project management success.

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INTERNAL AND EXTERNAL EVALUATION AS MECHANISMS FOR QUALITY ASSURANCE IN SERBIAN SCHOOLS

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Abstract: This paper aims to describe the quality standards for educational institutions which are part of the quality assurance system and the mechanism for better communication between the main target groups in education. They have been adopted by consensus as a method for evaluating the quality of educational institutions and provide a clear, detailed and comprehensive picture of a quality school or the conditions in which such quality can be achieved. Special attention is paid to the internal and external evaluation that are at the centre of the quality education system and represent the most effective mechanisms for assuring and improving quality of school operations.
Key words: quality assurance in education, quality standards, internal evaluation, external evaluation

INTRODUCTION

Society is ever changing and now at a faster pace than ever before. The rapid evolution of technology, the increased globalisation and the unpredictable developments in society are some of the challenges to today's societies and, in turn, to education which presents a key element in the development of the nations and plays an important role in human capital development [7]. Moreover, education is also seen by many as a driver of social mobility with the potential to help improve the socioeconomic status of different social groups [5].
School education is one of the most important threads in the social and economic "weaving" of every nation. It requires significant economic resources of the country. High quality education is crucial for employment, social cohesion and the overall economic and social success of Europe. Therefore, there is a strong international movement to introduce modern quality assurance procedures that help ensure that national school education systems are as effective as possible. The main task of education systems in the world is to establish and ensure the quality of work of educational institutions. This implies:

- Responsibility of all actors in the education system;
- Generally accepted and harmonized quality standards for school operations;
- Application of standards in practice;
- Mutual trust;
- School autonomy.

Quality, however, needs to be continuously monitored and improved, which calls for effective quality assurance systems covering all education levels.

QUALITY ASSURANCE IN EDUCATION

The Quality Assurance concept was imported from business sector into the educational sector in 1980s and since than it has occupied a central place in the education policies of countries around the world and has been a powerful tool for improving the efficiency of education. There are numerous scientific studies in the field of education in which authors attempted to define precisely this concept. Author [6] suggests three different paradigms of quality assurance in education. They are: Internal quality assurance, Interface quality assurance and Future quality assurance. The Internal quality assurance focusses on improving the internal environment and processes, so the effectiveness of learning and teaching can be ensured to achieve the planned goals. The Interface quality assurance ensures that education services satisfy the needs of stakeholders and is accountable to the public. The Future quality assurance stresses ensuring the relevance of aims, content, practice and outcomes of education to the future of new generations. Biggs [2] divides quality assurance into two concepts, which are retrospective quality assurance and prospective quality assurance. Retrospective quality assurance focusses more on an accountability theme than on an enhancement one, whereas the prospective quality assurance concerns itself with improvement themes. The retrospective quality assurance looks back to what has already been done, makes a summative judgement against external standards, and it is not functionally concerned with the quality of teaching and learning, but with quantifying indicators of good teaching and good management. In this sense, the concept of retrospective quality assurance implies that quality can be measured easily by using a check list of external standards. The prospective quality assurance is concerned with assuring that teaching and learning does now, and in the future, will continue to fit the purpose of a school. This definition mentions that the aim is to ensure that the teaching and learning is "fit the purpose". Harvey [8] defines quality assurance as a process of establishing stakeholder confidence that provision (input, process and outcomes) fulfils expectations or measures up to threshold minimum requirements.

Quality assurance is a powerful means to improve the effectiveness of education. Its key principle is that the main actors at the forefront of education – such as teachers, head teachers and other stakeholders at school level (students, parents, school administrators and other staff, members of school governing bodies, the community) – are responsible for improving educational performance. Therefore, at the centre of quality assurance are school self-evaluation and development planning processes. However, these processes are not sufficient for ensuring improvement. They need to be part of a fully-fledged quality assurance system in which the national education authorities create the conditions and provide the support for performance improvement by schools [3].

Quality assurance in education can be understood as policies, procedures, and practices that are designed to achieve, maintain or enhance quality in specific areas, and that rely on an evaluation process [1].

In European Union, the basis of the quality assurance policy in education consists of internal and external evaluation as the most effective mechanisms for improving the quality of work at school.

INTERNAL EVALUATION

Self-evaluation or internal evaluation is a process initiated and carried out by schools themselves to evaluate the quality of the education they provide. The goal of internal evaluation is to improve the quality of work at school. Self-evaluation is also a sign that the school is ready to accept responsibility for its own work and development. It is performed primarily by members of school staff, and in some cases in collaboration with other school stakeholders, such as students, parents, or members of the local community. The 2001 Recommendation of the European Parliament and of the Council on European cooperation in quality evaluation in school education emphasises the interest of this approach for enhancing quality. The Recommendation calls on Member States to encourage school self-evaluation as a method of creating learning and improving schools [12]. Three basic questions are at the heart of the process of evaluation [9]:

1. How are we doing?
2. How do we know?
3. What are we going to do now?

The answers to these questions can primarily be given by:

- Teacher - self-evaluation, viewed from the perspective of teachers, means a continuous process of conducting, analysing, correcting and planning their own teaching practice and their own contribution to the entire life and work of the school.
- Pupil - self-evaluation allows the pupils to objectively examine and develop skills that will help them to create a habit of planning, monitoring, evaluating and improving their activities at school. This creates a culture of evaluation of both own work and the work of others.
- School leader - management and organization of school operations, as an important segment, quite logically, imposes the need for the school leader or members of the school or local administration to check their own efficiency and effectiveness in order to organize and provide as high quality conditions for the work of pupils and employees as possible.
- Parent - By involvement in the process of self-evaluation, the parent is given the opportunity to contribute to a more objective and more realistic school image through personal participation, as well as through assessing the work of others and to decide and conduct actions to improve school performance.

The participation of students, parents, and other school stakeholders in addition to school staff, is seen as one of the key features of successful internal evaluation, as it promotes a shared responsibility for the improvement of schools. Additionally, the participation of members of the local community in the process of internal evaluation may ensure that schools are more responsive to the needs of their environment.
In order to perceive the quality of school operations as a whole, it is necessary to think about the conditions in which the school operates, the processes that occur in school and the outcomes or the results that the school achieves (Figure 1.).

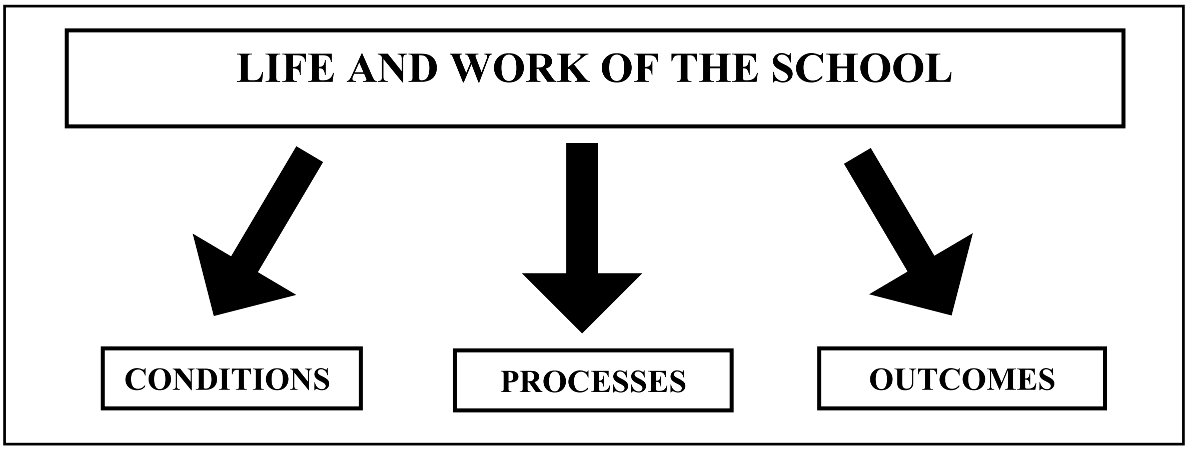

Figure 1. Categories for identifying key areas [4]

