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ACTA TECHNICA CORVINIENSIS
– BULLETIN of ENGINEERING

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ACTA TECHNICA CORVINIENSIS
– BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]

Aims & Scope

General Aims:

ACTA TECHNICA CORVINIENSIS – BULLETIN OF ENGINEERING is an international and interdisciplinary journal which reports on scientific and technical contributions.

ACTA TECHNICA CORVINIENSIS – BULLETIN OF ENGINEERING publishes invited review papers covering the full spectrum of engineering. The reviews, both experimental and theoretical, provide general background information as well as a critical assessment on topics in a state of flux. We are primarily interested in those contributions which bring new insights, and papers will be selected on the basis of the importance of the new knowledge they provide.

Topical reviews in materials science and engineering, each including:

- *surveys of work accomplished to date*
- *current trends in research and applications*
- *future prospects.*

As an open-access journal ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering will serve the whole engineering research community, offering a stimulating combination of the following:

- *Research Papers - concise, high impact original research articles,*
- *Scientific Papers - concise, high impact original theoretical articles,*
- *Perspectives - commissioned commentaries highlighting the impact and wider implications of research appearing in the journal.*

ACTA TECHNICA CORVINIENSIS – BULLETIN OF ENGINEERING encourages the submission of comments on papers published particularly in our journal. The journal publishes articles focused on topics of current interest within the scope of the journal and coordinated by invited guest editors. Interested authors are invited to contact one of the Editors for further details.

Every year, in three issues, ACTA TECHNICA CORVINIENSIS – BULLETIN OF ENGINEERING publishes a series of reviews covering the most exciting and developing areas of engineering. Each issue contains papers reviewed by international researchers who are experts in their fields. The result is a journal that gives the scientists and engineers the opportunity to keep informed of all the current developments in their own, and related, areas of research, ensuring the new ideas across an increasingly the interdisciplinary field.

ACTA TECHNICA CORVINIENSIS – BULLETIN OF ENGINEERING exchange similar publications with similar institutions of our country and from abroad.

Audience:

Scientists and engineers with an interest in the respective interfaces of engineering fields, technology and materials, information processes, research in various industrial applications. It publishes articles of interest to researchers and engineers and to other scientists involved with materials phenomena and computational modeling.

About us:

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering is an international and interdisciplinary journal which reports on scientific and technical contributions and publishes invited review papers covering the full spectrum of engineering.

Every year, in four online issues (fascicules 1 - 4), ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering [e-ISSN: 2067-3809] publishes a series of reviews covering the most exciting and developing areas of engineering. Each issue contains papers reviewed by international researchers who are experts in their fields. The result is a journal that gives the scientists and engineers the opportunity to keep informed of all the current developments in their own, and related, areas of research, ensuring the new ideas across an increasingly the interdisciplinary field.

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering has been published since 2008, as an online supplement of the ANNALS OF FACULTY ENGINEERING HUNEDOARA – INTERNATIONAL JOURNAL OF ENGINEERING.

Now, the ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering is a free-access, online, international and multidisciplinary publication of the Faculty of Engineering Hunedoara.

Coverage:

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering is a good opportunity for the researchers to exchange information and to present the results of their research activity. Scientists and engineers with an interest in the respective interfaces of engineering fields, technology and materials, information processes, research in various industrial applications are the target and audience of ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering. It publishes articles of interest to researchers and engineers and to other scientists involved with materials phenomena and computational modeling.

The journal's coverage will reflect the increasingly interdisciplinary nature of engineering, recognizing wide-ranging contributions to the development of methods, tools and evaluation strategies relevant to the field. Numerical modeling or simulation, as well as theoretical and experimental approaches to engineering will form the core of ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering's content, however approaches from a range of environmental science and economics are strongly encouraged.

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering appear in four issues per year and is open to the reviews, papers, short communications and breakings news inserted as Scientific Events, in the field of engineering.

General Topics:

ENGINEERING
- MECHANICAL ENGINEERING
- METALLURGICAL ENGINEERING
- AGRICULTURAL ENGINEERING
- CONTROL ENGINEERING
- ELECTRICAL ENGINEERING
- CIVIL ENGINEERING
- BIOMEDICAL ENGINEERING
- TRANSPORT ENGINEERING

ECONOMICS
- AGRICULTURAL ECONOMICS
- DEVELOPMENT ECONOMICS
- ENVIRONMENTAL ECONOMICS
- INDUSTRIAL ORGANIZATION
- MATHEMATICAL ECONOMICS
- MONETARY ECONOMICS
- RESOURCE ECONOMICS
- TRANSPORT ECONOMICS
- GENERAL MANAGEMENT
- MANAGERIAL ECONOMICS
- LOGISTICS

COMPUTER AND INFORMATION SCIENCES
- COMPUTER SCIENCE
- INFORMATION SCIENCE

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- AGRICULTURAL & BIOLOGICAL ENGINEERING
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- ANALYTICAL CHEMISTRY
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- MATERIALS SCIENCE & METALLOGRAPHY
- POLYMER CHEMISTRY
- SPECTROSCOPY
- THERMO-CHEMISTRY

EARTH SCIENCES
- GEODESY
- GEOLOGY
- HYDROLOGY
- SEISMOLOGY
- SOIL SCIENCE

ENVIRONMENTAL
- ENVIRONMENTAL CHEMISTRY
- ENVIRONMENTAL SCIENCE & ECOLOGY
- ENVIRONMENTAL SOIL SCIENCE
- ENVIRONMENTAL HEALTH

BIOMECHANICS & BIOTECHNOLOGY
- BIOMECHANICS
- BIOTECHNOLOGY
- BIOMATERIALS

MATHEMATICS
- APPLIED MATHEMATICS
- MODELING & OPTIMIZATION
- FOUNDATIONS & METHODS

Invitation:

We are looking forward to a fruitful collaboration and we welcome you to publish in our ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering. You are invited to contribute review or research papers as well as opinion in the fields of science and technology including engineering. We accept contributions (full papers) in the fields of applied sciences and technology including all branches of engineering and management.

Submission of a paper implies that the work described has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis) that it is not under consideration for publication elsewhere. It is not accepted to submit materials which in any way violate copyrights of third persons or law rights. An author is fully responsible ethically and legally for breaking given conditions or misleading the Editor or the Publisher.

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Editorial & Advisory Board

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Review process & Editorial Policy

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering is dedicated to publishing material of the highest engineering interest, and to this end we have assembled a distinguished Editorial Board and Scientific Committee of academics, professors and researchers.

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering publishes invited review papers covering the full spectrum of engineering. The reviews, both experimental and theoretical, provide general background information as well as a critical assessment on topics in a state of flux. We are primarily interested in those contributions which bring new insights, and papers will be selected on the basis of the importance of the new knowledge they provide.

The editorial policy of ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering is to serve its readership in two ways. Firstly, it provides a critical overview of the current issues in a well-defined area of immediate interest to materials scientists. Secondly, each review contains an extensive list of references thus providing an invaluable pointer to the primary research literature available on the topic. This policy is implemented by the Editorial Board which consists of outstanding scientists in their respective disciplines. The Board identifies the topics of interest and subsequently invites qualified authors. In order to ensure speedy publication, each material will be report to authors, separately, thought Report of the Scientific Committee. For an overview of recent dispatched issues, see the ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering issues.

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering encourages the submission of comments on papers published particularly in our journal. The journal publishes articles focused on topics of current interest within the scope of the journal and coordinated by invited guest editors. Interested authors are invited to contact one of the Editors for further details.

The members of the Editorial Board may serve as reviewers. The reports of the referees and the Decision of the Editors regarding the publication will be sent to the corresponding authors.

The evaluated paper may be recommended for:

- *Acceptance without any changes – in that case the authors will be asked to send the paper electronically in the required .doc format according to authors' instructions;*
- *Acceptance with minor changes – if the authors follow the conditions imposed by referees the paper will be sent in the required .doc format;*
- *Acceptance with major changes – if the authors follow completely the conditions imposed by referees the paper will be sent in the required .doc format;*
- *Rejection – in that case the reasons for rejection will be transmitted to authors along with some suggestions for future improvements (if that will be considered necessary).*

The manuscript accepted for publication will be published in the next issue of ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering after the acceptance date.

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering accept for publication unpublished manuscripts on the understanding that the same manuscript is not under simultaneous consideration of other journals. Publication of a part of the data as the abstract of conference proceedings is exempted.

All the authors and the corresponding author in particular take the responsibility to ensure that the text of the article does not contain portions copied from any other published material which amounts to plagiarism. We also request the authors to familiarize themselves with the good publication ethics principles before finalizing their manuscripts.

Manuscripts submitted (original articles, technical notes, brief communications and case studies) will be subject to peer review by the members of the Editorial Board or by qualified outside reviewers. Only papers of high scientific quality will be accepted for publication. Manuscripts are accepted for review only when they report unpublished work that is not being considered for publication elsewhere.

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Regional Associate Editors & Collaborators

The Editor and editorial board members do not receive any remuneration. These positions are voluntary.
We are very pleased to inform that our journal ACTA TECHNICA CORVINIENSIS – BULLETIN of ENGINEERING is going to complete its four years of publication successfully. In a very short period it has acquired global presence and scholars from all over the world have taken it with great enthusiasm. We are extremely grateful and heartily acknowledge the kind of support and encouragement from you.
ACTA TECHNICA CORVINIENSIS – BULLETIN of ENGINEERING is seeking qualified researchers as members of the editorial team. Like our other journals, ACTA TECHNICA CORVINIENSIS – BULLETIN of ENGINEERING will serve as a great resource for researchers and students across the globe. We ask you to support this initiative by joining our editorial team. If you are interested in serving as a member of the editorial team, kindly send us your resume to redactie@fih.upt.ro.

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Content of FASCICULE 4 [OCTOBER–DECEMBER]

ABSTRACT: *This paper presents the assessment of building security system and active fire protection system in administration building. Building is a structure that gives protection to human. A building needs to protect human from extreme weather and danger created by human. Apart from giving us protection; building gives us privacy as well. Our generation is different from the previous generations. The environment is now more dangerous than the past. People can get hurt or killed even in the house. Other than building security system, an active fire protection system is also crucial to ensure that the occupants in the building are protected adequately against fire. Fire can spread to a wide area in seconds if we do not have fire protection system to prevent the fire from spreading. Administration building is a building accommodating ten to hundreds of people. It needs a proper security system to monitor and control the flow of people. Vandalism and burglary can happen easily without a proper and effective security system. Besides that, since an administration building accommodates many people, therefore, its active fire protection system needs to comply with Uniform Building By-Law (UBBL) of Malaysia.*

ABSTRACT: *A transformation is a sequence of states through which a thermodynamic system when its parameters vary from baseline values to those in the final state. All thermodynamic properties at a time system are the system state. State parameters are all measurable physical quantities that characterize the unique thermodynamic state of the system. A substance is characterized, as we know, the state variables: pressure, volume, temperature, etc. At a certain amount of substance, these three variables are a well established interdependence of thermal equation of state. To ease the study of gases have made some considerations that lead to a relatively simple model study. This so-called ideal gas, the molecules are considered material points, and the interaction forces between molecules are void. It is obvious that this case can not be met in practice, but the considerations made on this system can be extended with some corrections and within certain limits, the real gas. The application is done using Microsoft Access and was made for students to be able to easily own knowledge about the transformations simple ideal gas of this gas. Students can calculate and make conclusions can be drawn, however this program is not meant to replace the teacher but to offer a tool to study in classes, the theory that parties are not very many. The menu is affordable, intuitive and helpful. For a better understanding of the application is structured in four parts.*

ABSTRACT: *With conventional noncircular grinding the uneven shape of workpieces is created by pendular movement of a round grinding disk. In contrast with rpm-synchronous noncircular grinding the workpiece is machined with an unround grinding disk. In process the workpiece and the tool are turning with a certain rpm-ratio. With this special method it is possible to machine several types of unround shapes (e.g. all cams of a camshaft) with just one step of positioning. This paper is focused on basic research in rpm-synchronous noncircular grinding. It shows which possible applications this method offers and also their limits.*

ABSTRACT: *The sawing regimes of some woodworking machines have been analyzed, and it has been found out that there are cases when the load of their cutting mechanisms can be increased. The period of operation for which these regimes have been established has been analyzed. When there are lower requirements for the quality of the sawn surfaces, it has been recommended to develop the sawing regimes step by step, for the whole period between two sharpenings of the cutting blades. This allows making a better use of the cutting power of the sharp cutting blades.*

ABSTRACT: *Electric, hydraulic and pneumatic drives are widely used in industrial environment. In robotics different types of pneumatic actuators - e. g. cylinders and pneumatic motors - can be found commonly to date. A less well-known type is that of the so-called pneumatic artificial muscles (PAMs). Different designs have been developed, but the McKibben muscle is the most popular and is made commercially available by different companies, e. g. Fluidic Muscle manufactured by Festo Company. Many researchers have investigated the relationship of the force, length and pressure to find a good theoretical approach for the equation of force produced by pneumatic artificial muscles. This paper presents the static model of PAM and our newest model for the force generated by Fluidic Muscle. The accuracy of this new model for the hysteresis loop is analysed by mathematical methods of statistics.*

ABSTRACT: *The main objective of this study was to compare human and robot performances for a simple dismantling operation by conducting a time study and cost evaluation. The dismantling task consisted of separation of a battery from a mobile phone (MP). Two work stations were analyzed and compared, one robotic and one human. The robotic work station was schematically designed and evaluated in simulation in order to achieve the dismantling times and costs. The human dismantling work station was tested in laboratory conditions. On the basis of calculating the average costs of dismantling of the battery for one mobile phone we can conclude that in the assumed conditions the robotic work station is a more efficient dismantling work station (1.20 eurocent per MP), and the human dismantling work station is less efficient.*

ABSTRACT: *In this paper we have investigated Microstrip line fed semi circular printed monopole antenna, which is basically printed microstrip antenna with etched ground plane for UWB applications. In particular we have simulated circular patch monopole antenna and then after etched some part of the radiating patch in order to make semi circular antenna with good performance for UWB communication. While doing simulation study, a simple rectangular microstrip line is used for feeding the printed monopole antenna. Finally the simulated antenna is having frequency bandwidth under -10dB return loss is ranging from 2.8 GHz to 15 GHz. This semi circular printed monopole antenna works well for the whole UWB frequency band 3.1-10.6GHz.*

ABSTRACT: *According to the recent economic situation, the actual business model will not be sustainable for a long time. In this paper we want propose a design methodology, which leads the possibility to influence people behaviours through the products. The aim of this paper is to underline the role of the designer, as director of the process, in order to coordinate involved actors and actions. This approach suggests a result, namely a product, which uses the local resources preserving material and cultural tradition and furthermore understanding the relationships between the costumer and his territory. The link between the product and its context defines a "surplus value" which characterizes the design process as "sustainable". According to that, the final aim should be a "customised product" defined through a muldisciplinary approach, where the role of the designer is creating a dialogue among all the different actors involved in the definition of the product.*

ABSTRACT: *The aim of this article is basic overview of actual situation in principles of industrial robot programming and introduction of simple extended remote control principle. Remote control is realized by serial communication port and software in C# programming language. It is used for positioning articulated robot with 5 DOF Mitsubishi RV-2AJ. These industrial robots are usually used for student education to teach robot programming languages. Introduced software provides simple interface to robot program only by mouse control or import trajectory of movement from external position list file. We can set two movements types PTP and CP interpolated linear movement. Remote control software of robot can be used for many special task; we tested reliability by drawing equipment.*

ABSTRACT: *There is poor information in the literature written on this theme, regarding the re-utilization without regenerating operations of the moulding sands prepared with synthetic resins. In practice, these methods have a lot of difficulties regarding the separation of moulding sands with organically bonding agents in comparison with the sands prepared with non-organically agents. The re-utilisation of moulding sands based on resins without technological regenerating processes is not to be applied in the practice of the preparation with resins. Therefore is intended a re-utilisation of these moulding sands, with non-organically bonding agents (clay), replacing thus, partly, with new sand. The industrial foundry practice showed that this method could be applied with good results to any type of mould based on the organically bonding agents.*

ABSTRACT: *During the last years, the self-cleaning surface structures of lotus flowers have been reproduced in numerous ways on textiles or paints and other surfaces to reduce sensitivity against pollution which, in turn, allows a reduction of water- and detergent consumption. Unfortunately, some of these techniques suffer from wear or are potentially biohazardous due to the small particle size. We present a method to produce nanostructures on surfaces by multi-beam interference of ultra-short laser pulses. Intensity distributions of various configurations have been simulated and show the feasibility of the suggested process.*

ABSTRACT: *This article describes the use computer supported systems in practise. CA systems supported activities in all stages of production – from design region and construction, through production and finally mounting, storage and expedition. These systems represent very effective tool in region before-production and production stages in this time. They represent tool which can increase company´s market position.*

ABSTRACT: *This paper presents the results of a study demonstrating an approach for using aerodynamic coefficients for a missile with grid fins. A grid fin is an unconventional lifting and control surface that consists of an outer frame supporting an inner grid of intersecting planar surfaces of small chord. The calculations were made at a mach number of 0.2 and angle of attack 0° for a missile with grid fins. The simulations were also successful in calculating the flow structure around the fin in the separated-flow region at the higher angles of attack. This was evident in the successful calculation of the nonlinear behavior viscous computational fluid dynamic simulations to calculate the flow field and for that fin, which showed negative normal force at the higher angle of attack. The effective angle of attack is negative on either part of the entire top grid fin for the higher angle of attack. The modeling of unconventional grid fin missile is done in CAD software called CatiaV5. The meshing of geometry is in a pre processor called Gambit. And the solving and post processing is done in a solver called Fluent.*

ABSTRACT: *The important aspect related to both banks' and other financial institutions' a performance is the analysis of the clients' obligations fulfillment through applying various mathematical models. Furthermore, the main purpose of the models is estimation of the possibility of default (default rate). Moreover, it is important for the users of the model to posses data related to possibilities' accuracy. There are various ways for testing the accuracy related to the default possibilities, and in this paper the minimal number of observations will be presented. Thus, simple statistical operations will be presented, important for gaining a minimum level related to sample size. Moreover, the paper will point out that for determining the minimum size of the sample, the absence of correlation among data is essential. If the correlation is present, the minimum level of accuracy of the sample size could be altered, representing the important conclusion of this paper. Furthermore, if there is fixed sample, this approach allows minimum difference between estimated and actual empirical default rate. Finally, the cases indicating inaccurate minimum level of the sample size will be shown as well.*

ABSTRACT: *After recent research activities focused on water jet technology and abrasive water jet process parameters optimalization, it is necessary to stress attention to aspects which have been out of main research stream but they are very important for understanding cutting process physical principles, improving production systems operability and cutting quality improving. The paper deals with a research of technology parameters fluctuation effect on AWJ production system technology head vibration generation during technical ceramics cutting production process. The submitted paper points at possible sources of undesirable vibrations: pump pressure, which can be a reason of reliability and AWJ technology production systems lifetime reduction, and of abrasive nozzle wear increasing as well as of cutting edge quality reducing. New knowledge submitted in this paper was formulated on the base of performed experiments and graphic relations. On the base of gained relations, conclusions, recommendations and contributions for scientific activity and business practice were formulated as well.*

ABSTRACT: *Foundry technology is developing in Nigeria and other developing countries in the world; therefore, there are high demands for raw materials. New materials continue to be developed to meet special requirements which require special processing in order for their properties to be effectively utilized. High cost of imported binders has generated great interest in characterizing the locally available materials, therefore necessitating the need to look into domestically available binders that will meet the criteria for manufacturing, that is, reliability, cost, toxicity and availability; these are rationale behind this work. In this study, efforts were made to produce inexpensive and efficient binders from locally sourced materials (starch, and rubber latex) in Nigeria for the use of foundry cores. This was carried out by blending the locally sourced materials: starch-rubber latex (1:2) with silica sand, and water in different proportions while bentonite was used as control. Binders from various blend compositions were used to make core samples, and each core sample produced was subjected to the following mechanical tests: green compressive strength, dry compressive strength, collapsibility, and surface hardness. The blending caused great improvement in the mechanical properties of the core samples produced. The dry compressive strength values for all the core samples produced were greater than the corresponding green compressive strength values. The collapsibility decreased with increasing proportions of blended binders while the surface hardness values for starch-rubber latex binder cores were higher than for the core samples from bentonite binder.*

ABSTRACT: *The pollution monitoring is a necessary part of any environmental management system, being the basis for a fully informed decision-making process and developing environmental management strategies. To ensure a thorough decision, it is essential to be fully convinced that the measurements reflect the reality. The discharges into the environment from the major sources are pursued in a general monitoring process of the significant sources of pollutants within catchments. The objectives also include monitoring systems, optimization issues, verification and compliance with legislative requirements, such as allowable emission limits. We have analyzed the quantities of metallic elements (Mn, Ni, Zn, Cr, Cu and Pb) found in the wastewater from the areas of steel works and rolling mills, and we performed a calculation of pollutants in water, based on the measurements made (according to Romanian standards) between 2008-2010. The monitoring plans are designed and implemented to collect data about the water quality and the significant discharges of pollutants from the major sources. In this paper, we present the assessment of emission impact on waters, based on a case study conducted on the company TMK Reşiţa (Romania). The environmental plan provides the necessary works for reducing the emissions of pollutants in soil and groundwater, these works being executed by the company. Likewise, the drillings required for groundwater monitoring on the company site and the slag dump have been made. The quality assurance plan formulated the arguments that led to the establishment of the number of sampling points, the location of these points, the sampling frequency, the equipment and methods of sample collection.*

ABSTRACT: *Gas dynamics is synonymous with aerodynamics when the gas field is air and the subject of study is flight. It is highly relevant in the design of aircraft and spacecraft and their respective propulsion systems. Progress in gas dynamics coincides with the developments of transonic and supersonic flight. As aircraft began to travel faster, the density of air began to change, considerably increasing the air resistance as the air speed approached the speed of sound. Most phenomena in real world are described through nonlinear equations and these kinds of equations have attracted lots of attention among scientists. A wide range of nonlinear equations do not have a precise solution, so analytical methods have been used to handle these equations. Many different new methods have recently presented some techniques to eliminate the small parameter. In this paper, a new analytical technique called the Reconstruction of Variational Iteration Method (RVIM) is suggested for finding the exact solution of gas dynamic equation. The solution procedure explicitly reveals the complete reliability and simplicity of the proposed algorithm. The RVIM technique has been successfully applied to many nonlinear problems in science and engineering. All of these verify the great potential and validity of the RVIM technique in comparison with Variational Iteration Method (VIM) for strongly nonlinear problems in science and engineering. The results reported here provide further evidence of the usefulness of RVIM for finding the analytic and numeric solutions for the linear and nonlinear diffusion equations and, it is also a promising method to solve different types of nonlinear equations in mathematical physics.*

ABSTRACT: *This paper presents the technical solutions of an installation for completion of drying hay up to the humidity of 17 ... 18%, by ventilation with cold air or hot air. The installation is constructed from assemblies developed within a modular structure so that users can configure their drying installation according to the needs of the farm. Specific to the installation is the solar panel constructed from a number of solar collectors Nc made of light materials, painted inside with paint or solar lacquers of black color for having an as higher as possible absorption degree of the solar radiation. For the sizing of the drying installations depending on the needs of the feedingstuffs farm were developed tables based on the interdependence of drying platform dimensions, the necessary flow to the fan and the amount of conserved forage material.*

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SOLVING TRAVELLING SALESMAN PROBLEM BY USE OF KOHONEN SELF-ORGANIZING MAPS

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ABSTRACT: *This paper presents an approach for solving the travelling salesman problem (TSP) by using artificial neural network (ANN). The ANN model adopted in this paper is the Kohonen's self-organizing map (SOM) which uses competitive, unsupervised learning. The paper briefly describes the competitive learning and Kohonen's SOM model development. The possibilities of SOM were applied for solving real problem of disposal plastics waste. The Kohonen's SOM was trained using original geo coordinates for container locations in the city of Niš. The results demonstrate that the proposed approach is comparable in terms of solution quality and computational requirements to classical approaches such as Clarke-Wright saving algorithm.*
KEYWORDS: *Self-organizing maps, vehicle routing problem and simulation*

INTRODUCTION

The vehicle routing problem (VRP) can be defined as a problem of finding the optimal routes of delivery or collection from one or several depots to a number of cities or customers, while satisfying some constraints. Collection of household waste, gasoline delivery trucks, goods distribution, snow plough and mail delivery are the most used applications of the VRP [1]. The VRP plays a vital role in distribution and logistics. Huge research efforts have been devoted to studying the VRP since 1959 where Dantzig and Ramser [2] have described the problem as a generalized problem of Travelling Salesman Problem (TSP). The travelling salesman problem (TSP) is a classical optimization problem. Given a list of cities and their pair wise distances, the task is to find a shortest possible tour that visits each city exactly once. The decision-problem form of TSP is a NP complete (non-deterministic polynomial-time hard) problem [3], hence the great interest in efficient heuristics to solve it.

The problem was first formulated as a mathematical problem in 1930 and is one of the most intensively studied problems in optimization. It is used as a benchmark for many optimization methods. Even though the problem is computationally difficult, a large number of heuristics and exact methods are known, so that some instances with tens of thousands of cities can be solved.

There are many of the heuristics that utilize the paradigm of neural computation or related notions recently [4]. Most solutions have used one of the following methods: Hopfield network, Kohonen's SOM, genetic algorithm, simulated annealing and etc. The first approach to the TSP via ANNs was the work of Hopfield and Tank in 1985 [5], which was based on the minimization of an energy function. In this paper an attempt has been made to solve a real problem of disposal plastics waste in the city of Nis using the Kohonen's self-organizing map (SOM).

SOM BASICS

Invented by Kohonen in the early 1980's, SOM, employ a dynamic mixture of competition and cooperation to enable the emergent formation of an isomorphism between a feature space and an array of neurons [6]. It simply inspects the input data for regularities and patterns and organizes itself in such a way to form an ordered description of the input data. This description may lead to a solution of the problem under consideration [7]. It maps input vectors of any dimension onto map with one, two or more dimensions (Kohonen layer). Output neurons are usually structured in a geometrical arrangement such as linear array or a two dimensional lattice on which a meaningful coordinate system for different features is created (feature map). It has only an input layer and an output layer where neurons are fully connected to all input neurons with a scalar weight. Figure 1 shows an example of Kohonen's SOM with output neurons arranged in two-dimensional lattice.

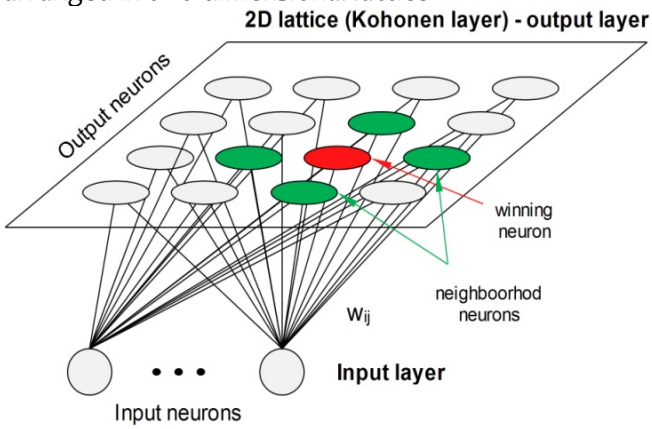


Figure 1. Schematic representation of a Kohonen SOM with 2D lattice of output neurons

SOM is one of the most popular unsupervised ANNs. When learning is unsupervised, ANN is only provided input patterns without desired outputs. The unsupervised learning process comprises two phases. In a competitive phase, a winning neuron is identified

as one which is closest to the input data (typically, the square minimum of the Euclidian distance). In the next phase, adaptive phase, the weights of winning neuron and its neighboring neurons are updated in order to approach the presented input data. The neighborhood of a neuron is usually considered to be 2D i.e. square, rectangular or hexagonal which means that each neuron has 4, 8 or 6 nearest neighbors respectively. Also one-dimensional neighborhood can be applied where each neuron has two neighbors (on the left and on the right).

The basic SOM algorithm can be described as follows [9]:

procedure train SOM
begin
randomize weights for all neurons
for *i = 1 to predefined iterations* ***do***
begin
take one random input pattern
find the winning neuron
find neighbors of the winner
update synaptic weights of these neurons
end
end
reduce the learning rate and neighborhood function
end

SOM APPLIED TO TSP

To apply the SOM to the Euclidian TSP, a two-layer network, which consists of a two-dimensional input and m output neurons is used. Two dimensional input defines the coordinates of the waste disposal sites (WDS) in the two dimensional Euclidian space. The input neurons receive the coordinate values of a WDS. The input neurons are fully connected to every output neuron. To simplify the implementation, the scaled coordinates for WDS were used. The scaling to range [0-1] was performed using the equation:

$$x_{scaled} = \frac{(x - x_{min})}{(x_{max} - x_{min})} \qquad (1)$$

where x is the data to be scaled, i.e. WDC's, and x_{min} and x_{max} are minimum and maximum values of the raw data. The SOM architecture consists of a one ring upon which the neurons are spatially distributed.

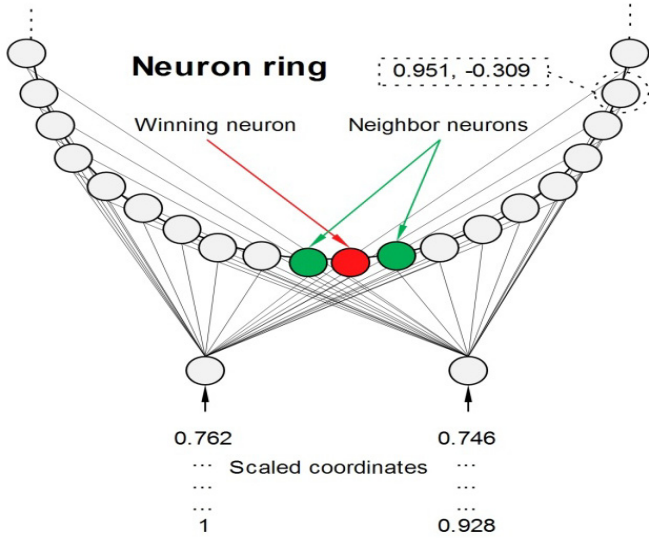


Figure 2. Kohonen's SOM with output neurons in ring architecture

Figure 2 represents the ring structure proposed. The ring can be considered as a route for an ideal problem. The weights of the neurons, which define the position of the neuron in the ring, are initially set as follows. Assuming a ring of m neurons, the neurons are equally positioned on a circle of radius equal to 1 using the angle position of given neuron that is equal to 360° divided by m.

The input data (a set of n WDS) are presented to the SOM in a random order and a competition based on Euclidian distance is performed between neurons in the ring. The winner neuron is the neuron I^* with the minimum distance to the presenting city. $I^* = \text{argmin}_j\{||x_i - w_j||_2\}$, where x_i is the coordinate of the i-th WDS, w_j is the position of the neuron j and $||\cdot||_2$ is the Euclidian distance. Hence, the winner neuron, as well as neighboring neurons, moves toward the presenting i-th WDS using the neighborhood function:

$$f(\sigma, d) = e^{\left(\frac{-d^2}{\sigma^2}\right)} \qquad (2)$$

According to the following updated function:

$$y_j^{new} = y_j^{old} + \alpha \cdot f(\sigma, d) \cdot (x_i - y_j^{old}) \qquad (3)$$

where α and σ are learning rate and neighborhood function variance, respectively. And d=min{||j-J||,m-||j-J||} is the cardinal distance measured along the ring between neurons j and J, where ||·|| represents absolute value [8]. Learning rate has dynamic characteristic i.e. it decreases normally during training and usually takes values from 0 to 1. Similarly, the neighborhood function f(σ, d) is set large at very beginning of training, and slowly decreases in size with the progress of the training. After many iterations of training, the neurons tend to move closer to the WDS and finally are attached in WDS. Once all neurons are attached in the WDS, simply walk around the neurons connections and read the WDS coordinates in the order that they appear. The resulting sequence constitutes a TSP solution.

Figure 3 illustrates the evolution of the algorithm starting from the initial state of the ring, (a) reaching an intermediate stage after some iteration (b) and stopping at the final state (c).

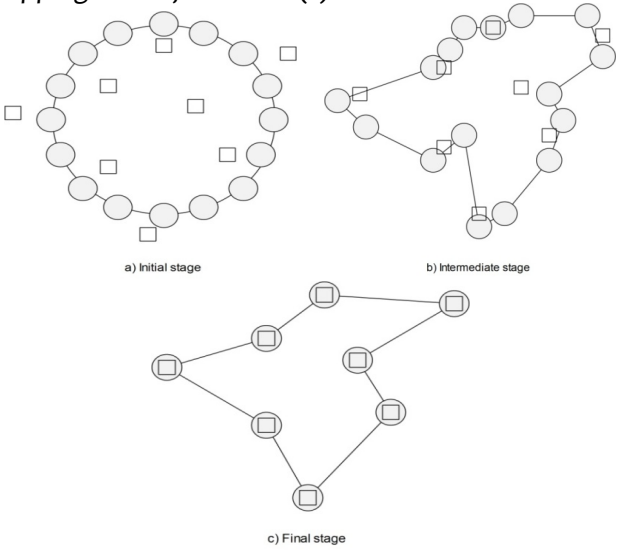


Figure 3. Evolution of Kohonen's SOM for TSP: (O) neurons and (□) WDS's coordinates

The number of neurons should be greater than the number of cities to avoid the oscillation of a neuron between different neighboring WDSs. In the present study m is set to 2n. An extensive analysis of SOM algorithm and its parameters could be found in [6] [7] [8] [9] [10].

CASE STUDY

In this paper, SOM was applied for solving the problem of 20 waste disposal sites (WDS). The container is disposed of plastic waste. WDS are not randomly chosen but they are existed in the city of Niš, i.e. in the paper solves a real problem. Waste collection is done by company JKP Mediana. This company has a large transport costs for emptying the containers due to lack of optimal route of the vehicle. Therefore, vehicles are moving in the opinion of the driver or by a previous practice. In the process of determining the optimal route of the vehicle for collection plastic waste in the city of Niš, the first issue was to define location of containers. Locations of containers are defined with geo coordinates (table 1) so that each site has its own coordinate.

Table 1: Position of WDSs

	Coordinate of WDS			Coordinate of WDS	
WDS	latitude	longitude	WDS	latitude	longitude
A	53.214	19.155	K	52.349	18.924
B	53.560	19.221	L	49.763	19.076
C	53.280	19.167	M	52.758	18.790
D	53.111	19.220	N	52.988	18.920
E	54.200	19.210	O	53.719	19.194
F	54.390	19.185	P	53.684	19.031
G	53.848	19.079	Q	54.058	19.269
H	53.721	19.170	R	54.076	19.399
I	53.603	19.027	S	54.390	19.399
J	53.494	18.969	T	49.763	18.790

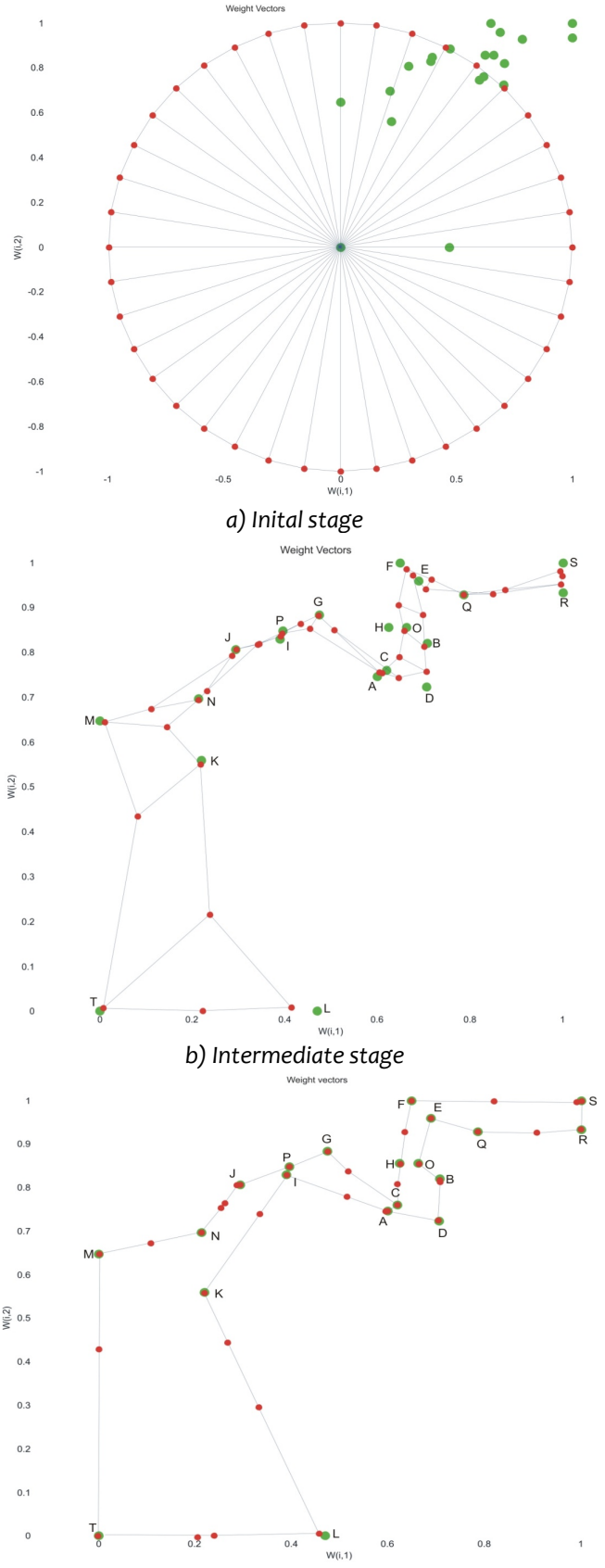
The coordinates are latitude and longitude locations. To simplify the implementation, the coordinates given in table 1 are scaled using the equation 1 and then are presented to the SOM. Determining the optimal the vehicle routes significantly reduces transportation costs and reduces the total discharge time of 20 containers.