These three categories were the basis for defining and identifying key areas:

1. Curriculum - By evaluating the quality of the school curriculum, its structure, the quality of teaching, compliance with the specifics and needs of students and the relation of the development plan with the results of the school internal evaluation are assessed
2. Learning and teaching - Planning and preparing for teaching and other forms of educational work, realization of teaching, student activity, way of learning, assessment, monitoring and reporting are monitored and evaluated in this area.
3. Attainment - in this area it is possible to evaluate: success in learning, quality of knowledge, pupils' achievements in qualification and entrance exams and competitions, student motivation.
4. Support for pupils – This is an area in which the quality of care for students, support of their learning, social and personal development, professional orientation are perceived.
5. Ethos - An area in which the quality of climate and relationships in school and in the environment, community, cooperation, sense of belonging to school and environment, equity and partnership are evaluated.
6. Management, leadership and quality assurance – An area in which professional competence, skills and abilities of the manager, management efficiency, team work, school management, planning and implementation of the school development plan, reporting on quality of work and quality assurance are evaluated.
7. Resources - In this area, personnel, space, equipment and disposal of financial assets are evaluated.

Self-evaluation is done in key areas by selecting appropriate areas of evaluation and applying indicators. Areas of evaluation are narrower thematic units (in relation to key areas) that closely define the subject of monitoring and evaluation. Each key area is divided into areas of evaluation in contents similar to those within which the quality achievement is evaluated.
Indicators represent the next step in the concretization of individual areas of evaluation. They even more precisely define the contents and activities in them. Each area includes several indicators.
Levels of performance are another step in the specification of individual areas. They contain a clear and precise description of the performance of individual indicators within a particular area. Based on

the experience of other countries, with the intention of avoiding the established practice of resorting to the medium value, the evaluation of what is achieved is done using a four point scale. Each level has a certain meaning, from the highest level 4 to the lowest level 1:

- Level 4 represents the most desirable situation, the situation that the school seeks to achieve or to maintain. Strengths dominate, there are very few weaknesses and any that do exist do not diminish the pupil experience. Whilst an evaluation of 4 level represents a high standard of provision, it is a standard that should be achievable in all schools. It implies that it is fully appropriate for a school to continue its provision without significant adjustment. However, the school would always be expected to continue to take advantage of opportunities to improve.
- Level 3 is characterised by strengths, but one or more weaknesses reduce the overall quality of the pupil experience.
- Level 2 reflects the presence of certain strengths but some important weaknesses have an impact on the quality of pupils' experiences and on the quality of school operations. This situation requires the undertaking certain actions to eliminate the observed weaknesses.
- Level 1 indicates that the weaknesses prevail which jeopardizes progress and development of the school.

The process of internal evaluation involves the following steps [4]:

- Establishing a school team for internal evaluation;
- Choosing the monitoring and evaluation subjects;
- Creating an internal evaluation plan;
- Preservation, protection and disposal of data (evidence);
- Processing and analysis of the obtained data;
- Report writing;
- The action plan;

EXTERNAL EVALUATION

External evaluation of schools is a well rooted approach to quality assurance in Europe. External school evaluation deals with the activities carried out within the school without seeking to assign responsibility to individual staff members. Evaluation of this kind aims to monitor or improve school quality and/or student results. External evaluation is conducted by educational advisors from the Ministry (evaluators who are not staff members of the school concerned, and reporting to authorities responsible for education.), and, if necessary, by representatives of the Institute for evaluation of the quality of education. External evaluators have mastered a mandatory training program and use a unique package of instruments. This ensures the uniformity and quality of processes and products, as well as the objectivity and reliability of the assessment which evaluates the quality school operations.
The external evaluation is regulated by Article 48 of the Law on the Foundations of the System of Education ("Official Gazette of the Republic of Serbia" No. 72/2009, 52/2011, 55/2013) and together with the self-evaluation is a part of the system for ensuring the quality of education.
The quality of work of primary and secondary schools is assessed on the basis of 30 quality standards related to the seven key areas of school operations. Each standard is presented through a number of quality indicators (from four to six), which totals 158 indicators of quality [11].
There are four categories of standards in the Framework for external evaluation: [10]:

- Key standards that are pre-defined for all institutions in which the key priorities of the institution's development can be recognized in relation to regulations and strategic documents pertaining to the education system;
- Additional standards that are pre-defined for all institutions relate to the educational work of the institution in the narrow sense (teaching and students' achievement);
- Selected standards (five) determined in the process of preparing the evaluation team which means that the team of evaluators determines a group of five standards that they consider to be specifically important for a particular school;
- Remaining standards (10 standards that are not in the first three groups of standards).

Practical process of implementing external evaluation is divided into three phases:
1. Collecting and analysing data on single schools. In most cases, evaluators collect a variety of data from different sources prior to a school visit. The nature of documents and data collected and analysed falls in one of the four following categories:

- Statistical data on performance and other quantitative indicators: the main indicator is students' attainment or performance in national tests, sometimes benchmarked at regional or national level or with schools of similar socio-economic contexts. Such data is usually complemented by other quantitative information, such as class size, pupil: teacher ratio, number of children with special needs, rate of early school leavers, turnover of teachers, or pupil and staff attendance records.
- Reports and other qualitative documents: inspectors make use of previous external, and where possible, internal evaluation reports. Other documents are also consulted, such as the school development plan, the pedagogical offer, the school website, and general school policy documents.
- Administrative documents: timetables, annual school calendar, minutes of board meetings, activity schedules, school layout plans, or internal regulations are consulted. Specific documents are also taken into account, such as the procedures for handling complaints, schedules for continuous professional development, financial reports, or decisions issued by the school head.
- A source of information also derives from various school stakeholders, such as school leaders, teachers, parents, pupils, or representatives of the local community. However, such information is not always gathered prior to the school visit, especially when information is collected through interviews or during meetings.

2. Visit to the school to observe practices, inspect documents, and consult in-school actors as well as other relevant stakeholders. Visits are meant to provide evaluators with first-hand evidence of school performance and functioning and are organised around three main activities:

- Interviews with staff (Interviews and discussions mainly take place with school leaders and other representatives of the school management. Teachers are also often interviewed, as well as other school staff);
- Classroom observation;
- Inspection of school activities, premises, and/or internal documents (Usually, evaluators visit the school facilities, verify administrative documents, and observe pupils during breaks to better understand the school climate.).

3. Compiling the evaluation report. The work of evaluators, their findings, their judgements, are described in a final evaluation report. Based on the final evaluation report, the school makes a Plan for improving the quality of school operations in areas defined by the quality standards of school operations, on the basis of which the development goals defined by the development plan of the school can be changed, and submits it to the school administration.

CONCLUSION

Establishing a quality system is necessary in all areas of work as well as in education which influences the development of the society as a whole. Internal and external evaluation are at the centre of the quality system of school education in Serbia. This means that schools, as institutions of professionals and experts, through self-evaluation (internal evaluation), have the opportunity to plan their own development and to be equal partners to the educational authorities in establishing, improving and securing quality that through external evaluation provide information on the quality of school operations, help schools to reduce subjectivity of self-evaluation and point out the strengths and weaknesses on the basis of the collected evidence.
Quality assurance encompasses all aspects of school life. Therefore, internal and external evaluation as mechanisms for quality assurance i Serbian schools can focus on various subjects: schools, school heads, teachers and other educational staff, programmes, local authorities, or the performance of the

whole education system. It includes ensuring that equality and fairness are embedded in the day to day work of schools. Quality and equality are 'built in', not 'bolted-on'. It is about establishing an ethos that only the best will do. A school that reliably knows to determine and evaluate the effects of its work and life in whole or in some segments and which, based on self-evaluation, can develop and improve its own development, is on a good way to build its own quality assurance system.
Getting quality assurance embedded in the way school thinks and does things is the responsibility of education authorities, head teachers, teachers, pupils, ancillary staff and parents. By working together, they can make a significant improvement in the quality of Serbian education.

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INNOVATION CULTURE OF ORGANIZATION

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Abstract: In modern business environment, organizational behaviour and organizational culture present essential part of business. A dominant role which organizational culture plays in achieving the economic performance of the organization, is visible in the process of initiating and implementing organizational changes. Innovation in organizational context leads into a positive changes in efficiency, productivity, quality, competitiveness and market share. Culture of organization determines the creation of cognitive schemes of the employees, encourages their internal integration, identification with organizational values, teamwork but also affects the way of defining the goals and vision of the organization. Awareness of different cultural behaviours, especially in fashion field can be crucial for strategic management.
Key words: innovation, organization, culture, fashion industry, organizational changes.

INTRODUCTION

Cultural changes are the main resource for survival and an engine of growth and development of modern organizations, and thus the functioning of organizations determined their behavior. In addition to numerous challenges in managing placed before managers for inclusion in the European integration process is to motivate employees, because the greatest impact on the success of having people as a key business resources. Right organization and organizational changes incorporated with cultural innovation present successful management strategic with constant changes, globalization, transparency in technology increase the working performance of the company. Knowledge and skills, or human capital is a resource that can be an initiator, but also a limiting factor for economic growth. [1]

Regardless of whether the organization belongs to fashion of any other sector investment in developing the skills and abilities of its employees, culture and organizational behavior in general, their professional advancement and motivation provide job security, have an adequate system of evaluation and remuneration as well as success in the competitive global business conditions.
Organizational culture belongs to the field of management who studies the social and psychological aspect of the organization. There must be harmony between organizational culture and management principles that the organization successfully operated.

Problem witch organizational culture is that it can not be precisely defined, because it is something that is perceived, felt and guessed. It consists of attitudes, values, norms of behavior and expectations that members of the organization share.
There is no such thing as the agreement about what the culture is, but there is a consensus about how to describe the organisational culture in terms of values, norms and practice [2]:

- The values indicate what is it in an organization that the members believe in, and it is more valuable than what they do or have. It is important to differentiate between the acknowledged values discussed, but that do not affect the behavior, and the values that truly motivate the behavior of companies.
- Norms are sharing beliefs about how people should behave in the organization, or how to do their job. Norms are expected patterns of behaviors.
- Practices are formal and informal routines that are used to realize the job in the organization. Each practice, formal or informal, has a specific role and rule.

Culture exists at different organizational levels. Values are deeply embedded, and this knowledge is difficult to express and even more difficult to change. On the other hand, standards and practices are much more visible and easier to identify by the employees. The most direct way to change a behavior is to change the practice which generates that behavior. New behaviors result from new practices and they change norms over time, which will allow long-time support for more efficient usage of knowledge. In modern business conditions, which are characterized by exceptional dynamics and intensity of change, it is important to point out the role of organizational culture in determining the organization's ability to adjust to changes. The understanding concerning the influence of organizational culture on the ability of organization to react will have great importance in realizing its impact on fostering innovation in it. [4]

INNOVATION CULTURE

Creating a brand and success comes largely as a result of innovation. While competitive advantage can arise as a consequence of the size of the company or disposition of resources, the increasingly dominant position in the market is occupied by those companies that are able to mobilize knowledge, technology skills and experience to constantly create new products, processes and services.[3]

The organizational culture that creates a climate where it fosters creativity, creation and exchange of ideas, where both collective and individual knowledge are properly used, is the culture of innovative organization that builds a favorable atmosphere in the organization to generate and support innovation.

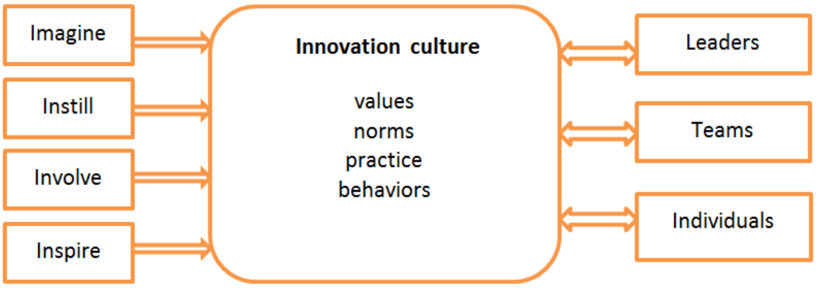

Figure 1. Organizational culture

Comparative review of the data in Table 1 shows the characteristics and differences between the traditional corporate culture and the culture of innovative organization. [4]

Recent studies and literature reviews indicate different characteristics of innovative culture within organizations. The ability to focus on customers is seen as highly-ranked factor for the development of innovative culture. However, the same sources think that this individual approach does not guarantee that the culture will be innovative. Current users can not see the possibilities of relevant technological changes, as well as the ways and means by which companies can conquer new markets with different demands by the customers.

Current and potential customers in recent decades have been the ones who manage and influence the innovations in companies. Today the organizations are those which take the idea of focusing on the consumers but in a different way, through the absorption of consumer ideas. [5, 6]

Table 1: The difference between traditional and innovative organizational culture

Predictability	Unpredictability
Tendency towards stability	Tendency towards innovations
Focus on the core of competencies	Focus on the limits of the organization
Evaluating success	Evaluating failure
Strengthening the organizational hierarchy	Strengthening the organizational network
Hierarchical power	Focus on creative tensions

Avoiding surprises	Accepting surprises
Focus on internal knowledge	Focus on both internal and external knowledge
Efficiency through standardization	Efficiency through innovation
Prolongation of the status quo	Leaving the status quo
Avoiding changes	Accepting change
Measuring stability	Measuring innovation
Seeking data to confirm the existing management model	Seeking data to contradict the existing management model
Seeking accuracy	Accepting ambiguity

In order to be successful in changing the organizational culture which supports and encourages innovation, companies need to have sufficient resources and opportunities in creating the organization in which there is a strong teamwork, communication, trust, sharing knowledge, creative people, risk tolerance, and many other elements that are of great importance in developing, fostering and supporting innovation. In fashion industry where creativity and fast actions are the most important, cultural and enviroment changes present specific field for human resourse, finding specific strategis for specific fashion customers. Idea of researches was to show differeces and habits of different fashion brends.