THE EXPERIMENTAL RESULTS

The paper presents three simulations. The first simulation (figure 4b) was performed with 1000 epochs and the learning rate 0.1. This corresponds to the first phase in which neurons tend to WDC. The second simulation was performed with 2000 epochs and the learning rate 0.1. An extension of learning can be seen that all the neurons are closer to WDC and some are in the centers of these coordinates. The third simulation (figure 4c) corresponds to the maximum number of epochs. All m neurons coincided with WDC. The route can be read from the weighting coefficients of neurons. Under this optimum vehicle route is:

M-T-L-K-I-A-D-B-O-E-Q-R-S-F-H-C-G-P-J-N-**M**.

The resulting route of vehicles using the SOM model is compared to the route which was obtained by heuristic methods Clark-Wright savings algorithm [11]. Routes are the same length only difference is that it does not start from the same node.



a) Inital stage

b) Intermediate stage

c) Final stage

Figure 4. Evolution of Kohonen's SOM for TSP

CONCLUSIONS

The method of solving the TSP presented in this paper is based on Kohonen's SOM. This method represents an alternative for collection of plastics waste in the city of Niš. The advantages of this method are:

- Easy implementation and fast computation, robust applicability, production of good solutions.
- Based on our experiments it can be concluded that SOM provides flexible and quick means to obtain optimized routs for collecting plastic waste.
- Although the concept of using SOM for this task was shown to be viable, additional work must be done to obtain improved results.

But each method has some disadvantages:

- Some of the SOM parameters need to be optimized such as learning rate, neighborhood distance and number of iterations.

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THREE PHASE FOUR WIRE SHUNT ACTIVE POWER FILTER BASED FUZZY LOGIC DC-BUS VOLTAGE CONTROL

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ABSTRACT: *In this paper a simple fuzzy logic control is proposed in order to ensure DC-bus voltage regulation and to keep the capacitor voltages balanced with minimizing the zero-sequence component in the source current in three phase four wires active power filter. A comparison of the proposed method against the conventional proportional integral one is illustrated through simulation results and a clear advantage of the fuzzy logic control can be observed. Moreover, identification of reference currents will be developed by the use of Multi-Variable Filter having the advantage of extracting harmonic voltages directly from the αβ axis. Computer simulation results show that the dynamic behavior of the fuzzy controller is better than the conventional proportional-integral (PI) controller.*
KEYWORDS: *Fuzzy logic control, DC-bus voltage control, Four-wire shunt active filter, harmonics current compensation, multi-variable filter*

INTRODUCTION

Conventionally, the major part of electrical power was consumed by linear loads. In recent years, the application of power electronics has grown tremendously. These power electronics systems offer highly non-linear characteristics and draw non sinusoidal current from utility, causing harmonic pollution into supply system. Increase in such non-linearity results in undesirable features such as distortion of supply voltage, low system efficiency and a poor power factor. They also cause disturbance to other consumers and interference in near by communication networks [12].

Since their basic operating principles were firmly established in 1970s, active filters have attracted the attention of power electronics researchers/engineers who have had a concern about harmonic pollution in power systems [1].

They compensate, in real-time, the disturbances due to a nonlinear load. However, the control of active filter is difficult [9]. In many commercial and industrial installations, electric power is distributed through a there phase four wire system with incorrectly distributed or uncompensated loads.

Such systems may suffer from excessive neutral currents caused by nonlinear or unbalanced loads. This type of system has a problem. If nonlinear single phase loads are present or the three phase load is unbalanced, line currents are unbalanced and neutral currents flow. In severe cases, the neutral currents are potentially damaging to both the neutral conductor and the transformer to which it is connected.

Three phase three wire shunt active power filters cannot effectively reduce or eliminate line harmonics in this situation. Three phase four wire active power filters have been proposed by researchers as an effective solution to these problems [5].

Most active filters can use as their power circuit either a voltage-source pulse width-modulated (PWM) converter equipped with a dc capacitor or a current-source PWM converter equipped with a dc inductor. At present, the voltage-source converter is more favorable than the current-source converter in terms of cost, physical size, and efficiency [1].

The shunt-active filter allows a compensation of the load currents, so that compensation drawn from the network is sinusoidal, balanced and minimized. It is connected in a back-to-back which the shunt converter is responsible for regulating the common DC-link voltage [10].

The PI controller used requires precise linear mathematical models, which are difficult to obtain, and fails to perform satisfactorily under parameter variations, nonlinearity, load disturbance, etc. It will cause DC voltage overshoot and inrush source current which will lead to protection or even equipment damage when APF is plunged into the system. The voltage overshoot and inrush current have been the constraints which restrict the development of active power filter [11].

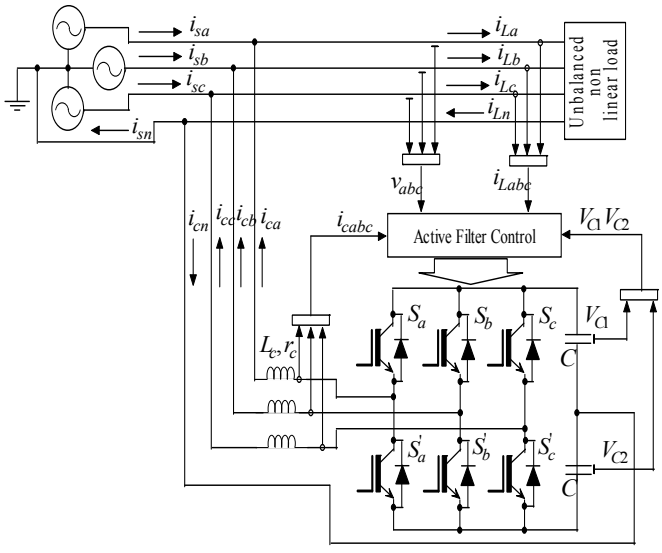

Figure 1. Three-phase four-wire active power filter

Recently, Fuzzy Logic Controller (FLC) is used in power electronic systems; for adjustable motor drives and active power filter applications.
The advantages of FLC's over the conventional controllers are: It does not need accurate mathematical model; it can handle nonlinearity and is more robust than conventional controllers [8].
In this paper, an active power filter is proposed to eliminate harmonics both in the three phases and in the neutral conductor of an unbalanced three phase four wires electrical distribution system, feeding three single non-linear loads where the problem of DC-bus voltage control in three-phase four-wire shunt active filter is treated by a simple fuzzy logic control and the identification of reference currents is developed by the use of Multi-Variable Filter to extract harmonic voltages directly from the $\alpha\beta$ axis.
This combination improves the active power filter performances.

CIRCUIT CONFIGURATION

The main circuit of the shunt active parallel filter shown in figure 1 uses a Three-Leg Split-Capacitor (TLSC) and the neutral current is provided through the fourth wire connected directly to the midpoint of this bus.
This configuration (TLSC) which used in this paper is preferable to the Four-leg Full Bridge FLFB, that provides the neutral current through the fourth leg.
From the point of view control, the TLSC topology permits each of the three legs to be controlled independently [14], making its current tracking control simpler than the FLFB topology.
However, in this case all the zero-sequence injected current flow through the DC-bus capacitors. So, in order to compensate the source neutral current, the DC-bus capacitor of the filter is split into two series connected capacitors in order to create a mid point that is directly connected to the mains neutral [7]. This current gives rise to voltage unbalance between the two capacitors C_1 and C_2 in the DC-bus especially when the compensated currents are highly distorted and unbalanced. The DC-bus voltage control is generally included in the process of current reference identification, because it provides additional active current that the active filter must inject or absorb in or from the main to achieve DC-bus voltage regulation. Due to this effect, the source currents after compensation will depend strongly on the efficiency DC-bus control. For the TLSC topology, two control loops are generally performed to control respectively the DC-bus voltage absolute value and unbalance.
To mitigate the oscillation between the voltage V_{C1} and V_{C2} across the capacitors C_1 and C_2 of the DC-bus, some ideas are proposed in the literature. The fuzzy logic control is already performed successfully for active filter control.
The present paper proposes a fuzzy logic control in order to overcome eventual inconvenient of the usual methods. Two fuzzy logic controllers performe respectively the total bus voltage and the unbalance between the two capacitors.
The filter presented by a PWM converter is controlled with conventional hysteresis regulator.
The active power filter operates as a controlled current source generating the load harmonic current. As a result, the current supplied from the mains at the point of common coupling will be sinusoidal. The harmonic current detection is a very important; it determines the performance of active power filter in a certain extent [4]. This filter is based on an extension of the instantaneous power theory that considers the existence of zero-sequence phase current components in un unbalanced three phase four wire electrical distribution system feeding three single non-linear loads.

CONTROL STRATEGY. Conventional instantaneous powers theory

Active power filter can be used with different control strategies. One of the most widely used is based on the conventional instantaneous real and imaginary powers theory initiated by Akagi.
Phase voltage imports the phase-locked loop (PLL), PLL exports the sine and cosine signal circuit which produce sinusoidal signals in phase.
Figure 2 presents supply voltage waveforms before using PLL, and figure 3 presents it after the use of PLL.

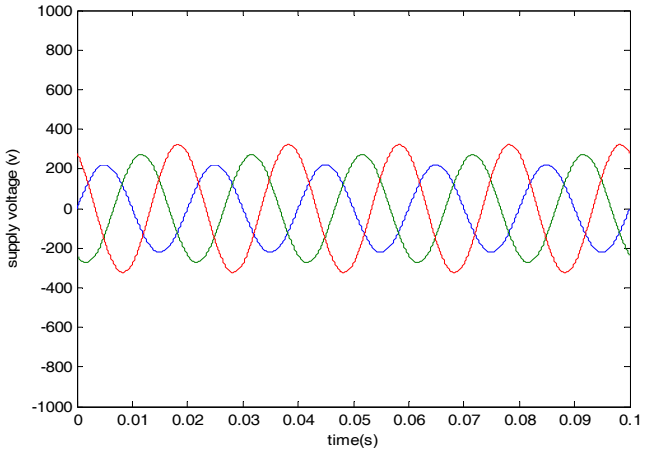

Figure 2. Supply voltage waveforms without PLL

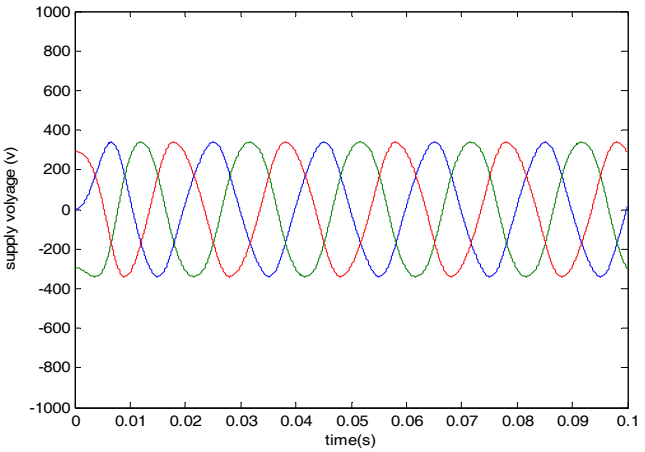

Figure 3. Supply voltage waveforms with PLL

This theory is based on a-b-c phase reference currents computation by transferring three phase voltage and current signal into corresponding α-ß-o components. Simply, the basic p-q theory consist of an algebraic transformation, known as Clarke transformation, of the sensed three-phase source voltage (V_{sa}, V_{sb}, V_{sc})

and load currents (I_{La}, I_{Lb}, I_{Lc}) from a-b-c coordinates to the α-β-o coordinates is shown in (1) and (2) .

$$\begin{bmatrix} V_\alpha \\ V_\beta \\ V_0 \end{bmatrix} = \sqrt{\frac{2}{3}} \begin{bmatrix} 1 & -\frac{1}{2} & -\frac{1}{2} \\ 0 & \frac{\sqrt{3}}{2} & -\frac{\sqrt{3}}{2} \\ \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{bmatrix} \begin{bmatrix} V_{sa} \\ V_{sb} \\ V_{sc} \end{bmatrix} \quad (1)$$

$$\begin{bmatrix} i_\alpha \\ i_\beta \\ i_0 \end{bmatrix} = \sqrt{\frac{2}{3}} \begin{bmatrix} 1 & -\frac{1}{2} & -\frac{1}{2} \\ 0 & \frac{\sqrt{3}}{2} & -\frac{\sqrt{3}}{2} \\ \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{bmatrix} \begin{bmatrix} I_{La} \\ I_{Lb} \\ I_{Lc} \end{bmatrix} \quad (2)$$

Load side instantaneous real power (pαβ), imaginary power (qαβ) and zero sequence power (po) are calculated as in (3).

$$\begin{bmatrix} P_\alpha \\ P_\beta \\ P_0 \end{bmatrix} = \sqrt{\frac{2}{3}} \begin{bmatrix} V_\alpha & V_\beta & 0 \\ -V_\beta & V_\alpha & 0 \\ 0 & 0 & V_0 \end{bmatrix} \begin{bmatrix} i_\alpha \\ i_\beta \\ i_0 \end{bmatrix} \quad (3)$$

Instantaneous real and imaginary powers include oscillating (AC) and average (DC) components as shown in (4). pαβ and qαβ may be, split into two parts (average values and oscillating values) as:

$$p_{net} = p_{\alpha\beta} + q_{\alpha\beta} + p_0 = \bar{p}_{\alpha\beta} + \tilde{p}_{\alpha\beta} + \bar{q}_{\alpha\beta} + \tilde{q}_{\alpha\beta} \quad (4)$$

After determining the active and reactive power signals, they are smoothened by passing through a low pass filter.

$$\begin{bmatrix} i_\alpha \\ i_\beta \\ i_0 \end{bmatrix} = \frac{1}{V_0 V_\alpha^2 + V_0 V_\beta^2} \begin{bmatrix} V_0 V_\alpha & -V_0 V_\beta & 0 \\ V_0 V_\beta & V_0 V\alpha & 0 \\ 0 & 0 & V_\alpha^2 + V_\beta^2 \end{bmatrix} \begin{bmatrix} \tilde{p} \\ \tilde{q} \\ p_0 \end{bmatrix} \quad (5)$$

Later, they are converted back to three phase reference currents and made available for comparison with actual currents [6].

$$\begin{bmatrix} i_{ha} \\ i_{hb} \\ i_{hc} \end{bmatrix} = \sqrt{\frac{2}{3}} \begin{bmatrix} \frac{1}{\sqrt{2}} & 1 & 0 \\ \frac{1}{\sqrt{2}} & -\frac{1}{2} & \frac{\sqrt{3}}{2} \\ \frac{1}{\sqrt{2}} & -\frac{1}{2} & -\frac{\sqrt{3}}{2} \end{bmatrix} \begin{bmatrix} i_\alpha \\ i_\beta \\ i_0 \end{bmatrix} \quad (6)$$

The neutral current is equal to:

$$i_n = \left(i_{ha} + i_{hb} + i_{hc}\right) \quad (7)$$

Multi-Variable Filter

Now a multi variable filter developed by Benhabib in 2004 is presented in order to obtain a good voltage signal without harmonics [2]. It can be presented by the following transfer function:

$$V_{xy}(t) = e^{j\omega t} \int e^{-j\omega t} U_{xy}(t) dt \quad (8)$$

After Laplace transformation, we get:

$$H(s) = \frac{V_{xy}(s)}{U_{xy}(s)} = \frac{s + j\omega}{s^2 + \omega^2} \quad (9)$$

After developing this equation, we obtain:

$$\hat{x}_\alpha = \frac{k}{s}\left[x_\alpha(s) - \hat{x}_\alpha(s)\right] - \frac{\omega}{s}\hat{x}_\beta(s) \quad (10)$$

$$\hat{x}_\beta = \frac{k}{s}\left[x_\beta(s) - \hat{x}_\beta(s)\right] + \frac{\omega}{s}\hat{x}_\alpha(s) \quad (11)$$

The scheme of this filter is illustrated in figure 4.

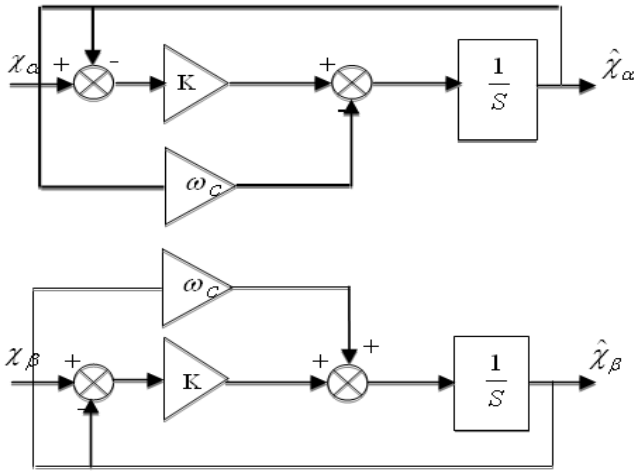

Figure 4. Multi-variable filter

Description Regulation of Capacitor Voltage

There are two types of power circuits applicable to three-phase active filters, the author prefers the voltage- source to the current-source PWM converter because it is higher in efficiency, lower in cost, and smaller in physical size than the current-source PWM converter, particularly in terms of comparison between the dc capacitor and the dc inductor .