RESEARCH RESULTS

In an effort to examine the characteristics of organizational cultures in local companies in terms of organizational changes, a sample survey was conducted in September and October 2016 covering 14 fashion companies in Serbia which were of different size and the ownership structure. Fashion brands which were surveyed are: Afrodite mode collection, Artex, Brem, Ivatex, Ivković, Jasmil, Kika, Leonardo, Luna, Sanatex, Đukić-MB, TibStil. Tiffany Production and PS Fashion. Data were collected through surveys using pre-designed questionnaires which were completed by 500 randomly selected respondents. The questionnaire was designed to obtain information about the studied variables: attitude towards changes, factors that affect the implementation of organizational changes, the causes of resistance to changes, characteristics of organizational culture, qualities of leaders, leadership styles, sources and distribution of power, preferences to teamwork and fostering creativity and motivational factors.

On the basis of the data obtained during the research the following conclusions can be drawn:

1) National culture in Serbia is in the primary classification marked as a culture with very tight tolerance of uncertainty. In domestic fashion enterprises there is a surprisingly high percentage of respondents (78%) who answered that they are willing to engage into a process of organizational change.

This willingness to change is logical, given the fact that our companies are facing numerous problems and their very survival is at risk, so changes occur as a necessity that can not be ignored. This was certainly contributed by the arrival of a large number of foreign companies on our market, bringing the specific values of their national cultures, including larger tolerance of uncertainty.

2) The largest number of respondents believe that the most important is the involvement of all employees in creating change (51%) and the support of managers in the implementation of change (36%), whereas a number of employees responded that it is the awareness of a clear vision of the future. This confirms, beyond doubt, the collectivist orientation of our culture in which people feel that it will be far easier for them to deal with the changes if there are a lot of members of the organization involved.

3) Having in mind the standard classification of Harrison and Handy, most of our companies are dominated by the culture of role (bureaucratic culture). Thus, 61% of respondents said that the most important thing in their companies is to respect the established rules, procedures and standards. In second place (22.7%) there is the efficient and professional carrying out tasks, which implies the culture of the task, while 9% of respondents said it is essential to strictly respect the decisions of the manager no matter what, which is equivalent to the culture of power.
Only in 7.3% of cases the most important thing is the individual development of employees, which can be considered a culture of support. In fashion companies a teamwork as a characteristic of more flexible types of cultures is represented to a very small extent. In 55% of companies it is poorly represented, while in 17% it is not represented at all. Of the total number, 28% of respondents said that teamwork is very common in their companies and it mainly refers to highly successful companies.
These results are alarming, considering the fact that modern forms of organization are increasingly based on teamwork, and that classical organizational units transform into multifunctional teams of high flexibility and interconnectivity. This companies are also characterized by an even distribution of power, which is not the case in the analyzed companies, because as much as 83% of respondents said that the power in their companies is very unevenly distributed across organizational units.
This implies the prevailing hierarchical structure and greater centralization in decision-making which, also, is not in line with modern trends in the design of the organization, but is consistent with high distance of power which is the characteristics of our national culture.
4) To the question "To what extent does your company value creativity and individual initiative?" 57% of respondents indicated that it is valued a little, up to 29% that it is not valued at all, making a total of 86%, and it is a very alarming result. Only 14% of respondents said that creativity and individual initiative are highly valued in their companies and it shows again that there is a collectivist type of national culture in our country.
5) Large distance of power as a dimension of national culture is expressed through the relationship of leaders towards the employees. Even 70% of respondents said that their managers are willing to listen to their ideas and suggestions a little or not at all, and 66% said that managers almost never try to understand their problems and needs. These results indicate poor communication between managers and employees which results in poor performance of the company, and in the process of implementing organizational changes it can create many problems and make it more complicated.
6) Researches of dominant source of power of the leaders in fashion companies indicate that half of respondents believe in the competence, abilities and moral qualities of managers and is therefore ready to follow them, making them certainly more acceptable sources of power than the power of punishment or formal position in the organization.
7) It is a directive leadership behavior which dominates in fashion companies, i.e. a task-oriented behavior, that the participative style is partially represented, and that the supportive behavior, or the one directed towards relationships, is represented in a very small percentage, which are the characteristics of styles related to high distance of power and bureaucratic culture.
The fact that it is all about the tendency for changes and low tolerance of uncertainty is confirmed by the very high percentage of 55.6% of the respondents who replied that they prefer working in an environment with clearly defined roles and tasks of each individual in which everybody knows what his job is, compared to the environment where they are given the option to create their own job, make decisions and take responsibility, preferred by 44.4% of respondents.

CONCLUSIONS

Aiming to make the process of organizational change successfully implemented, the organizational culture must be based on the values into which a tendency to changes is incorporated, otherwise, before starting the changes it is necessary to carry out their redefinition and adaptation. It can be viewed from many different aspects depending on whether the focus of research are dominant values of the organization, the relationship to changes in the environment or the intensity of interpersonal relations of employees.

The dominant influence on the characteristics of organizational culture is seen through cultural characteristics of different national communities. The study, the results of which are presented in this paper, demonstrates causality of characteristics of organizational culture of the local companies to the national specificities and, on the bases of them, formed prevailing values of employees.

National culture, which is characterized by high distance of power, collectivism and low tolerance of uncertainty implies in most cases the bureaucratic organizational culture that is characterized by clear hierarchy, strict obeying rules and procedures, overwhelming centralization of decision-making and a very weak tendency to changes, providing strong resistance to their implementation. However, when asked directly, employees in a relatively high percentage say that they are willing to change on the condition that a number of other employees take part in them, suggesting a high degree of team spirit.

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REDUCTION OF RIGHTS ON DIGNIFIED WORK IN SERBIA

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Abstract: The Republic of Serbia can not boast of decent work, given the fact that it has reached a record when it comes to the unemployment rate, bearing in mind that it is not just about those who are on the National Employment Service records. The general public increasingly leads to suspicion of the unemployment rate, the expert public disputes data on the increase in the number of employees, while representatives of the government politically interpret the statistics of work and present it as evidence of their own contribution to economic development. Is the Serbian worker far from decent work, did the amendments to the Labor Law ease the dismissal of workers, or were they provided with basic labor rights? Do workers often consciously consent to various compromises in the desire to get a job, all in order to ensure basic existential needs for them and their family? On the other hand, when employers would not receive workers for work without a signed employment contract, then they would not be in a situation of blackmail, and these issues would not adorn the cover of public media.
Key words: dignified work, unemployment rate, compromise

INTRODUCTION

Long-term unemployment in Serbia is high and is continuously increasing. The fact that citizens in their country can not live from their work is more than alarming. The high unemployment rate, the inability to find an adequate job, the difficult situation on the labor market - all these are the problems that both employers and workers face.

There are many examples of people who do not get an employment contract on the first day of work, believing it is a serious firm or a reputable employer, because everything will be resolved as agreed. Certain insecurity occurs when other workers get to know each other and they are also heard that they have been working for some time without a job contract. Culmination arouses when the employer shifts his mind and decides to invite the employee to a conversation to offer him new conditions of employment, much different from the agreed, higher salaries instead of the application, the example works. Every one of us heard at least one such story from his surroundings, or did he find himself in such a situation and we can not ask ourselves what else can be done differently? Do you pay off employers in such cases to risk big penalties? Not really, but why do these employers risk and do not enter into a work contract before they start work? Just because I can. Neretko, in such situations, we become an unfair competitor to ourselves, because, if an employer can choose between a worker for whom he has to pay taxes and contributions, and the one who will pay it "on hand", the answer to the question of who to choose can easily be understood. In such situations, it is also important that the employee hand over to the employer a request for the protection of rights, which in this case is the conclusion of an employment contract. On the other hand, an employer who employs black workers with high misdemeanor penalties also risks a ban on work, and so does the stability of his business, as far as the law is concerned. Although the Labor Law greatly complicates the termination of the employment contract, it gives the employer some freedom to cancel the employment contract, unless it is satisfied with the worker's work.

Getting into the moor of regulations and legal provisions is a nightmare for employers. Different laws, regulations, and procedures that the employer must know and apply is covered in the mass of various provisions whose disregard can lead to serious difficulties in the company's operation and even to its closure. Whether the employer, in accordance with the Labor Law, checks the inspection of the work whose activities are aimed at suppressing black work, reducing the number of violations of radon-legal relationships and safety and health at work, as well as the perception of fatal, severe and collective injuries at work.

STRATEGIC GOAL'S

The Labor Inspectorate's work plan in 2017 is aimed at achieving the strategic objectives of the labor inspection [1], such as:

- Redressing the work "in the black" and reducing the number of injuries of radon-legal institutes in the field of labor relations determined by law, collective agreement and labor contract;
- Reducing the number of occupational injuries and occupational diseases by minimizing job-related risks in accordance with laws and practices;
- Suppressing the gray economy by translating unregistered entities into legal business;
- Identify priorities in addressing issues related to occupational safety and health and the area of employment for categories of particularly vulnerable groups of employees - issues related to women's workforce (maternity protection - pregnant women and maternity), child labor, work of persons with disabilities, work of volunteers , the work of foreign holders, etc .;
- Promoting prevention and prevention culture in the field of occupational health and safety and in the area of labor relations (awareness raising and public information) with a special focus on the small and medium-sized enterprises and high-risk activities (construction, chemical industry, agriculture, etc.).

The proposal of the annual plan and activities of the organizational units is also made on the basis of the analysis of the situation in certain activities, municipalities, individual employers, on the basis of the requests of employees for protection of labor rights, as well as on the basis of the analysis of the application of certain law institutes [2]. Heads of organizational units are obliged to submit the Work Plan Proposal for 2018 by December 25, 2017 at the headquarters of the Labor Inspectorate [3].

Table 1. Tabular overview of planned activities [2]:

Month	**Control area**		
	Work relations	**Safety and Health at Work**	**Integrated control**
JANUARY	Preparation of work reports Wholesale and retail trade Catering	Preparation of work reports Manufacture of food products Controls	Wholesale and retail trade Controls
FEBRUARY	Wholesale and retail trade Manufacture of bread, pastry and cakes	Machining of metals, manufacture of machines and metal products Manufacture of bread, pastry and cakes	Catering Betting and casinos
MARCH	Personal service activities Financial activities - banks and insurance companies Car repair and maintenance activities (caravans, vulcanizers repair service, etc.)	Manufacture of textiles and textile products; Processing of leather and production of footwear and leather goods Car repair and maintenance activities (caravans, vulcanizers, etc.)	Driving schools, computer schools, etc. Autocentres - sales and service of vehicles
APRIL	Slaughtering of animals, processing and processing of meat (slaughterhouses, butchers, etc.) - complete surveillance Production of ALU and PVC joinery Exchange offices	Construction Slaughter of animals, processing and processing of meat (slaughterhouses, butchers, etc.) Production of ALU and PVC joinery	Building materials stores and other wholesale trade

MAY	Construction Private medical and dental offices and health centers Pharmacies Medical laboratories	Construction Collection, storage and processing of all types of waste Metal casting Manufacture and processing of paper and paperboard Printing	Agricultural and veterinary pharmacies
JUNE	Construction Youth Cooperatives - full control Agriculture Processing and wood processing	Construction Processing and wood processing Manufacture of furniture made of wood and boardboards Agriculture	Treatments for beautification (hairdressers, beauticians and others) Other personal services
JULY	Construction Catering and tourism (hotels, motels, restaurants) Purchase, conservation and processing of forest products, preservation of fruits and vegetables (cold storage)	Construction Cutting and shaping of stone Purchase, conservation and processing of forest products, preservation of fruits and vegetables (cold storage)	Tourist agencies Centers for entertainment and recreation of adults and children
AUGUST	Construction Agriculture - Animal husbandry (farms) Manufacture of alcoholic and non-alcoholic beverages, breweries, water factories, etc. - Full control	Construction Agriculture - Animal husbandry (farms) Manufacture of alcoholic and non-alcoholic beverages, breweries, water factories, etc.	Retail trade of fuels for motor vehicles (petrol stations)
SEPTEMBER	Construction Growing and cutting of forests Homes for the elderly - full control Production and transmission of electricity - complete control	Construction Growing and cutting of forests Production and transmission of electricity Machining of metals, manufacture of machines and metal products	Cleaning and maintenance of buildings Physical-technical security of facilities and people
OKTOBER	Public enterprises whose founder is local self-government is full control Activity of private employment agencies - complete supervision Human Resources Assistance Agency ("Leasing" Workforce) Manufacture of chemicals and chemical products - complete control Production of base lubricating oils and fats Preparation of the Work Plan Proposal for 2018	Construction Public enterprises founded by local self-government Production of sugar, oil Agency for the transfer of human resources ("leasing" labor force Manufacture of chemicals and chemical products - complete control Production of base lubricating oils and fats	Printed and electronic media Services of mobile, internet and cable providers
NOVBEMBER	Schools - full control The activity of food production and distribution	Construction Manufacture of rubber and plastic products Manufacture of medicines Communal activities	Activities of passenger traffic and transport of goods - taxi services, bus transportation, freight forwarding and similar.

DECEMBER	Veterinary clinics - full control Shopping centers Kindergartens	Machining of metals Production and processing of coffee, teas, production of ready-made food, confectionery products and other food products	Sports centers, fitness and spa centers, etc.