Proportional Integrator Controller

In many industrial applications, a PI controller is generally used to regulate the DC bus voltage of shunt active power filters. The regulation of the continuous voltage at the boundaries of the capacitor being ensured by a regulator made up of a low-pass filter of time constant and proportional regulator with Kc as a gain, which makes it possible to compensate losses in the inverter [3]. Since converter consumes an instantaneous active power given by:

$$Pc = \frac{d}{dt}\left(\frac{1}{2} C V_{dc}^2\right) \quad (12)$$

For small change in V_{dc}^* around its reference, this equation can be linearized as:

$$Pc = C V_{dc} \frac{d}{dt}\left(V_{dc}\right) \quad (13)$$

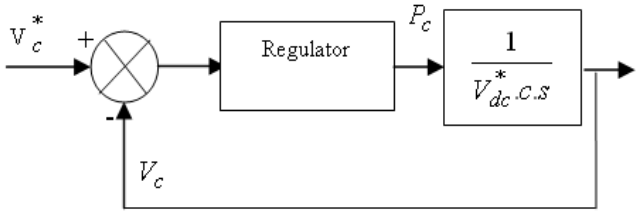

Figure 5. DC Voltage control bloc diagram

For stabilizing the DC voltage, a proportional controller is used, response of it is calculated by:

$$\Delta V_{C12} = K_p\left(V_c^* - \left(V_{c1} + V_{c2}\right)\right) \quad (14)$$

where V_{C1}, V_{C2} are voltages on capacitor C_1 and C_2, Kp gain of voltage controller, Vc* is DC voltage reference, where

$$C = K\left(1 - e^{-Ts/\tau}\right) \quad (15)$$

$$d = -e^{Ts/\tau} \quad (16)$$

In recurrence notation, we have:

$$P_c(K) = C\varepsilon(K-1) - dP_C(K-1) \quad (17)$$

FUZZY LOGIC CONTROL OF DC-BUS VOLTAGE

In recent years, fuzzy logic controllers have generated a great deal of interest in certain applications. The advantages of fuzzy logic controllers are: robustness, no need to accurate mathematical model, can work with imprecise inputs, and can handle non-linearity [13]. In this part of paper, the error signal caused by the filter losses has been computed firstly. Then this error signal has been compensated using the fuzzy logic controller.

Mamdani fuzzy system has been used in the fuzzy controller. The fuzzy controller is characterized for the following: - Seven fuzzy sets for each input - Seven fuzzy sets for the output-Triangular membership functions Defuzzyfication using the "centroid' method. Figure 4 shows a schematic block diagram of fuzzy inference system or fuzzy controller.

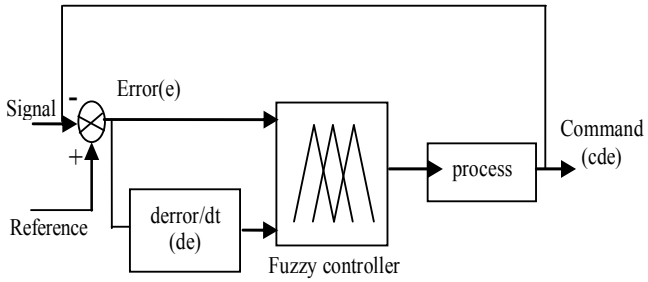

Figure 6. Fuzzy controller synoptic diagram

Figure 6 shows a schematic block diagram of fuzzy inference system or fuzzy controller. In our application two fuzzy logic controllers are implemented to control the DC-bus voltage.

SIMULATION RESULTS

The performance of the proposed method is examined with an active filter simulation model using the instantaneous power theory and the results are compared with a multi-variable filter.

The dynamic response of control strategy (and overall active power filter) is studied by switching three single phase inverter feeding unbalanced loads. The simulation results where carried out using Matlab under the following parameters:

Table 1. Parameters of simulation

f=50Hz		
V_{s1}=220 v	V_{s2}=271 v	V_{s3}=322v
R_s=1,18e^{-3} Ω	L_s=37,6e^{-6}H	
R_c=4,3e^{-3} Ω	L_c=68,67e^{-6}H	
R_f=5e^{-3} Ω	L_f=300^{-6}H	
R_{l1}=0,2 Ω	L_{l1}=1e^{-3}H	
R_{l2}=0,3 Ω	L_{l2}=2e^{-3}H	
R_{l3}=0,4 Ω	L_{l3}=3e^{-3}H	

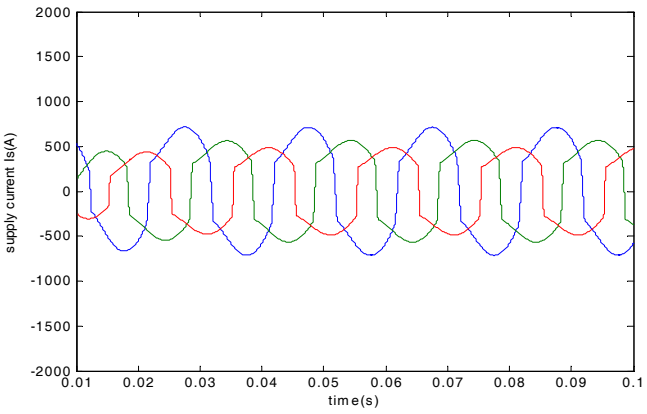

Figure 7.a Supply current wave form

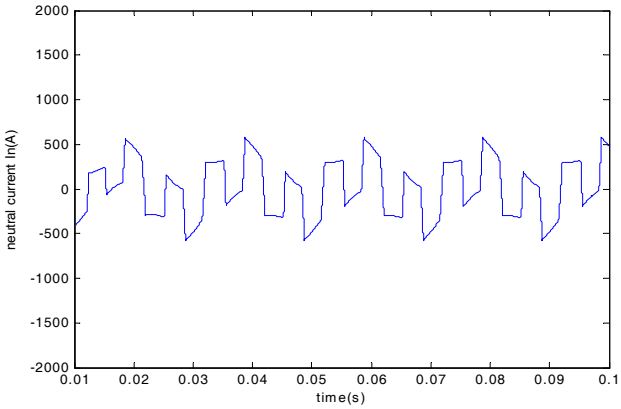

Figure 7.b Neutral current wave form

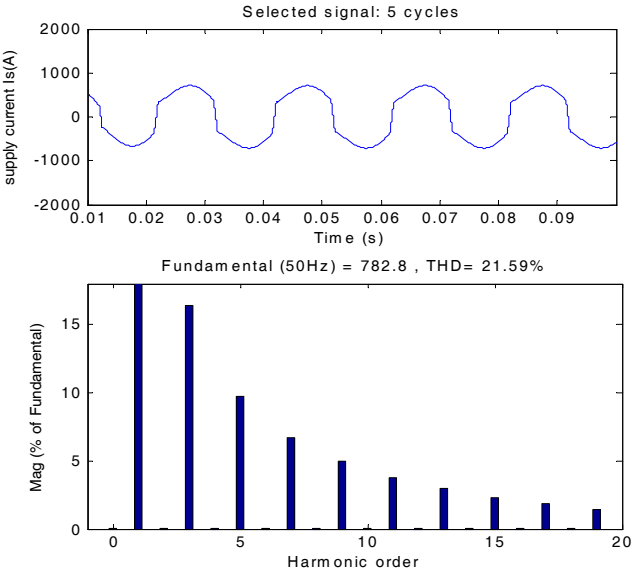

Figure 7.c Supply current wave form with TDH

Figure 7. Waves form signal before compensation

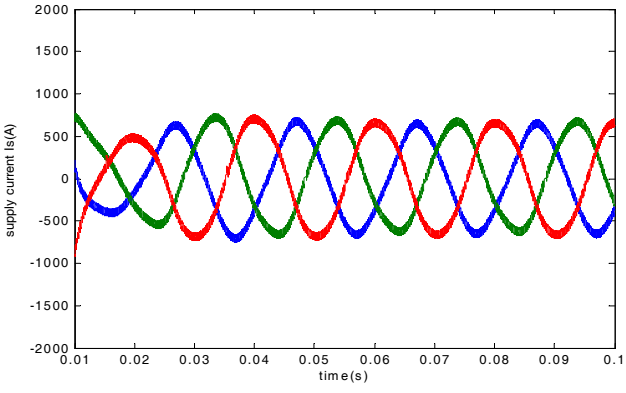

Figure 8.a Supply current wave form

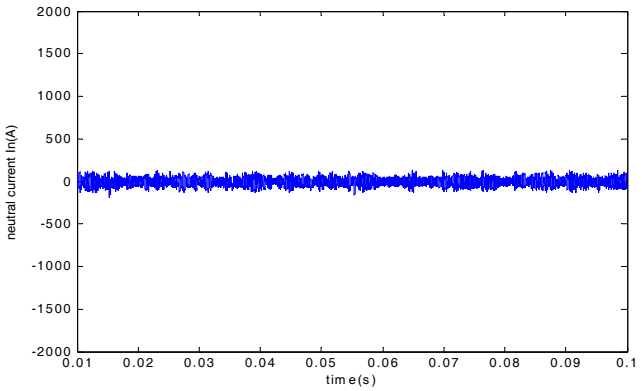

Figure 8.b Neutral current wave form

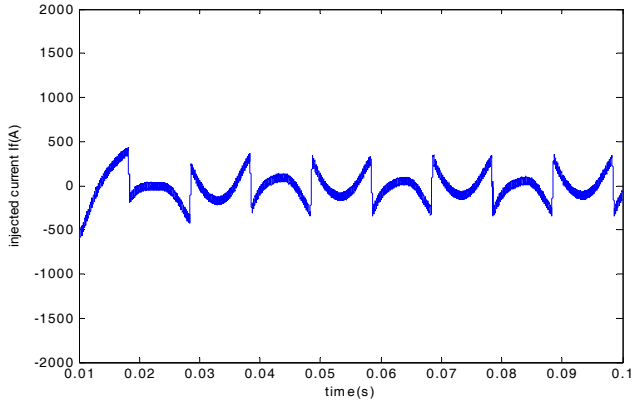

Figure 8.c Injected current wave form

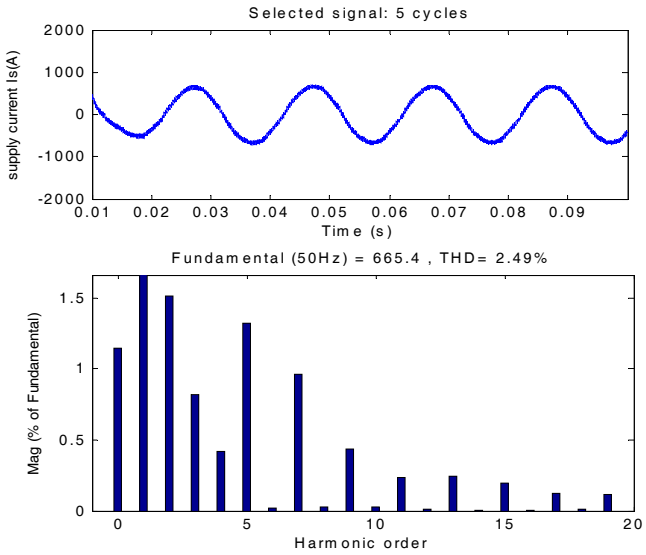

Figure 8.d Supply current wave form with THD

Figure 8. Waves form signal using instantaneous power theory and PI Controller for DC voltage

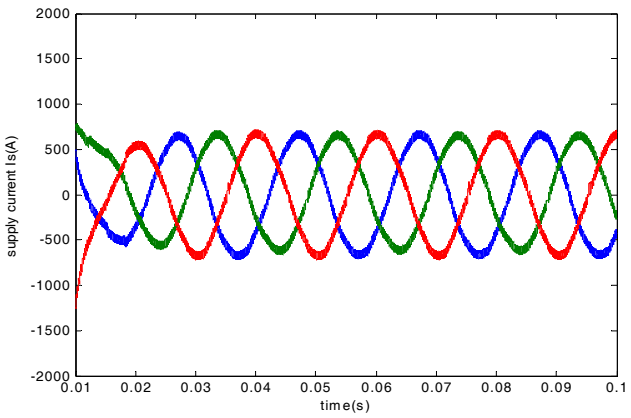

Figure 9.a Supply current wave form

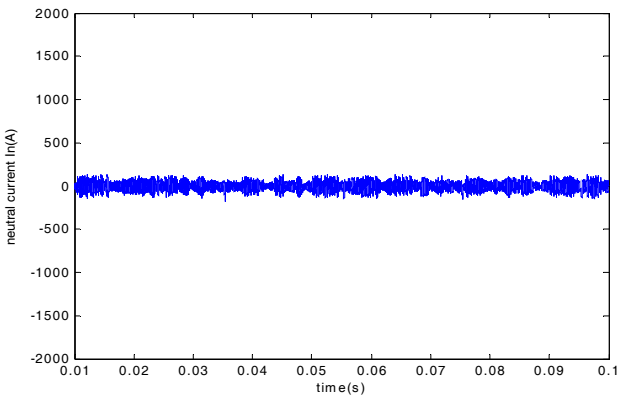

Figure 9.b Neutral current wave form

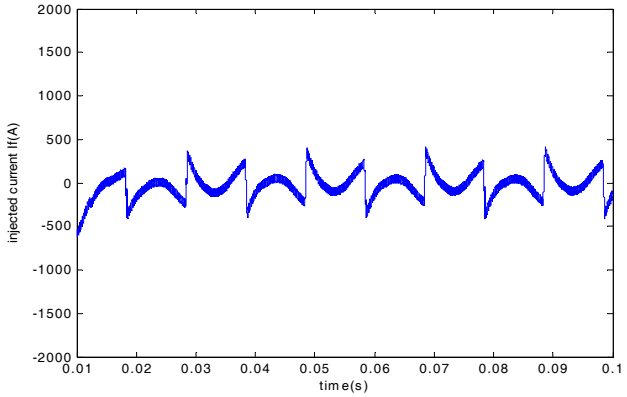

Figure 9.c Injected current wave form

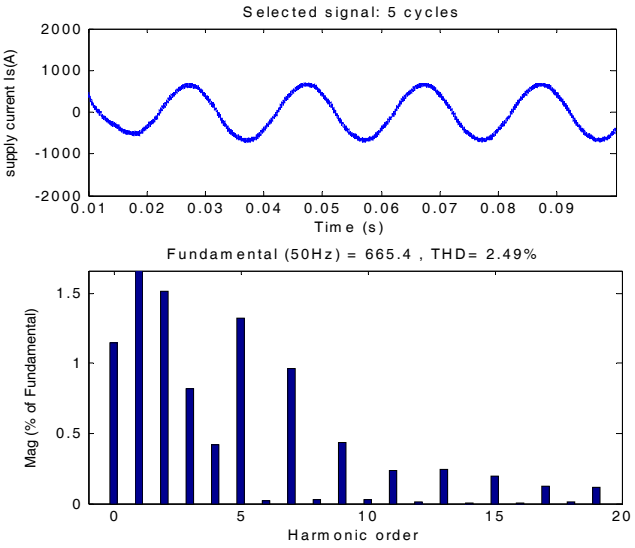

Figure 9.d Supply current wave form with THD

Figure 9. Waves form signal using multi variable filter and PI Controller for DC voltage

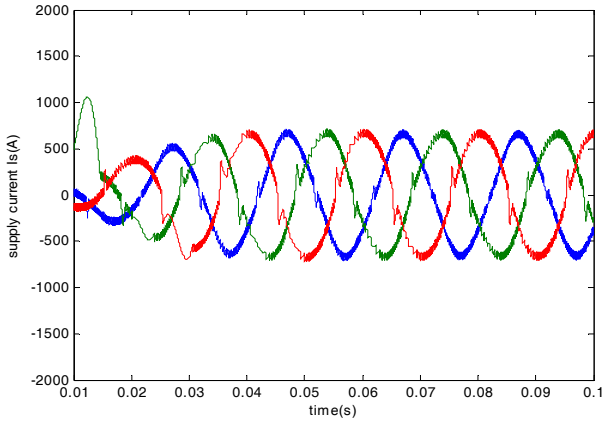

Figure 10.a Supply current wave form

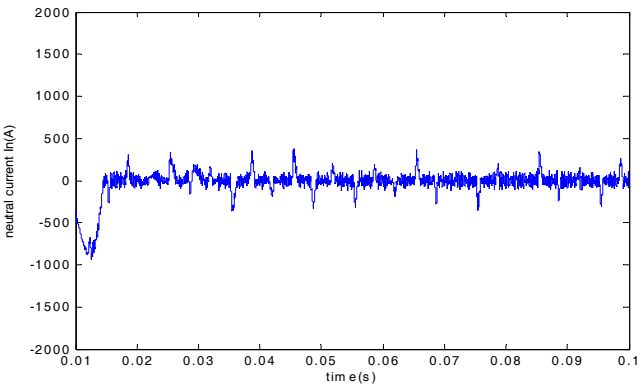

Figure 10.b Neutral current wave form

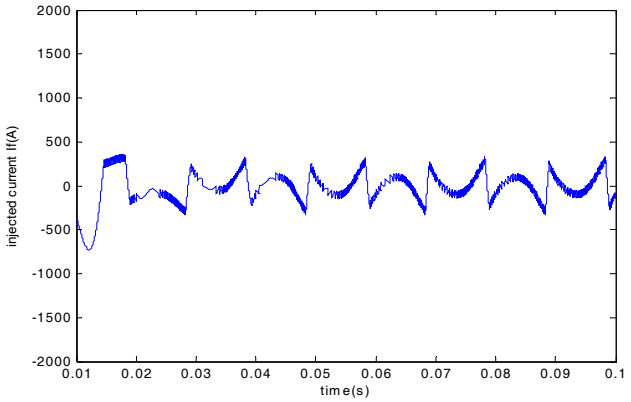

Figure 10.c Injected current wave form

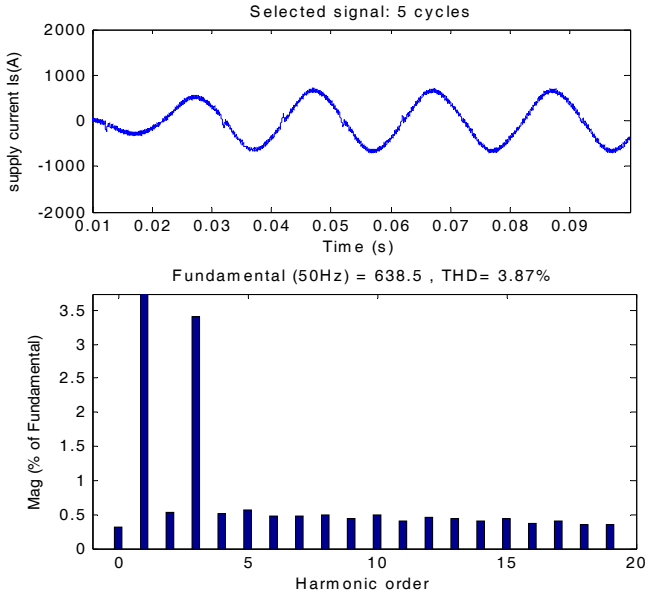

Figure 10.d Supply current wave form with THD

Figure 10. Waves form signal using instantaneous power theory and fuzzy logic Controller for DC voltage

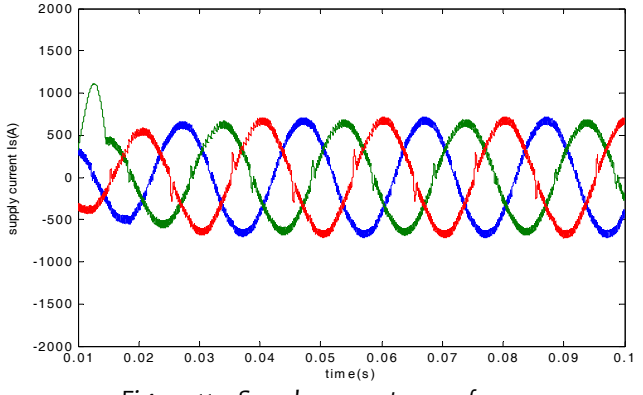

Figure 11.a Supply current wave form

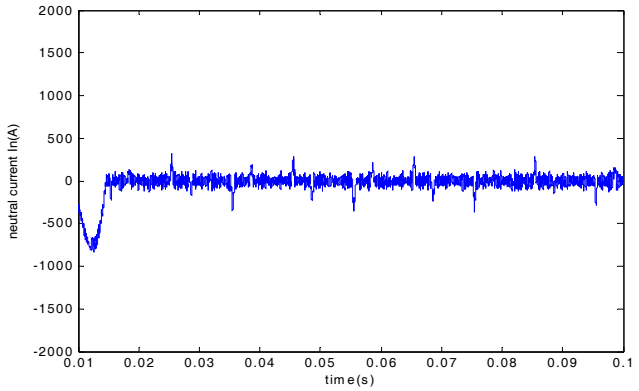

Figure 11.b Neutral current wave form

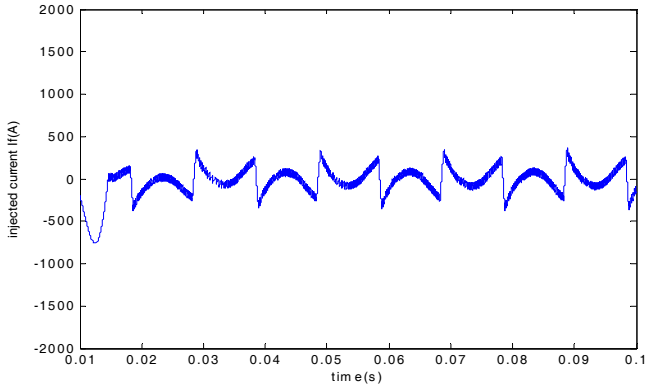

Figure 11.c Injected current wave form

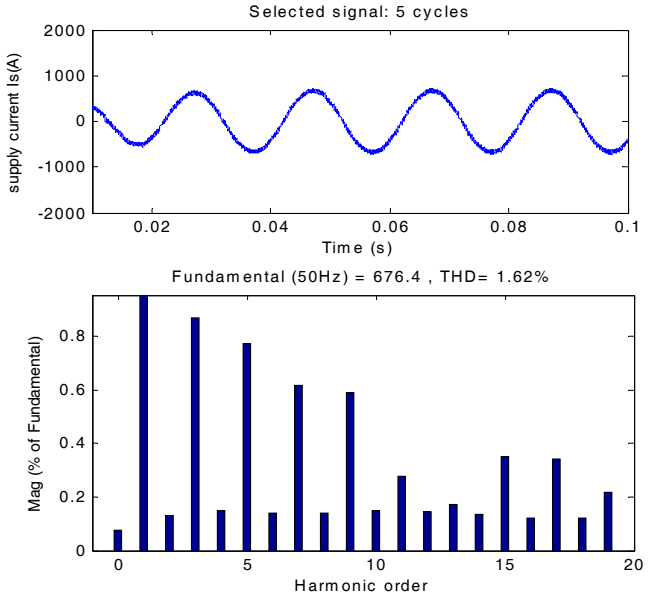

Figure 11.d Supply current wave form with THD

Figure 11. Waves form signal using multi variable filter and fuzzy logic Controller for DC voltage

INTERPRETATION

Simulation results based on MATLAB software are presented to validate the control strategy. Figures 9.a, 10.a and 11.a show that the line currents are sinusoidal and balanced after the use of the active filter. As can be seen that the THD before compensation was 21,59%, and it becomes 4,25% by using instantaneous power theory 2,49% using multi variable filter with the PI controller which is used to regulate DC bus voltage. Moreover the THD is 3, 87% by using Instantaneous Power Theory and 1,62% using a multi variable filter with fuzzy logic controller to regulate DC bus voltage. So, with all those methods, THD is less then 5% which

satisfies the CEI norms. Consequently, the obtained results have shown a better performance for multi variable filter with fuzzy logic controller to regulate DC bus voltage.

CONCLUSIONS

A digital active filter for phase and neutral currents harmonic compensation in three phase four wire system feeding three single non-linear loads and fuzzy logic controller used in the regulation of the continuous voltage at the boundaries of the capacitor is proposed. the problem of the DC-bus voltage control of the three-phase three-leg voltage source inverter based four-wire shunt active filter control is treated. An alternative solution based on fuzzy logic control is proposed to overcome the principal inconvenient of this configuration which is unbalance between the two capacitors in that bus. The performances of the fuzzy logic control in DC-bus voltage control is verified through computer simulation. The dc link fuzzy control has better dynamic behavior than conventional PI control strategy.

Beside this, the use of a multi-Variable Filter having the advantage of extracting harmonic voltages directly from the $\alpha\beta$ axis have improved the filtering performances of the active power filter, therefore it makes the filter more attractive for four-wire compensator implementation.

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MONITORING RESULTS ON INDUSTRIAL WASTEWATER POLLUTANTS IN STEEL INDUSTRY

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ABSTRACT: *In the steel manufacturing process where the molten steel is cast, high volumes of water are used to quench and cool the steel. This contact or direct cooling water becomes contaminated with high levels of suspended solids and mill scale along with oil and grease. Being familiar with the sources of pollution, their monitoring and control represent a first step towards reducing the quantity and the toxicity of all emissions, focusing on applying a "cleaner" production in the industry of elaborating and processing metallic materials, too. Monitoring water quality has now become an indispensable tool for assessing trends in pollutant concentration and loads. Taking into consideration the effect of exceeded allowed values of various pollutants in discharged waste water upon the environment and human health, this paper presents their monitoring in a case study from a steel unit.*
KEYWORDS: *monitoring, pollutant, quality, environment, waste water*

INTRODUCTION

The steel industry is classified among the largest users, particularly due to high temperature within manufacturing processes. Starting with cooking and sintering processes, continuing with furnaces and steel plants to steel mills all these departments use large quantities of water [1].

Waste water discharged from a steel unit is the result of summation of many waste water treatment processes for a refinement [2].

Wastewater treatment systems typically include operations: sedimentation to remove suspended solids, physical or chemical treatment. Advanced technologies include microfiltration, nanofiltration, ultrafiltration, reverse osmosis and advanced oxidation [2-6]. Monitoring and control of water is also factor that influences the performance of the water treatment system [3].

All these categories of contaminated water from steel industry need to be treated impurities must be eliminated or reduced to certain values before their discharge into emissary in order for these not to harm the recipient they are discharged into and not endanger its water reuse [4].

These industrial discharge or wastes include pesticides, polychlorinated biphenyls (PCBs), dioxins, poly-aromatic hydrocarbons (PAHs), petrochemicals, phenolic compounds, microorganisms and the various heavy metals, which are a real threat to the environment and public health, because their toxicity and persistence in the environment [5]. The removal of toxic metals such as chromium, cadmium, copper, lead, nickel, mercury and zinc from waste waters became a necessity due to their toxicity and carcinogenicity [6-7].

Industrial effluents are a main source of direct and often continuous input of pollutants into aquatic ecosystems with long-term implications on ecosystem functioning including changes in food availability and an extreme threat to the self-regulating capacity of the biosphere [8-9].

Considerable quantities of suspended and colloidal matter in the discharge reduce the penetration of sunlight. In the water bodies, resulting in reduction of Photosynthetic activity, an essential feature of self purification of polluted water bodies [10]. Suspended and colloidal matter can also smother bottom dwelling aquatic organisms affecting the life of water bodies/streams and may lead to heavy siltation which affects the flow [10-11].

MATERIALS AND METHODS

Research has been directed to understanding the current situation of the amount of pollutants in the industrial water analyzed, based on pH measurements, chemical content of oxygen (CCO), suspension and heavy metals concentration, and using experimental data.

For experimental research it was chosen as research material the wastewater coming from continuous casting process of semi-finished products, and flowing into emissary.

The samples were collected using 500 ml polythene bottles. The bottles were thoroughly cleaned in soap solution first, soaked in 10 % hydrochloric acid (HCl) for 24hrs, and then rinsed with deionised water. All samples were tightly sealed and kept cool using ordinary dry ice in the field and while on transit to the laboratory.

Methods of analysis to determine concentration for each physical and chemical indicator have been applied according to current standards and for each method of determination the value is calculated separately.

PHYSICO-CHEMICAL VARIABLES

Water quality parameters provide important information about the health of a water body. These parameters are used to find out if the quality of water is good enough for drinking water, recreation,

irrigation, and aquatic life. Physico-chemical variables were examined from January to December 2011.
pH of the water were measured using pH meter. Turbidity was subjectively assessed as high, medium or low.

Figure 1. pH-meter

Total dissolved salts (TDS), were determined by filtering 100 ml of water and then evaporating it gradually in pre-weighed crucibles. The change in weight was used to determine the dissolved salts.
Chemical oxygen demand (COD) was determined by titration method, using ferrous ammonia sulphate and ferroin as indicator.
The concentration of sulphates (SO_4^{2-}) in water samples was determined by using the turbidimetric procedures based on the precipitation of sulphate from the water using a conditioning reagent and barium chloride dihydrate.
The concentrations of the heavy metals and anions in the samples were determined according to standard procedures. The concentrations of the heavy metals were determined by using spectrophotometer DR/2000.

Figure 2. Spectrophotometer DR/2000

RESULTS

To determine the efficiency of wastewater management in continuous casting department and to identify the impact that industrial wastewater can generate upon the degree of contamination of surface water where they are being discharged, and therefore upon the natural emissary, various samples were taken and the following indicators were analyzed: pH, the total suspended solids (TSS), fixed residues, sulphates and heavy metals (Fe, Cd, Cr, Cu, Mn, Ni and Pb). The maximum admissible values of the analyzed parameters, according to NTPA 001/2005 (GD, 2005).
The results for monthly and quarterly monitoring of wastewater physical and chemical parameters when discharged into emissary during 2011-2012 are in figures 3-13 using an Access database.

DISCUSSION

The pH varied between pH 6.93 and 8.02. The highest value was obtained in September while the lowest was obtained in May (Figure 3).

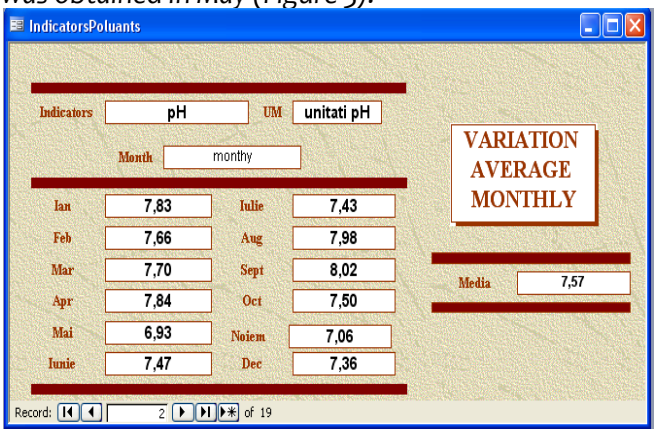

Figure 3. Variation average monthly from pH

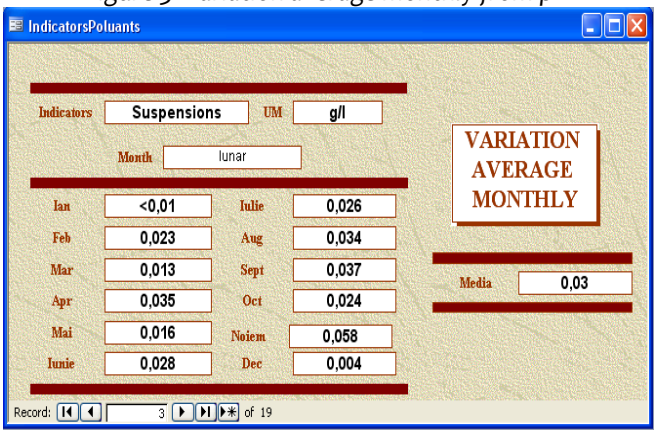

Figure 4. Variation average monthly from suspension

The total suspended solids (TSS) varied between 4 and 58 mg/l (Figure 4). The highest value was obtained in November while the lowest was obtained in December. Comparing with NTPA 001/2005 (GD, 2005), it was observed that the TDS values in effluents were within the permissible limits.

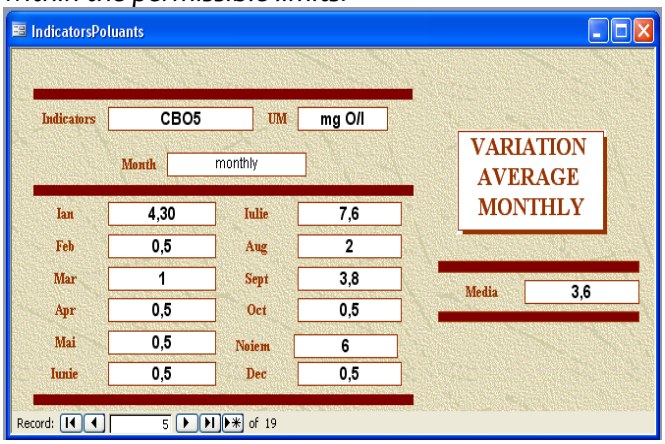

Figure 5. Variation average monthly from CBO5

Biochemical Oxygen Demand, or BOD, is a measure of the quantity of oxygen consumed by microorganisms during the decomposition of organic matter. BOD is the most commonly used parameter for determining the oxygen demand on the receiving water of a municipal or industrial discharge. BOD can also be used to evaluate the efficiency of treatment processes, and is an indirect measure of biodegradable organic compounds in water.

Sulphates: 58.13 mg/l is within the values allowed by law for discharge (600mg/l). The minimum value was measured in spring season and the maximum value was measured in autumn season, (Figure 6).

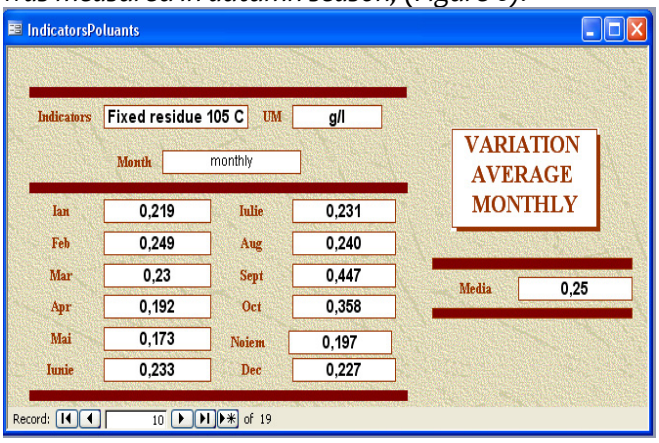

Figure 6. Variation average monthly from fixed residue

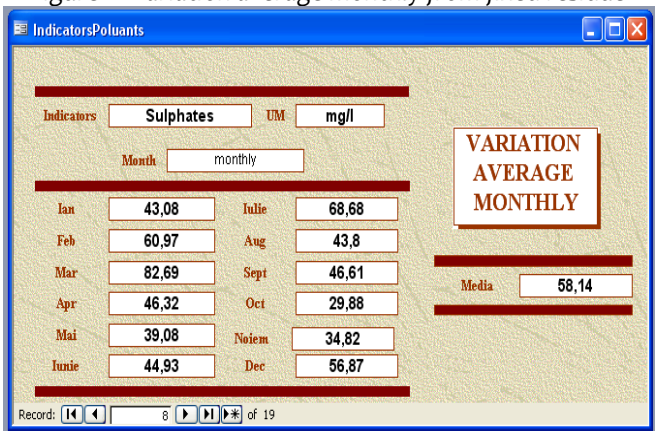

Figure 7. Variation average monthly from sulphates

For heavy metals concentration (Cd, Cr, Cu, Fe, Mn, Ni, Pb and Zn) results showed in Figure 8-13 that the levels for all were above the permissible limits compared with standards:

- *Fe : 0.04 mg/l is within the value allowed by law for discharge (5mg/l);*
- *Ni: 0.02 mg/l is within the value allowed by law for discharge (0.5 mg/l);*
- *Mn: 0.12 mg/l is within the value allowed by law for discharge (1 mg/l);*
- *Zn : 0.02 mg/l is within the value allowed by law for discharge (0.5 mg/l);*
- *Cd was not detected.*

These characteristics are dependent on the main activity developed in each sector. If untreated wastewater would be discharged in aquatic environment, some effects could take place, for example:

- *Effect of pH: organisms are very susceptible to acids and bases.*
- *Effect of biological oxygen demand: depletes dissolved oxygen from streams, lakes and oceans; may cause death of aerobic organisms (fish kills etc.); increases anaerobic properties of water*
- *Effect of total suspended solids: increases turbidity (less light-reduced photosynthesis, causes fish's gills to get plugged up); increases silting (reduces lifetime of lakes, changes benthic ecology).*