SCOPE AND EFFECTS OF EXECUTED INSPECTION CONTROLS IN THE PERIOD 1 JANUARY - 31 DECEMBER 2016

In the period 01. January - 31. December 2016, the Labor Inspectorate undertook measures and activities in the field of labor relations and safety and health at work with the primary goal of ensuring the implementation of the provisions of the Labor Law, the Occupational Safety and Health Act, The Law on Strike, the Law on Prevention of Abuse at Work, the Law on Gender Equality, the Law on Protection of the Population from the Exposure to Tobacco Smoke, the Law on the Protection of the Accuser. The Law on sending employees to temporary work abroad and their protection, the Law on Volunteering and other laws, by-laws and collective agreements.
Priority action was aimed at reducing the number of occupational injuries and occupational diseases, as well as the suppression of "black" work.
The Labor Inspectorate carried out a total of 53,069 inspections, on that occasion 19,472 persons were found on actual work - work "in black" (including the number of persons without contract for work in both registered and unregistered entities), which is about 19% more than in In 2015, when 16,408 persons were found at work "in black".
After the supervision, the employers established a working relationship with 17,589 persons who were caught on the job "in black", ie 44% more persons than in 2015, when employers had an employment relationship with 12,250 persons found at work "in black ".
In 2016, a total of 10,419 decisions were taken on the imposition of removal of identified irregularities, as well as 478 decisions on prohibition of work at the place of work[4].
3,571 requests for initiation of misdemeanor proceedings, 1,084 issued misdemeanor orders and 62 criminal charges against responsible persons were filed. Based on submitted requests for initiation of misdemeanor procedure, employers were fined in the amount of 289,588,350.00 dinars.
813 unregistered entities were found, whereby, in addition to natural persons who performed the activity unregistered, another 459 persons were employed at work "in black". Of the total number of unregistered entities, 503 were immediately registered in the Register of Business Registers Agency[5].

DISCUSSION

The highest employment growth in 2016 is recorded in self-employment and is 18% higher. The number of self-employed and other workers is smaller in formal and informal ones sector, and the number of self-employed without workers in the informal sector is higher by 32%. The large share of self-employed workers without a worker of 41% and assisting family members of 36% in the total number of informal employees suggests that this is a low-productive and radon-intensive agricultural sector, and a weak growth of jobs in the formal economy. Agriculture presents itself as the only source of income for more than 500,000 employees, and this is largely the production for its own needs.

CONCLUSION

Without dignified labor, there is no exit from poverty. The fact that millions of unemployed, 50% of young people do not have a job, that our earnings are the lowest in Europe and the environment, that the minimum wage is one of the lowest, that some 600,000 people irregularly receive wages. The right to dignified work is endangered by those who abused at work. Whether it sexually harasss, threatens, insults, humiliates the employee and its results, the goal is to abuse the abused worker by worsening the conditions of work or to make him isolate himself and leave the job himself. In America, the cost of abuse at work is estimated at about $ 4 billion a year. We respect the right to dignified work.

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STUDIJSKI PROGRAM MAŠINSKO INŽENJERSTVO NA TEHNIČKOM FAKULTETU „MIHAJLO PUPIN“, UNIVERZITETA U NOVOM SADU

MECHANICAL ENGINEERING STUDY PROGRAM AT THE TECHNICAL FACULTY "MIHAJLO PUPIN", UNIVERSITY OF NOVI SAD

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Uvod
Studijski program Mašinsko inženjerstvo je napravljen iz dosadašnjih studijskih programa (usvojenih 1988. god.) : Diplomirani inženjer za razvoj - mašinske struke, kao i studijskih programa (usvojenih 2006. god. i 2010. god.): Industrijsko inženjersvo - mašinske struke, Upravljanje tehničkim sistemima sa modulima: energetika, procesna tehnika, održavanje mašina, ekologija, medicinsko inženjerstvo.
Mašinsko inženjerstvo (traje 8 semestara). Svrha studijskog programa je obrazovanje studenata za profesiju – stručni naziv diplomirani inženjer mašinstva, u skladu sa potrebama privrede. Studijski program Master inženjer mašinstva traje jednu godinu, odnosno 2 semestara. Studijski programi su akreditovani 2014. god.

Introduction
Study program Mechanical Engineering is made from previous study programs (Adopted in 1988): Graduate engineer for development - mechanical professions, as well as study programs (Adopted in 2006. And 2010.): Industrial engineering consultancy - mechanical engineering, Management of technical systems with modules: power engineering, process engineering, maintenance, ecology, medical engineering.
Mechanical Engineering (lasting 8 semesters). The purpose of the study program is to educate students for the profession - the professional title of graduate mechanical engineer, in accordance with the needs of the economy. Study Master program in Mechanical Engineering is one year, or two semesters. Study programs are accredited 2014th year.

MAŠINSKO INŽENJERSTVO

Cilj i zadatak je upoznavanje, edukacija i osposobljavanje studenata za rad u oblastima mašinske tehnike: mehanizacija, transportna sredstva, skladišta i mašinske konstrukcije i tehnologije, termotehnike, termoenergetike, procesne i gasne tehnike, održavanje mašina i opreme.

Ovo se postiže izučavanjem predmeta na studijskom programu „Mašinsko inženjerstvo“ – Osnovne akademske studije i Master akademske studije.

Na taj način stiču se teorijska i praktična znanja, tako da dipl. inž. kad završe fakultet, mogu odmah da počnu da rade u privredi. Iz tih razloga, nastavnici na svojim predmetima treba da prilagode i inoviraju nastavne sadržaje u tom cilju.

Treba u kontinuitetu stvarati uslove za razvoj Mašinskog inženjerstva, tako što će nastavnici biti u kontaktu sa privredom i pribaviti i deo opreme za Laboratorije iz saradnje sa privredom. Organizovati stručne posete studenata, proizvodnim preduzećima – fabrikama i upoznavanje sa tehnološkim procesima, mašinama i mernom opremom, pregledom tehničke dokumentacije i uvidom u stanje u fabrici.

Na taj način stvaramo bolje potencijalne mogućnosti zaposlenja diplomiranih inženjera u privredi. Fakultet treba da se prilagodi tržištu i da se studentima pruži praktično znanje, koje se može primeniti odmah. Na ovaj način osposobljavaju se diplomirani inženjeri, da kada završe fakultet mogu odmah da rade u raznim granama privrede:

- Mašinskoj industriji
- Prehrambenoj industriji
- Hemijskoj industriji
- Farmaceutskoj industriji
- Petrohemijskoj industriji
- Agroindustriji
- Termoelektranama
- Toplanama
- Industriji nafte i gasa...

To su kompleksni poslovi značajni za kapitalnu investicionu izgradnju: inženjering, projektovanje tehnoloških procesa - fabrika, mašina i opreme, proizvodnja, montaža, izgradnja i održavanje. Poslovi vezani za kapitalnu investicionu izgradnju: inženjering, projektovanje i izgradnja, zahtevaju mašinske inženjere sa Licencom Inženjerske komore Srbije.

Iz tih razloga, velika obaveza nastavnika, je inoviranje nastavnih sadržaja, i implementacija programa mašinsko inženjerstvo, tako da se školuju mašinski inženjeri za rad pre svega u privredi. Diplomirani inž. mašinstva i Master inženjeri mašinstava, imaju mogućnost da apliciraju za Licence.

U podizanju i oporavku privrede i oživljavanju domaće industrije, mašinski inženjeri mogu da obavljaju značajne i odgovorne poslove. Naš zadatak i cilj je da školujemo kvalitetne mašinske inženjere, koji će kad završe fakultet, moći odmah da rade u privredi. Mašinski inženjeri mogu da rade gotovo u svim granama privrede, nauke i prosvete.

Pozivamo buduće studente iz svih mesta i gradova Republike Srbije, da upišu studijski program MAŠINSKO INŽENJERSTVO i studiraju na Tehničkom fakultetu “Mihajlo Pupin”, Zrenjanin, kao matičnom fakultetu.