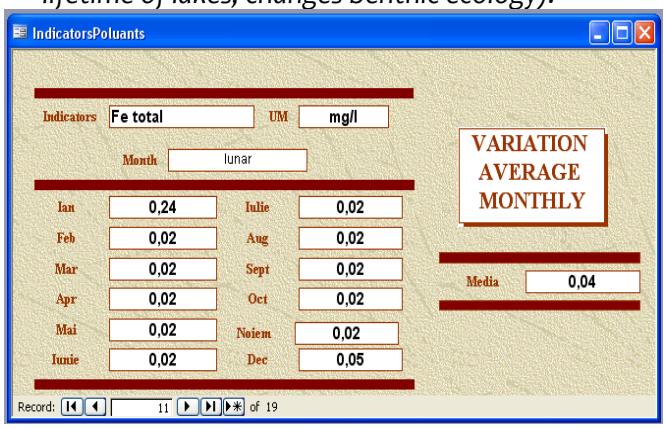

Figure 8. Variation average monthly from Fe

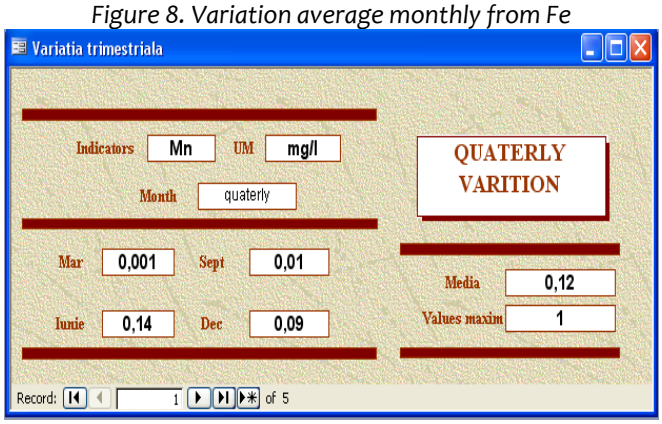

Figure 9. Quarterly variation from Mn

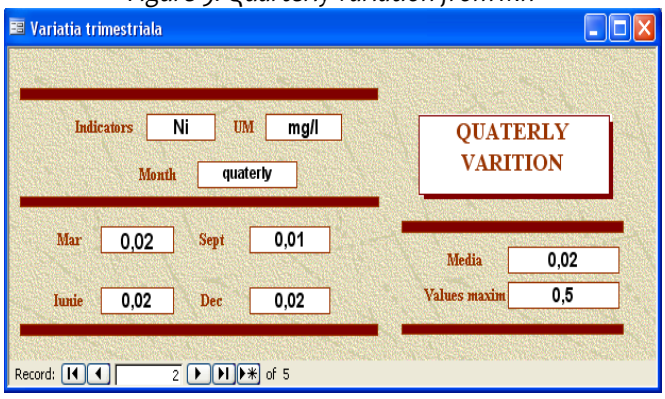

Figure 10. Quarterly variation from Ni

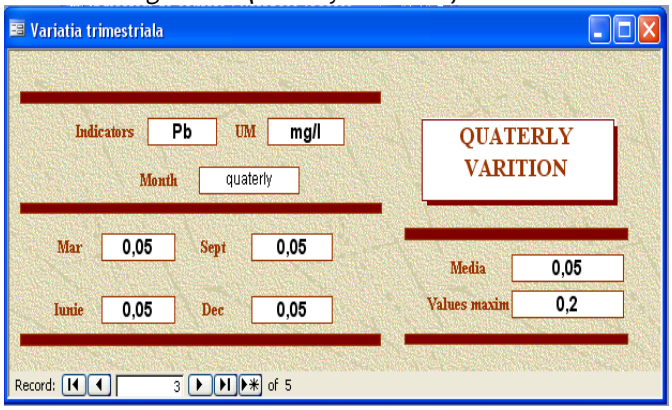

Figure 11. Quarterly variation from Pb

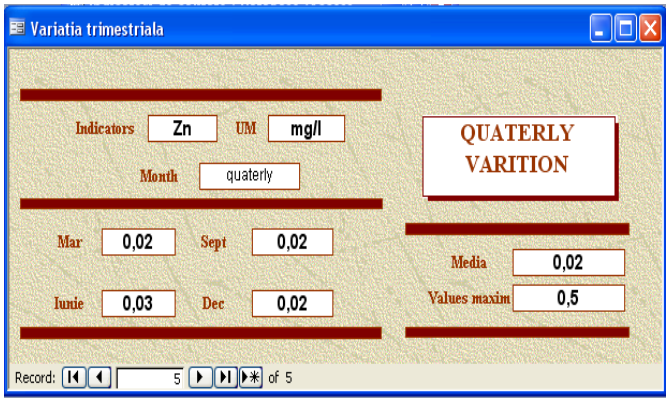

Figure 12. Quarterly variation from Zn

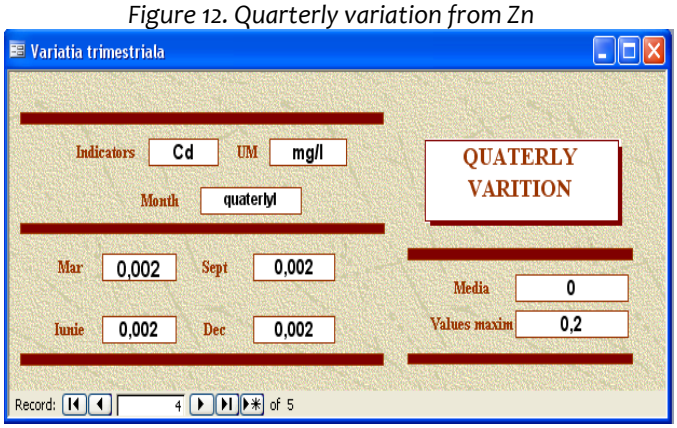

Figure 13. Quarterly variation from Cd

CONCLUSIONS

Taking into consideration the monitoring results in the industrial site, the following can be concluded:

- *The company doest not generate wastewater but water with low pollutant loading;*
- *Chemical analysis of wastewater discharged indicates that this is within the established limitations;*
- *Discharging this wastewater does not alter the quality of emissary;*
- *Wastewater discharges should be monitored daily for the listed parameters, except for metals, which should be monitored at least on a quarterly basis.*

Wastewater treatment systems typically include sedimentation to remove suspended solids, physical or chemical treatment such as pH adjustment to precipitate heavy metals, and filtration. To reduce consumption of chemicals for pH control, attempts should be made to replace dilution water with alkaline process wastewater from other process units.

The first step in a pollution prevention strategy for water is a thorough audit and characterization of wastewater from steel operations. A program of maintenance, inspection, and evaluation of production practices should be established. Significant reductions in water use can be made by implementing the following: minimizing leaks and spills, maintaining production equipment properly, identifying unnecessary washing of equipment, training employees on the importance of water conservation.

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OPTIMIZATION OF FLYWHEEL MATERIALS USING GENETIC ALGORITHM

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ABSTRACT: *An inventive approach to composite flywheel design is put forward for discussion. Flywheel design and development has dominated in many applications where minimizing mass is critical. This is also attractive for various industrial based applications. Hence, the minimum mass required for certain energy storage was used as the objective function. Based on an analytical approach for calculating stresses in flywheels, the nonlinear optimization problem was solved using genetic algorithms that combine an evolutionary algorithm with a nonlinear active set method. The problem was solved for a sample flywheel with varying materials. Minimum mass required is found out for different values of energy storage and corresponding other parameters are found out. Finally, the composite materials found to have the least values of minimum mass required with increased value of angular velocity out of five materials selected for optimization process.*
KEYWORDS: *Flywheel, Angular velocity, Carbon fiber composite, Optimisation*

INTRODUCTION

Many problems which occur in engineering cannot be handled satisfactorily using traditional optimization methods. Engineering involves a wide class of problems and optimization techniques. Some engineering design approaches are simply old fashioned, and have been replaced by computer simulations that exploit various mathematical methods such as the finite element method to avoid costly design iterations and time. The next step followed in the engineering of systems is the automation of optimization through computer simulation. If the required performance factors for the system can be appropriately found, then optimization over them is simply engineering on an ambitious scale.

FLYWHEEL

As stated in [1], a flywheel is a rotating mechanical element which is used to store energy of rotational form. Flywheels have a considerable moment of inertia, and thus it resist changes in rotational speed. The amount of energy stored in a flywheel is proportional to the square of its rotational speed (angular velocity). Energy is transferred to a flywheel by applying torque to it, thereby causing it to rotate, and hence its stored energy, to increase. Similarly, a flywheel releases stored energy by applying torque to a mechanical load, which results in decreased rotational speed.

FUNCTIONS OF FLYWHEEL

Flywheel is used to store the excess energy when the supply is more than the demand and to deliver it when the supply is more than the demand. Flywheel is essentially a rotating mass. It stores energy in the form of kinetic energy. Flywheels are used in many applications such as internal combustion engines, steam engines, power presses, slotting machines, etc.
Size optimization of flywheels for the minimization of mass, is an appealing thought that has received its fair attention. The concept of a flywheel is old, but could very well hold the key to forth coming problems of efficient energy storage. The flywheel has a bright view point because of the recent development of composite materials. A simple example of a flywheel is a solid, flat rotating disk. A flywheel stores kinetic energy by rotating a mass about a constant axis of rotation, which makes it easy to assimilate flywheels into energy conservation systems. Few vehicles currently use flywheels during braking for regenerating energy lost during deceleration. Electrochemical energy storage such as batteries are limited by low cyclic lifetimes, low longtime reliability and low specific energies, these are major concerns in satellite applications. The flywheel is well capable for this application due to high cyclic lifetimes, longtime reliability and high specific energies than batteries. Also, large scale flywheels could be used in energy plants to store large amounts of energy. Finding practical applications for flywheels is not a problem, but optimizing the mass of flywheels, in a given specific set of parameters and constraints, provides a challenge.
In this paper, five different materials namely, Grey Cast iron (GCI 25), Aluminium alloy, Maraging steel, Carbon fiber composite (40% epoxy), E glass fiber(40% epoxy) are taken for analysis[2,3]. Optimization is carried out for all the five materials to find the minimum mass required for certain energy storage values. A comparison is made between energy storage, minimum mass obtained through optimization and corresponding mean radius and angular velocity.

NEED FOR OPTIMIZATION ON FLYWHEELS

The energy storage by a flywheel is given by[1],

$$\Delta E = I.\omega^2.C_\Delta \qquad (1)$$

where, I is the mass moment of inertia (kg-m^2), ω is the angular velocity (rad/sec) and C_Δ is the coefficient of fluctuation of speed. The energy stored by a flywheel is the function of its mass, radius and angular velocity. But, the angular velocity is limited to some value because of the hoop stress produced at the rim of the flywheel.
Equation (1) can be written as,

$$\Delta E=mr^2\omega^2C_\Delta \quad (2)$$

where, $I= mr^2$, m is the mass of flywheel and r is the mean radius of the disc. Assuming coefficient of fluctuation of speed $C_\Delta=1$.

$$\Delta E=mr^2\omega^2 \quad (3)$$

The vertical upward force, which will produce hoop stress, is,

$$2\rho Ar^2\omega^2 \quad (4)$$

where, ρ is the density of the material and A is the cross sectional area.

This is resisted by 2P such that

$$2P=2[\sigma]A \quad (5)$$

By equating (3) and (4),

$$2\rho A r^2\omega^2=2[\sigma]A$$

$$\omega\leq[\sigma]/\rho r^2 \quad (6)$$

Therefore, for safer operation, the flywheel has to be operated at the speed which will not produce the hoop stress greater than the allowable stress of the material. The radius of the flywheel, which is also in direct proportion with the energy storage, is another parameter which decides the hoop stress. The minimum mass required to store a certain value of energy for different types of materials can be found by optimization by keeping the angular velocity and the radius as variables. By optimization, the minimum mass can be found for the different materials for same energy storage and the corresponding angular velocity and radius can be obtained.

OPTIMIZATION

In engineering, the bio-inspired evolutionary computation is a subset of artificial intelligence that involves combinatorial optimization problems [4]. Evolutionary computation uses iterative progress, in a population. This population is then selected in a guided random search using parallel processing to achieve the desired results. As evolution produces effectively optimized processes, it has been found in numerous applications in engineering.

Many such evolutionary algorithms are found in many typical applications of engineering fields. They are genetic algorithms, evolutionary programming, evolution strategy, swarm intelligence, ant colony optimization and particle swarm optimization. A genetic algorithm (GA) is an optimization tool that imitates the process of natural evolution [5]. This heuristic approach is frequently used to generate useful solutions to optimization problems. As the GAs belong to the larger class of evolutionary algorithms (EA), they generate solutions to optimization problems using bio-inspired techniques, such as inheritance, mutation, selection, and crossover [6,7].

OPTIMIZATION OF FLYWHEEL USING GENETIC ALGORITHM

In order to find the minimum mass required and corresponding angular velocity and radius by genetic algorithm for the required energy storage, objective function and constraints and bounds have to be determined. Optimization will be carried out for five different materials with five different combinations of energy storage values. The objective functions, constraints and bounds will be same for all the five materials.

MATERIALS AND THEIR PROPERTIES

The five materials that are used for design of flywheel, and their properties are given in table 1.

Table 1. Material properties[2,3]

Material	Allowable stress, [σ](MPa)	Density, ρ (kg/m^3)
Grey Cast iron (GCI 25)	220	7340
Aluminium alloy	400	2700
Maraging steel	900	8000
Carbon fiber omposite (40% epoxy)	750	1550
E glass fiber (40% epoxy)	250	1900

PROBLEM FORMULATION

The objective function and constraints are same for all the five materials with different values of density ρ, and allowable stress [σ]. This can be formulated by using equations (3) and (6).

OBJECTIVE FUNCTION AND CONSTRAINTS

The objective of this problem is to minimize the mass for the given value of energy storage.

From equation (6),

$$\Delta E=mr2\omega^2$$

$$m=\Delta E/ r^2.\omega^2$$

where, ΔE= 100,200,300,400,500 J

Therefore, the objective function is

Minimize,

$$m=\Delta E/(r^2.\omega^2) \quad (7)$$

The constraints of the problem falls under non-linear constrains because of the orders of ω and r.

From equation (6), the constraints are obtained as follows.

$$\omega^2\leq[\sigma]/\rho r^2$$

$$\omega^2-[\sigma]/\rho r^2\leq 0$$

$$\rho r^2\omega^2-[\sigma]\leq 0 \quad (8)$$

RESULTS AND DISCUSSIONS

The problem is solved by using MATLAB 7.10.0. The following procedure is carried out to run the iteration process. First, the objective function and non linear constraints is created as M-files [9]. The ga tool is invoked using command window. Next, fmincon solver is selected as the problem falls with non-linear constraint. Objective function and constraints are entered in the solver in the appropriate areas. The bounds are given as lower (0.1 0.1), upper (2 500) ie, 0.1<r<2 m and 0.1< ω <500 rad/sec. The crossover function is selected as scattered and the mutation function is selected as constraints dependent mutation. In stopping criteria functional tolerance is given as 1e-9, this is used to stop the solver based on two immediate falling results. The maximum iterations are limited to 400. All other functions are left default as they don't affect the iteration process of the problem. The procedure is repeated for all five materials with ΔE=100, 200, 300, 400 and 500 J.

Figure 1 is a plot which obtained after running the solver showing the convergence of soultion. It shows the functional value (minimum mass) and the iteration number for E glass fiber (40% epoxy) for the energy storage of 500 J (refer table 2).

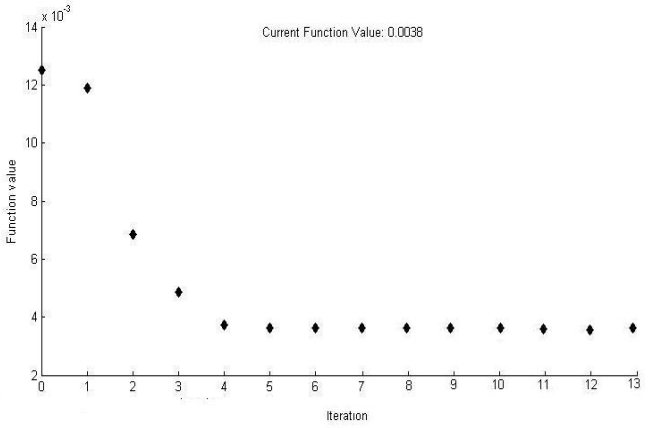

Figure 1. Functional value and iteration

The corresponding radius and angular velocities found from this optimization are, 1.491 m, 243.317 rad/sec respectively. Table 2 shows the materials and the minimum of mass, angular velocity, mean radius obtained for given values of energy storage.

Table 2. Materials and functional values

Material	Energy storage (ΔE) J	Mass (m) kg	Radius (r) m	Angular velocity (ω) rad/sec
Cast iron (GCI 25)	100	0.0033	0.829	208.91
	200	0.0066	1.039	166.67
	300	0.0100	1.089	159.00
	400	0.0130	1.109	156.16
	500	0.0166	1.128	153.42
Aluminium alloy	100	6.7E-4	1.065	361.46
	200	0.0013	1.423	270.48
	300	0.0020	1.488	258.59
	400	0.0027	1.510	254.87
	500	0.0033	1.528	251.95
Maraging steel	100	8.88E-4	1.009	332.26
	200	0.0017	1.344	249.58
	300	0.0026	1.406	238.59
	400	0.0035	1.427	235.04
	500	0.0044	1.444	232.28
Carbon fiber composite (40% epoxy)	100	2.06E-4	1.391	499.99
	200	4.13E-4	1.836	378.91
	300	6.20E-4	1.919	362.41
	400	8.26E-4	1.945	357.66
	500	0.001	1.964	354.15
E glass fiber(40% epoxy)	100	7.6E-4	1.040	348.62
	200	0.0015	1.388	261.31
	300	0.0028	1.452	249.80
	400	0.0030	1.474	246.12
	500	0.0038	1.491	243.31

Mass and the Energy Storage

Figure 2 gives the plot between minimum mass obtained for respective energy storages. It shows that, flywheel made up of cast iron has more mass for same values of energy storage compared with all other materials. It is because of high density and less strength of cast iron. It is followed by, maraging steel and E-glass fiber composite. Carbon fiber composite holds the least values of mass compared with other materials because of less density and good strength properties.

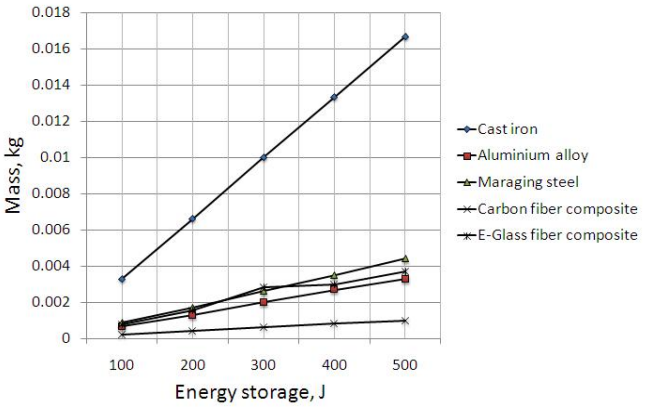

Figure 2. Minimum mass and energy storage of materials

Radius and the Energy Storage

The variation of radius of flywheels for respective energy storages is shown in Figure 3. For the same energy storage, cast iron flywheel holds less values of radius because of its high value of density and less strength properties. Carbon fiber composites have higher values of radius. It is followed by aluminum alloy, maraging steel and E-glass composites in this order.