Prava odluka je studirati Mašinstvo. Mašinstvo je najperspektivnije zanimanje, pokreće svet i srpsku privredu. Mašinstvo se može svrstati u umetnost, sve što vidimo oko sebe je velika većina delo mašinskih inženjera.

MAŠINSKO INŽENJERSTVO – Diplomirani inženjer mašinstva

Studijski program Mašinsko inženjerstvo osnovnih akademskih studija traje 4 godine, odnosno 8 semestara i vredi 240 ESPB bodova . Svaka godina studija vredi 60 ESPB bodova.

Studijski program osnovnih akademskih studija Mašinsko inženjerstvo sastavljen je iz obaveznih i izbornih predmeta, čijim se savladavanjem obezbeđuju neophodna akademska znanja i veštine za sticanje stručnog naziva diplomirani inženjer mašinstva, (skraćeno: dipl. inž. maš.).

Osnovni cilj studijskog programa osnovnih akademskih studija Mašinsko inženjerstvo je da student stekne akademska znanja i veštine koje odgovaraju akademskoj tituli diplomirani inženjer mašinstva, kao i osposobljavanje studenta za primenu stečenih znanja i veština u naučno-stručnoj oblasti mašinsko inženjerstvo.

To uključuje i razvoj kreativnih sposobnosti razmatranja problema i sposobnost kritičkog mišljenja, razvijanje sposobnosti za timski rad i ovladavanje specifičnim praktičnim veštinama potrebnim za obavljanje profesije.

Diplomirani inženjer mašinstva

Cilj studijskog programa diplomirani inženjer mašinstva je postizanje kompetencija i akademskih veština iz oblasti mašinskog inženjerstva. Završetkom studija diplomirani inženjer mašinstva je osposobljen da prepozna, formuliše i analizira probleme u oblasti mašinskog inženjerstva, kao i da ponudi rešenja za dati problem, a na osnovu stečenih fundamentalnih i aplikativnih znanja i veština, uvažavajući inženjersku etiku i koristeći standarde u mašinstvu, metode proračuna, projektovanja i konstruisanja, kao i savremene inženjerske alate. Kompetencije diplomiranih mašinskih inženjera uključuju i razvoj sposobnosti kritičnog mišljenja, analize problema, sinteze i projektovanja rešenja i donošenja odluka u realnom vremenu.

Diplomirani inženjeri mašinstva poseduju kompetencije za primenu stečenih znanja i veština u praksi i stalno inoviranje tih znanja i veština putem osposobljenosti za pristup stručnim i naučnoistraživačkim informacijama u sopstvenom području rada. Osposobljeni su za saradnju sa lokalnim i međunarodnim društvenim, javnim i stručnim okruženjem.

Specifikacija predmeta (Osnovne akademske studije)

Matematika 1
Tehničko crtanje sa kompjuterskom grafikom
Mašinski materijali
Informatičke tehnologije
Održivi razvoj
Teorija sistema
Matematika 2
Mehanika i mehanizmi
Osnovi mašinskih konstrukcija
Elektrotehnika sa elektronikom
Engleski jezik 1
Instrumentacije
Merne tehnologije
Otpornost materijala i konstrukcija
Engleski jezik 2
Termodinamika sa termotehnikom
Mašinsko inženjerstvo u praksi
Računarsko projektovanje
Verovatnoća i statistika
Industrijski dizajn
Mašinski elementi
Tribologija i podmazivanje

Mašine i aparati
Hidraulika i pneumatika
Tehnički sistemi u zaštiti kvalitetavoda i vazduha
Tehnička fizika
Upravljanje kvalitetom
Transportne mašine
Ekološko inženjerstvo
Menadžment održavanja
Pouzdanost mašina
Logički sistemi u tehnici
Baze podataka 1
Automatsko upravljanje
Tehnička dijagnostika
Parni kotlovi
Metode upravljanja i odlučivanja
Tehnologije montaže
Kompjuterski integrisano održavanje
Inženjerski materijali
Operaciona istraživanja
Upravljanje tehnološkim razvojem
Procesna postrojenja
Tehnologija mašinogradnje
Klimatizacija, grejanje i hlađenje
Projektovanje termotehničkih i procesnih sistema
Engleski jezik 3
Tehnologija održavanja
Projektovanje tehnoloških sistema
Konstruisanje mašina
Grafičko modeliranje
Upravljanje projektima
…………………………………………………….

Master inženjer mašinstva

Studijski program Master inženjer mašinstva traje jednu godinu, odnosno 2 semestara i vredi 120 ESPB bodova.
Na master akademskim studijama Mašinskog inženjerstva nastava je organizovana u dve oblasti. Studenti se, na osnovu sopstvenih sklonosti i želja, kroz izborne predmete, mogu opredeliti za jedan od ova dva modula:

1. ***Mehanizacija***
2. ***Procesna tehnika***

1. Mehanizacija

Cilj studijskog programa Master inženjer mašinstva je postizanje kompetencija i akademskih veština iz oblasti mašinskog inženjerstva. Nastavkom studija sa osnovnih i realizacijom dodatih naučnih disciplina kao i stručnih predmeta stepena master, omogućuje studentima razvoj kreativnih sposobnosti razmatranja problema i samostalnog kritičkog mišljenja, razvijanje sposobnosti za timski rad i ovladavanje specifičnim teorijskim, ali i primenom stručnih znanja iz oblasti mašinstva – mehanizacije, mašinskog projektovanja, transportnih sredstava, skladišta i mašinskih konstrukcija.

***U okviru izbornog modula Mehanizacija** akcenat se stavlja na projektovanje i tehničku eksploataciju mašina i opreme, a naročito na projektovanje transportnih sredstava, skladišta i mašinskih konstrukcija i tehnologija. Završetkom studija, master inženjer mašinstva ima sposobnost projektovanja, organizovanja i upravljanja proizvodnjom iz oblasti mehanizacije, transportnih sistema, tehnologije obrade proizvoda, industrijskog monitoringa i razumevanje osnovnih principa iz oblasti mašinskog inženjerstva.*

2. Procesna tehnika

Cilj studijskog programa Master inženjer mašinstva je postizanje kompetencija i akademskih veština iz oblasti mašinskog inženjerstva. Nastavkom studija sa osnovnih i realizacijom dodatih naučnih disciplina kao i stručnih predmeta stepena master, omogućuje studentima razvoj kreativnih sposobnosti razmatranja problema i samostalnog kritičkog mišljenja, razvijanje sposobnosti za timski rad i ovladavanje specifičnim teorijskim, ali i primenom stručnih znanja iz oblasti mašinstva– procesna i gasna tehnika, efikasnost energetskih postrojenja, mehaničke i hidromehaničke operacije i oprema.

***U okviru izbornog modula Procesna tehnika** akcenat se stavlja na projektovanje, tehničku eksploataciju mašina i opreme, a naročito na projektovanje iz oblasti energetske efikasnosti, procesne i gasne tehnike, mehaničkih i hidromehaničkih operacija. Završetkom studija, master inženjer mašinstva ima sposobnost projektovanja, organizovanja i upravljanja proizvodnjom iz oblasti procesne tehnike, energetske efikasnosti, hidromehaničkih operacija, računarskog merenja i razumevanje osnovnih principa iz oblasti mašinskog inženjerstva.*

Specifikacija predmeta (Master akademske studije)

Metodologija istraživačkog rada
Industrijska automatika
Mehaničke i hidromehaničke operacije i oprema

1. Tehnologije obrade proizvoda
2. Efikasnost energetskih postrojenja

1. Mašinsko projektovanje CAD/CAM
2. Mehanika fluida

Transportni sistemi
Priprema proizvodnje

1. Mašinske konstrukcije i mehanizacija
2. Procesna i gasna tehnika

Studijski istraživački rad MII
……………………………………………………………
(Napomena: Izborni predmeti pod brojem 1 su za modul Mehanizacija, a izborni predmeti pod brojem 2 su za modul Procesna tehnika)

KRATAK ISTORIJAT RAZVOJA [1)]

Otvaranje prvog fakulteta u Zrenjaninu je bilo usko vezano odnosom na relaciji dva grada Zrenjanina i Novog Sada. Zrenjaninci su bili jednodušni u zahtevu da se osim Pedagoško tehničkog fakulteta, koji je nudio Novi Sad, obavezno otvori Mašinski fakultet i Ekonomski fakultet, sve u okviru novosadskog Univerziteta. Novi Sad je uporno ostajao pri stavu da se ne osnivaju Mašinski i Ekonomski fakultet u Zrenjaninu, za kojima tobože vape samo potrebe Banata, a potrebe su, u stvari bile pre svega zbog razvijene metalne, prehrambene, tekstilne i druge industrije u svim većim mestima ovog dela Pokrajine. Stav Zrenjanina je bio *sve ili ništa,* a odgovor Pokrajine (Novog Sada), *uzmi što se nudi ili ostavi.* Nakon svega toga, Odbor za privredu SO Zrenjanin, usvojio je materijal o osnivanju Pedagoško Tehničkog fakulteta u Zrenjaninu, (1974.)
....
[1)]Dušan Duda Radaković: U blizini poznatih, IP Beograd, Zrenjanin, 2011.
....

40 godina TEHNIČKOG FAKULTETA „MIHAJLO PUPIN“ obeleženo je (1974 – 2014).

Akreditovani studijski programi, Osnovne akademske studije (2014):
Informacione tehnologije
Informacione tehnologije - softversko inženjerstvo
Informatika i tehnika u obrazovanju
Menadžment informacionih tehnologija
Inženjerski menadžment
Mašinsko inženjerstvo
Odevno inženjerstvo
Inženjerstvo zaštite životne sredine
Industrijsko inženjerstvo u eksploataciji nafte i gasa.

Akreditovani studijski programi, Master i Doktorske akademske studije (2014):

- Informacione tehnologije - master
- Informatika i tehnika u obrazovanju - master
- Inženjerski menadžment - master
- Odevna tehnologija - master
- Inženjerstvo zaštite životne sredine - master
- Mašinsko inženjerstvo - master
- Inženjerski menadžment - doktorske.

…………………………………………………………………….

SARADNJA SA PRIVREDOM

COOPERATION WITH THE ECONOMY

Prof. dr Dragiša Tolmač
University of Novi Sad, Technical faculty "Mihajlo Pupin", Zrenjanin, Serbia
e-mail: dragisatolmac@gmail.com

U podizanju i oporavku privrede i oživljavanju domaće industrije, mašinski inženjeri mogu da obavljaju značajne i odgovorne poslove. Naš zadatak i cilj je da školujemo kvalitetne mašinske inženjere, koji će kad završe fakultet, moći odmah da rade u privredi.

U kontinuitetu stvaramo uslove za razvoj Mašinskog inženjerstva, tako što su naši nastavnici u kontaktu sa privredom. Organizujemo stručne posete studenata, proizvodnim preduzećima – fabrikama i laboratorijama. Studenti se upoznaju sa tehnološkim procesima, mašinama i mernom opremom, pregledom tehničke dokumentacije i uvidom u stanje u fabrici. Na taj način stvaramo bolje potencijalne mogućnosti zaposlenja diplomiranih inženjera u privredi. Prilagođavamo se tržištu i studentima se pruža praktično znanje, koje se može primeniti odmah.

U tom cilju imamo potpisane Ugovore o poslovnoj tehničkoj saradnji sa mnogim firmama iz privrede, gde naši student imaju pristup i odlaze u stručne posete. U tom cilju zahvaljujemo se sledećim preduzećima i ustanovama:

1. "PETKUS - BALKAN", Zrenjanin - preduzeće za projektovanje proizvodnju i montažu procesne opreme - konsalting i inženjering,
2. "Cimos Group" - Livnica, Sečanj,
3. "Victorija Starch", Zrenjanin,
4. „EVROBROD" D.O.O. Zrenjanin – preduzeće za projektovanje, proizvodnju i montažu procesne opreme,
5. „Premitrade" – centar termovizije i vibrodijagnostike, Zrenjanin,
6. Ustanovi opšta bolnica „Đorđe Joanović", Zrenjanin,
7. AD „Tehnoradionica" – proizvodnja mašinsko tehnološke opreme, Zrenjanin,
8. "SM Inženjering" – projektovanje, konsalting, inženjering, Zrenjanin,
9. LMV Alatnica – proizvodnja, montaža, servis alata, livačkih modela i mašinskih elemenata,
10. Visoka tehnička škola, Zrenjanin,
11. MECAPLAST, Zrenjanin,
12. Livnica KIKINDA, d.o.o.

Prava odluka je studirati Mašinstvo. Mašinstvo je najperspektivnije zanimanje, pokreće svet i srpsku privredu. Mašinstvo se može svrstati u umetnost, sve što vidimo oko sebe je velika većina delo mašinskih inženjera.

VICTORIAGROUP

CIMOS

VTŠ

PETKUS

PETKUS BALKAN
Zrenjanin

Um-ing

M INŽENJERING
ZRENJANIN

PREMITRADE

1911
ZRENJANIN
AKCIONARSKO DRUŠTVO
TEHNORADIONICA
Petra Drapšina 1, 23000 Zrenjanin, Srbija Tel/fax: +381 (23) 544 598, 549 103, 545 451

OPŠTA BOLNICA
ĐORĐE JOANOVIĆ
ZRENJANIN

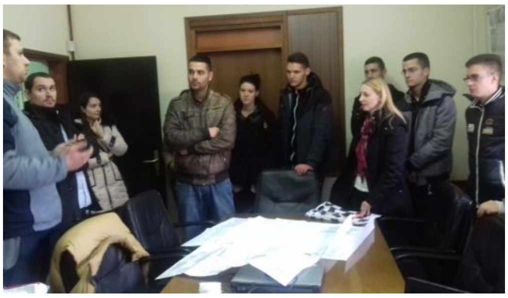
POSETA STUDENATA PRIVREDI

PETKUS BALKAN, ZRENJANIN

PREMI TRADE, ZRENJANIN


VICTORIA STARCH, ZRENJANIN

MECA PLAST, ZRENJANIN




LMV ALATNICA, ZRENJANIN

EVROBROD, ZRENJANIN

a)

b)

c)

d)





BOLNICA “ĐORĐE JOANOVIĆ”, ZRENJANIN

CIMOS LIVNICA, SEČANJ

VETROPARK „LA PIKOLINA“KOD VRŠCA

SKLADIŠTENJE BIOMASE

DIGESTOR