Angular Velocity and the Energy Storage

As like figure 3, figure 4 also gives the same order of materials in the plot for angular velocity as well. Carbon fiber composites take the maximum values of angular velocities which show the ability of the material to withstand higher speeds. Aluminum alloy, maraging steel and E-glass composites have almost same values of angular velocities and lies in-between carbon fiber composites and cast iron. Cast iron got minimum values of angular velocities which show the inability of the material to spin at higher velocities.

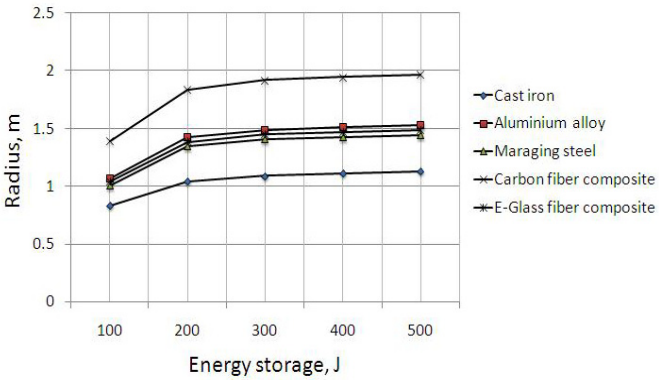

Figure 3. Radius and energy storage of materials

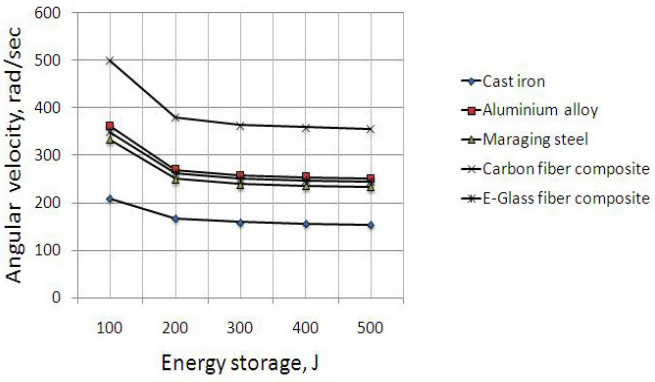

Figure 4. Angular velocity and energy storage of materials

CONCLUSIONS

This optimization is carried out to find the minimum mass and respective values of radius and angular velocity. From the analysis, it is clear that, cast iron flywheels are having higher mass and less angular speeds. Aluminum alloy, maraging steel and E-glass composites lies almost in a same category in between cast iron and carbon fiber composites. Among five materials, carbon fiber composites can be used in flywheels to store energy with less mass. It can be also used in high speed applications, as the values of angular velocities obtained are higher than that of other materials.

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MATLAB IN EDUCATIONAL ACTIVITIES ON PHYSICS

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ABSTRACT: *This article suggest a computer integration method in the didactic activities on physics by realization a dedicated interactive graphical interface for processing of the experimental data resulted by measurement in our laboratory. This data processing application created for help student to use computer in laboratory. Like programming medium we chosen the scientific language Matlab at 5.3 versions to up. These techniques have been used to successfully from Laboratory Course in our University.*
KEYWORDS: *computing educational method, interactive graphical interface, physics laboratory works experimental data processing*

INTRODUCTION AND MOTIVATION

Teaching the physics course has never been an easy task. Although it is universally accepted that a laboratory or demonstration is the best way to convey the more complex concepts. The present the problem for the physics educators is how to communicate the content, impart the knowledge, and, all the while, keep the fascination of physics alive. It is almost universally accepted that the way to convey these ideas is through a laboratory or a demonstration, where students can see physics in action and truly appreciate the natural world around them [1], [2]. The computer used by interactive graphical interface in data processing [3], [4] is an easy operation for all people, so that, an interface can be used in the didactic process for students with minimum computer abilities. For graphical interface, we work with Matlab. Matlab is a programming language with high performance, dedicated for a numerical calculation and graphical representation. We motivate this choice by: good performances and reduced instruction time, an easy modification of the source codes, for adapting this interface at any laboratory work and the using of this programming language in the university mediums and the research domains for simulation and experimental data processing.

GENERAL DESCRIPTION OF THE LABORATORY WORK

In this article we present in detail the graphical interface for laboratory work "Verification of the Balmer law". In this laboratory work we determinate the experimental wavelength of the spectral lines from a hydrogen series. This experimental wavelength is compared with the calculated wavelength by mathematical expression of the Balmer law [4]– eq.1.

$$\lambda = \frac{4n^2}{R_H(n^2-4)} \qquad (1)$$

where: n is the principal quantum number, R_H is the Rydberg constant for hydrogen with value equal to 109677,58 cm^{-1}.

The experimental installation is an optic side (spectroscope and spectral lamp) and an electric side (the impulses generator) [4]. The tension impulses are applied of the (Ar, Hg, H) discharged tubes electrodes fixed on a support.

The stages of the laboratory work are [4]:

1. *To read the spectroscope division scale of the Hg and Ar discharged tubes, for know wavelength (in Å).*
2. *To raise the standard diagram for spectroscope, $n = f(\lambda)$.*
3. *To read the division scale of the hydrogen lines.*
4. *To determine from standard diagram the experimental wavelength (in Å) for hydrogen lines.*
5. *To calculate the wavelength for the hydrogen lines using the mathematical expression of the Balmer law (eq.1).*
6. *To compare the theoretic values with experimental value of the wave length of the hydrogen lines from Balmer series.*

THE GRAPHICAL INTERACTIVE INTERFACE "LBALMER"

"lbalmer" is the graphical interface application for processing of the experimental data resulted from the laboratory work "Verification of the Balmer law". This application has the six files – figure1.

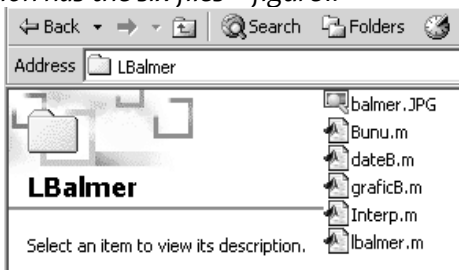

Figure 1. The lbalmer folder

For running the "lbalmer" application we type the name of the application by commanding window of the Matlab program [5], [6]- figure 2.

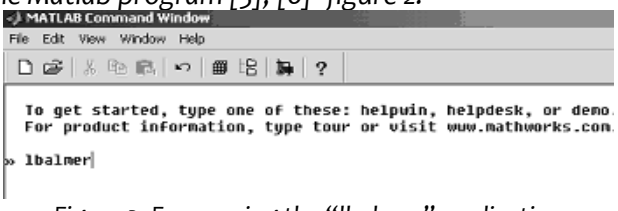

Figure 2. For running the "lbalmer" application

The action of the Enter key opens the principal frame – figure 3.

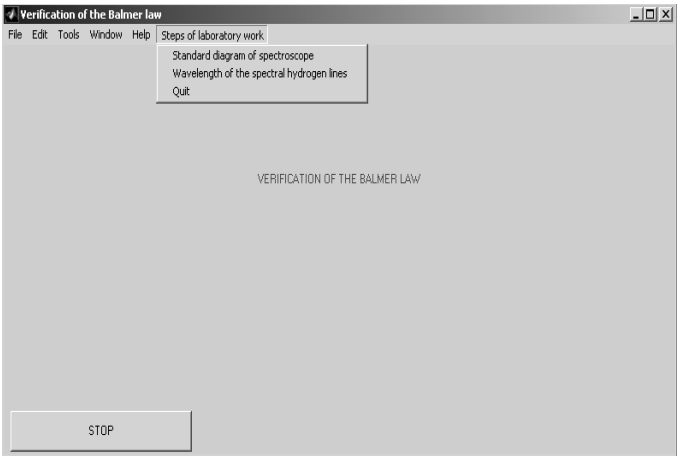

Figure 3. The principal frame of the application

Beside the standard menus of the graphical Matlab window [5], [6]: File, Edit, Window and Help, we create the menu "Steps of laboratory work" which has three commands: "Standard diagram of spectroscope", "Wavelength of the spectral hydrogen lines" and "Quit".

The closing of the application can be possible by commanding "Quit" from "Steps of laboratory work" menu, or operating the "Stop" button from the principal frame.

The "Standard diagram of spectroscope" command to open the intermediary frame which admits the introduction of the experimental data and the presentation of the standard diagram n = f (λ) – figure 4.

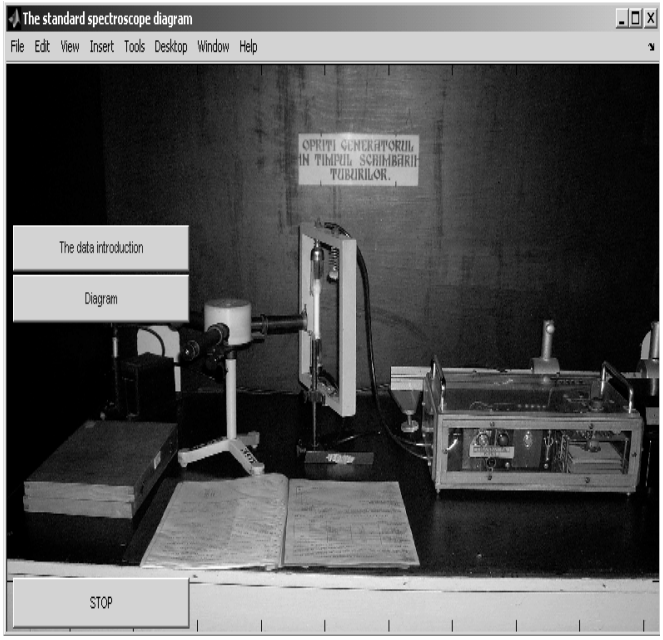

Figure 4. Intermediary frame

The "Wavelength of the spectral hydrogen lines" opens a frame, which asks, from the text box, to read experimental division scale for the hydrogen spectral lines and to display the experimental wavelength (in Å) and the theoretical wavelength witch are calculated with the Balmer law.

By activating of the "The data introduction" button, we have, in the text box: the division scale for the argon and mercury lines and the wavelength (in Å) for these lines – pursuant to figures 5 and 6.

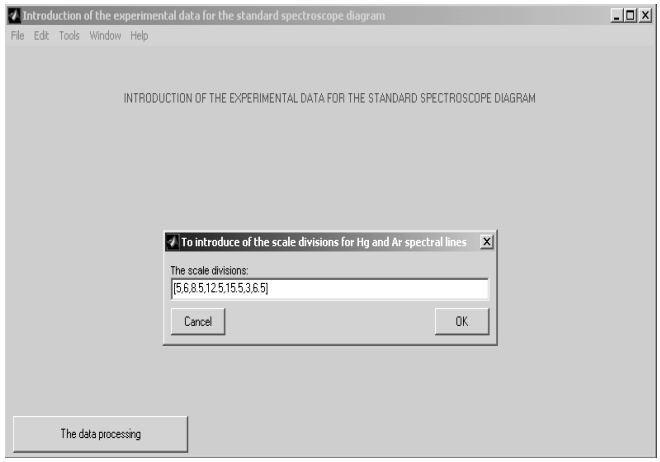

Figure 5. The frame for introducing the division scale

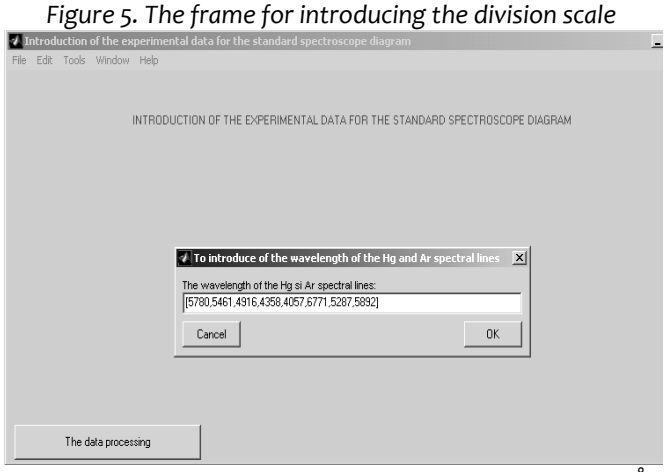

Figure 6. The frame for introducing of the wavelength in Å

If we make a wrong introducing data, we shall get an error message – figure 7.

Figure 7. The error message

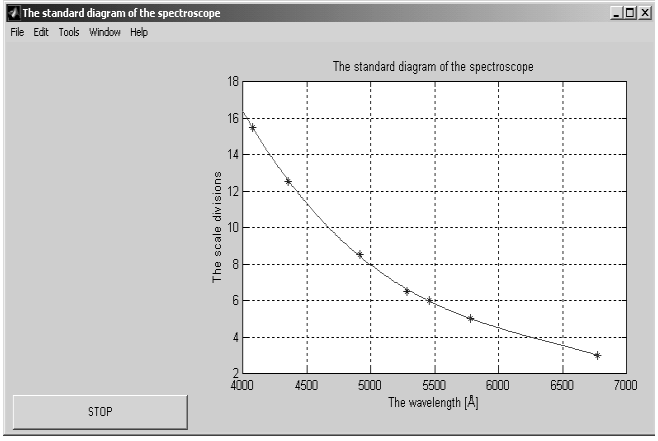

Figure 8. Standard curve of the spectroscope

We turn down in an intermediary frame, the action of "The data processing" (figures 5 and 6), and then, we prepare designing the curve by interpolation.
The action of the "Diagram" button leads to the standard curve of the spectroscope (figure 8).
This standard spectroscope diagram is rise by a regression method [7] with polyfit function from Matlab:

```
x=4000:10:6800;
y=polyfit(landa,n,3);
yt=polyval(y,x);
plot(landa,n,'*b',x,yt,'-r');grid;
xlabel('The wavelength [Å]');
ylabel('The scale divisions');
title('The standard diagram of the spectroscope');
```

Points represent the experimental data. The action of the "Stop" button leads to the principal frame.
By winnowing the command "Wavelength of the spectral hydrogen lines", we shall get the measured values in the division scale frame (figure 9).

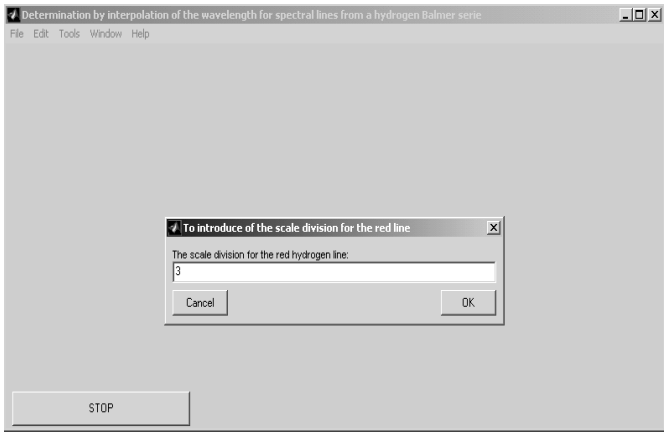

Figure 9. The introduction of the division scale for the hydrogen lines

After introducing the data for hydrogen lines on the active window, we shall have the theoretical and experimental data – figure 10. We turn down in the principal frame by action the "Stop" button.

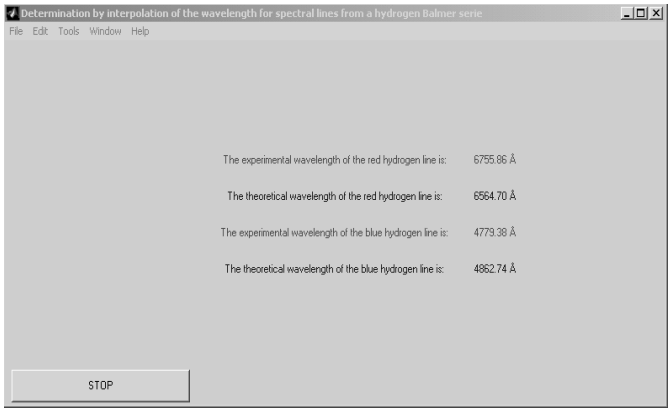

Figure 10. The frame for obtaining data by interpolation

We close the application by action the "Stop" button from the principal frame.

CONCLUSIONS

This work represents a modality for using the computer on data processing in laboratory work. The presented application use an existing software in our faculty (Matlab), no cost and trains the students in the computer utilization in data processing. Pursuant to this utilization methods to the hours of laboratory, the students with informatics skills are emphasize, they will be interested for the programming interfaces for next laboratory themes. Thus, the source code for this application can be used by other laboratory work with minimal modifications. Thus we are realized a collection of these applications for our Physics Laboratory, very interested for students, which represent an education computer support for learning physics.

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INFLUENCE OF SAMPEL SIZE BY SOUND ABSORPTION COEFFICIENT DETERMINATION

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ABSTRACT: *Sound-absorbing materials are utilized in almost all areas of noise control engineering. The designers of sound absorbers must know how to choose the proper sound absorbing materials, their geometry and the protective facing. The well-known Kundt's tube and reverberant room method are often used for measurement of acoustic absorption properties of samples under laboratory conditions [1]. In this paper the measurement of sound absorption coefficient is investigated under free-field conditions. Particularly is investigated how the sample size is influencing the measurements results.*
KEYWORDS: *measurement, sound absorption coefficient, sample size*

INTRODUCTION

The Microflown in-situ technique to determine absorption makes use of a Microflown particle velocity sensor and a sound pressure microphone. Both sensors are mounted in the PU-mini probe that is positioned close to the material with a sound source positioned at a certain distance (fig. 1). The sound pressure and acoustic particle velocity are measured right at the surface of the material. The impedance can be derived from the ratio of sound pressure and particle velocity. From this, the material absorption can be calculated. The usable bandwidth for the method is 300 Hz – 10 kHz. The method makes possible to measure under different angles, measuring with a high spatial resolution of just few millimetres, measure all type of materials and material sizes. There is also no need to take samples and measurement can be performed when the materials are installed. [3]

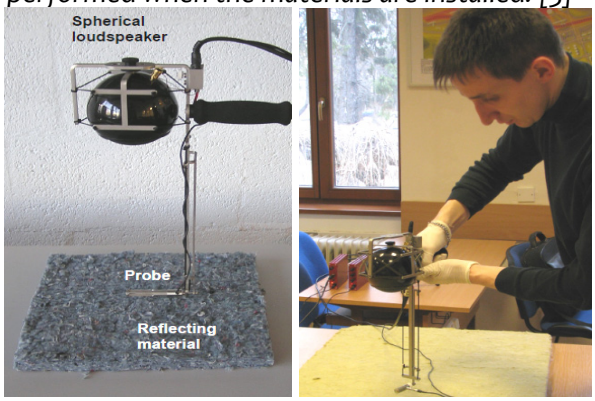
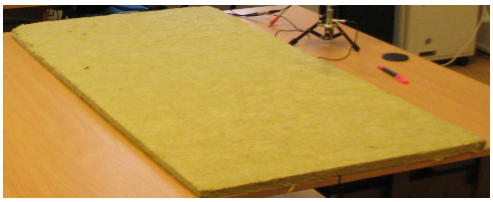


Figure 1 . In – situ absorption set up

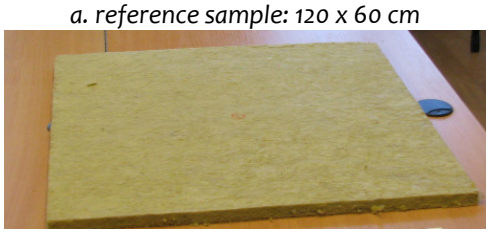
THE MEASUREMENT SET UP

For this experiment the chosen material is Isover 20 mm and one source-sample distances 32cm is used. To check the influence of the sample size several measurements were done (see fig. 2):

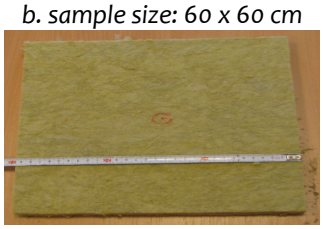
a) a large sample of 120 cm x 60 cm was measured as reference,
b) a 60 cm x 60 cm sample that was cut free,
c) a smaller (30 cm x 30 cm) sample that was cut free,
d) a small (15 cm x 15 cm) sample that was cut free,
e) a very small (5 cm x 5cm) sample also cut free.



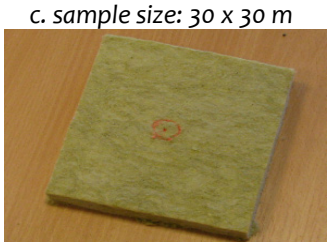
a. reference sample: 120 x 60 cm



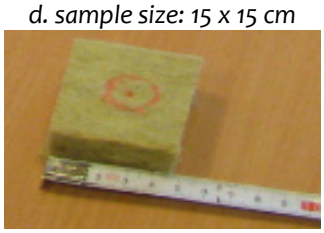
b. sample size: 60 x 60 cm



c. sample size: 30 x 30 m



d. sample size: 15 x 15 cm



e. sample size: 5 x 5 cm

Figure 2. Sample size reductions

The measurements were taken from the same measurement point, which was marked on the sample. The sample was cut gradually from the sides. 10 measurements were performed by each sample size to examine reproducibility and avoid measurement

errors. During the measurement the probe was positioned close to the sample. The distance between the PU- probe and the samples was 1 cm.
The measurement settings were the followings:

- Measurement time: 4 s.
- Hardware correction: correction off.
- High gain mode.
- Auto input gain control: on.
- Auto accept overload: off.

Before series of measurements DAQ calibration and calibration measurement were performed.

RESULTS AND DISCUSSION

The averages of sound absorption coefficients are presented by different sample size in in table 1 and graphically in figure 3. It can be concluded that the sample size is influencing the measurement. However it is also probable that the acoustic properties of the sample change and that the free field measurement is valid.

Table 1. Sound absorption coefficients by different sample size

Frequency f [Hz]	Sound absorption coefficient α[-]		
	120 x 60 cm	60 x 60 cm	30 x 30 cm
315	0,117723	-0,03195	-0,03247
400	0,144759	0,112756	0,08874
500	0,024065	0,054997	0,068153
630	0,22405	0,06067	0,078704
800	0,375166	0,292892	0,264559
1000	0,562896	0,577697	0,514574
1250	0,691063	0,70503	0,722936
1600	0,822076	0,815248	0,783357
2000	0,902187	0,899406	0,91274
2500	0,94686	0,941704	0,94196
3150	0,960568	0,95868	0,952055
4000	0,957848	0,95039	0,95379
5000	0,945939	0,942558	0,942214
6300	0,967605	0,966594	0,970186
8000	0,969724	0,97517	0,977244
10000	0,985057	0,990921	0,99086

Table 1. Sound absorption coefficients by different sample size

Frequency f [Hz]	Sound absorption coefficient α[-]	
	15 x 15 cm	5 x 5 cm
315	-0,03757	-0,00229
400	0,125516	0,061591
500	0,173694	0,144521
630	0,117648	0,209189
800	0,191895	0,124725
1000	0,408619	0,145791
1250	0,754156	0,199998
1600	0,836338	0,450901
2000	0,941601	0,510511
2500	0,922658	0,855966
3150	0,910011	0,937345
4000	0,958389	0,889431
5000	0,96476	0,600605
6300	0,958452	0,620444
8000	0,978393	0,934721
10000	0,989822	0,99927

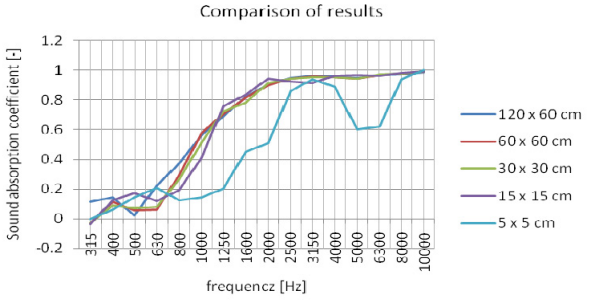


Figure 3. Comparison of measurement results

CONCLUSIONS

The method shows to be sensitive for sample size and especially at lower frequencies the results have a higher error. In general the reason for these errors can be found in:

- Wrong measurement distance: If the probe sample distance is underestimated the measurements results resemble better the tube results.
- Wrong source behavior: The real loudspeaker does have a behavior that only resembles a monopole. Increasing the source-probe distance must improve the measurement if the deviation in behavior at close distances is the cause of the inaccuracy. [3]
- Wrong calibration: Errors in the calibration can be expected at lower frequencies.
- Properties of the acoustic sample: A negative absorption can be a local effect.

Sample size: If the sample is too small edge effects take place. The properties of the acoustic sample can be the reason for the measurement error.

Acknowledgement

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AN ASSESSMENT OF BUILDING SECURITY SYSTEM AND ACTIVE FIRE PROTECTION SYSTEM IN ADMINISTRATIVE BUILDING

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ABSTRACT: *This paper presents the assessment of building security system and active fire protection system in administration building. Building is a structure that gives protection to human. A building needs to protect human from extreme weather and danger created by human. Apart from giving us protection; building gives us privacy as well. Our generation is different from the previous generations. The environment is now more dangerous than the past. People can get hurt or killed even in the house. Other than building security system, an active fire protection system is also crucial to ensure that the occupants in the building are protected adequately against fire. Fire can spread to a wide area in seconds if we do not have fire protection system to prevent the fire from spreading. Administration building is a building accommodating ten to hundreds of people. It needs a proper security system to monitor and control the flow of people. Vandalism and burglary can happen easily without a proper and effective security system. Besides that, since an administration building accommodates many people, therefore, its active fire protection system needs to comply with Uniform Building By-Law (UBBL) of Malaysia.*

KEYWORDS: *building security system, administration building, active fire protection system*

INTRODUCTION

Building is very important to human. Almost all of our activities cannot be done without a building. Students need lecture halls, doctors need hospitals. A building is a shelter, giving protection from the extreme environment, and danger from others. There are many types of building and every building has its own function. A house accommodates family members, a hospital houses medical staff and patients, office is used for administration work, and a factory is used for manufacturing. Administrative building functions as a space where officers and staff manage their daily administration work. Depending on its size, it accommodates from a few officers to hundreds of officers.

In order to prevent inconvenience and interruption from unwanted incidents such as burglary and fire, the building must have a building security system and fire protection system. Building security system is also important to ensure that the assets and corporate secrets are well protected by preventing or discovering employee theft [1]. Access control, for example, is to control the people who enter the building and to monitor when and why they did. This way, the building and the people inside are better protected. Hospitals need strong fire protection systems. If the security of the external environment is weak, this may attract intruders. Therefore, buildings should have fences, gates, doors and security guards to filter people who access the buildings.

The administration building that is used as the case study is Eureka building in USM and Malaysian Institute of Pharmaceuticals and Nutraceuticals (IPharm). Eureka building is commercial arm of Universiti Sains Malaysia and IPharm is the multidisciplinary research institute that focuses its efforts on drug discovery. Administration building is often the target for break-ins. This may be due to the assumption that small businesses and or small office buildings are not adequately secure [2]. Therefore, criminals believe it will be easier to break in without tripping alarms or encountering guards. Therefore, it is the responsibility of the owner to provide security to employees and assets of the business. Besides that, fire is extremely dangerous especially in buildings that have inadequate, or poorly maintained active fire safety system [3]. A fire outbreak, although restricted to a single compartment of a tall building, can prove to be deadly to people in the whole building.

METHODOLOGY

There are few steps to conduct this assessment. First, is to obtain the permission from the building owner or representatives. After obtaining their permission, observation is carried out at administrative buildings namely Eureka and IPharm buildings. The building security and active fire protection elements are observed and recorded using cameras and building plans. The quantity and operation of fire protection and building security are tabulated in this thesis. A part of the technical procedures used to classify the quantity active fire protection components is also tabulated. Some of the data comes from respondents who are managing the buildings. The data is very important in order for the researchers to identify the types and functions of building security system and active fire protection system.

OBSERVATION, RESULT AND DISCUSSION. Building Security System

Both buildings are being observed from several building security's elements such as intrusion detection, perimeter control, access control and lighting system.

i. Access Control

Access control is a system in which the visitors press a buzzer in order to identify him/ her. The lock will then be released via the electric striker or by an electric lock

Access control in Eureka is card reader access system. The sensor card needs to be placed at the card reader in order to deactivate the magnet at the door so the door will open. The access key card is only available at the main door. USM has guard house that monitors the flow of visitors. While the access control in IPharm is a biometric and access card control, the guards in IPharm are doing their job well. All the staffs need to have their access cards to pass through the guard house. As for visitors who want to visit the building they have to register at the guard house. On top of that, the guard house even has CCTV to monitor the traffic of people.

ii. Lighting System

Lighting system is the principal requirement of the lighting for safety and security has sufficient intensity whether in the day and night. With sufficient lighting, the chances of spotting burglary-in-progress will be higher because bright security lighting allows the guard to observe movements on the ground. The type of lighting system used in Eureka building is fluorescent. There are no security lightings in this building. The type of lighting system they use is cove lighting. IPharm does not use any security lighting system as well.

iii. Perimeter Control

Walls and fencing are the few elements that control human access. This is under perimeter control. Eureka building does not have any fences or wall systems to control the perimeter. This is because Eureka is situated within USM. It is already governed by the security and perimeter control of USM. IPharm has proper perimeter control system to control the flow of people. The fences are well maintained. It is a chain link type fence. This is a common type of fence used for security protection.

iv. Intrusion Detection

Intrusion detection is a device that monitors network or system for violent activities and produces reports to a Management Station. This system performs intrusion detection and attempts to stop possible incidents. It focuses on indentifying possible incidents, logging information about them, attempting to stop them, and reporting to the security administrators. There are no other intrusion detection methods except for CCTVs in Eureka building. The management of Eureka only installed CCTV on the ground floor while other offices install CCTVs according to their own financial capacity. So, some areas are installed with CCTVs while some areas are not installed with any. Pan tilts zoom and speed dome are the type CCTVs that installed in Eureka building. IPharm is also installing the same type CCTVs with Eureka. Speed dome is installed in IPharm while PTZ is installed outside the building, at the guard house. There are no other types of intrusion detections installed in IPharm except CCTV.

Active Fire Protection System

Active fire protection system that are being observed is fire extinguisher, sprinkler system, smoke detection, pressurized escape routes, hose reel, external hydrant, alarm system and emergency lighting.

i. Fire extingisher

Fire extinguisher is an extinguishing agent. Eureka building uses dry chemical extinguishing agent. Dry chemicals usually use a mix of monoammonium phosphate and ammonium sulfate. It insulates class A fire by melting at approximately 350-400°C. The powder breaks the chain reaction of class B fire by removing oxygen from the area and prevents vapour from reaching the explosion source. IPharm uses two types of fire extinguishers which are dry powder and carbon dioxide suppression system. The formation of the fog is due to discharging of gases in the protected area due to drastic lowering of the temperature to the dew point. It is stored in strong steel, pressure resistant tanks. The system is activated by the smoke and heat detectors.

ii. Sprinkler system

Eureka does not install any sprinkler system. IPharm uses a sprinkler system which is activated through the glass bulb. The soldering will melt and release the water. The liquid contents in the glass bulb will expand gradually when temperature increases and would burst upon the pre-set point, thus releasing the valve and water to the area.

iii. Smoke detection

Smoke detection is a detection system that alerts and warns the building occupants of the occurrence of a fire, thus providing them an early warning to escape from the building. There are many smoke detectors installed in Eureka because Eureka does not install any sprinkler system. Smoke detection can help to give the first indication to the occupants inside if there is fire. There are smoke detectors installed in the offices too. IPharm has lesser smoke detectors compared to Eureka. The number of smoke detectors in the AHU room and plants room contain the most units compared to other rooms. These two rooms controls electricity current and are highly flammable. Thus, smoke detectors are required to detect the occurrence of fire. There is no pressurized escape route in Eureka and IPharm.

iv. Hose Reel

Hose reel is considered as the main weapon in fighting fire, for the use of the building occupants. Hose reel delivers more water than several portable extinguishers added together. The hose reels in Eureka are in good condition. Every exit door has one hose reel beside it. Although they have been well maintained, the janitors of Eureka like to put their cleaning tools inside the special compartments for the hose reels. It is very important that they should know that this would cause disruption in case of a fire incident. The hose reels in IPharm are maintained at very good condition. Since the building is newly constructed, the things inside are very new. Furthermore, they have maintained it very well. Fire hydrant is an active fire protection and a source of water to enable fireman to tap into the water supply when extinguishing fire. There are 3 external hydrants constructed in Eureka and there is only 1 fire hydrant at the IPharm. Alarm system is used to warn the

building occupants in cases of occurrence of fire. It is to give them an early warning to escape the building. Every building must be equipped with alarm systems installed in accordance to the UBBL 1984 [4]. The fire alarm systems in Eureka are installed next to the hose reels located at every exit door near to the toilets. It is painted in red in colour. So, the occupants can notice it easily. The main control panel for fire detection and alarm system in Eureka is directly connected to the Development Unit in USM. The alarm systems in IPharm are usually installed near the exit door too. The ideal positions for fire alarm systems to be installed are almost the same on every floor. The fire detection system in IPharm is in the control panel room which is a restricted area. The control room is monitored by security guards.

v. Emergency Lighting

Emergency lighting is the lighting for an emergency situation when the main power supply fails. The occurrence of fire may cause a disruption of electricity supply. Emergency lighting is normally used to give lighting so that person of all ages can escape safely because it emergency lighting has the backup electricity to give luminance once the power has cut. Eureka has installed a number of emergency lighting in the building. The installation of emergency lighting along the walkway is mainly due to the structure of the building. When fire occurs, once the occupants come out of their offices, they will have lighting to guide them to the exit. Emergency lighting in IPharm is only installed at certain areas. They only installed emergency lightings in the office and lobby.

The number of emergency lightings in both Eureka and IPharm are almost the same. This chapter discusses the data collected from both buildings. Both buildings have installed building security system. They have installed proper Intrusion detection, perimeter control, lighting system and access control. The building security systems in both buildings are in good condition but Eureka needs to enhance its security system. Ipharm needs to enhance its lighting system only. Both buildings have adequately installed active fire protection system. All the active fire protection systems are in good condition.

DATA ANALYSIS

The security systems in IPharm is more advanced and tighter than Eureka judging from the criteria of access control, perimeter control and intrusion detection. Eureka is under the control of USM. USM has many buildings besides of Eureka. Therefore, the controls in Eureka (Figure 1) are not as tight as compared to IPharm (Figure 2), which is under the control of the Ministry.

Security in USM is not set up only for Eureka but the people who access USM. The security in IPharm is tighter compared to Eureka because are there to secure IPharm only. The access control system in IPharm uses a thumb print system (Figure 3) whereby the staff needs to verify their identity with their key card and thumb print. On the other hand, access card system is the only access control system used in Eureka (Figure 4). Thumbprint access system is more secure compared with key card access system. People need to identify themselves by using the keycard and thumbprint. Therefore, if someone's thumbprint is not stored in the system that particular person cannot access the building.

Figure 1: The condition of Eureka which manage by USM

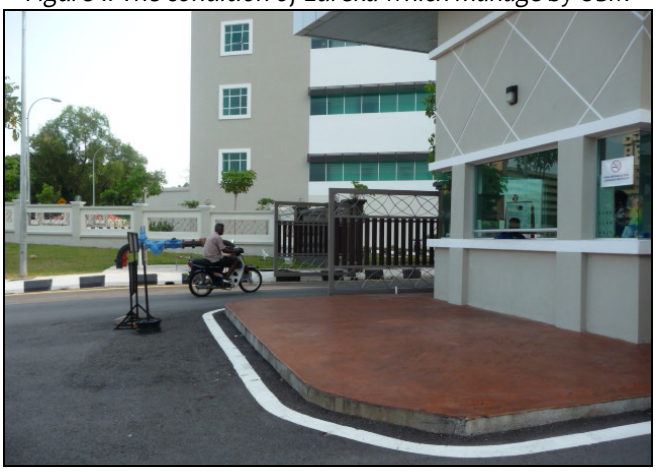

Figure 2: The perimeter control and access control in IPharm building

Figure 3: Thumb print access control system in Eureka building

Figure 4: Key card access control system in IPharm building

Security lighting is the element that both buildings need to improve. Both buildings did not install any security lighting. Security lighting is important that it give luminance to the space. This is because the

security lighting system has the sensor to detect the human heat. So, it will brighten the space if there is human passing by. The lighting system in Eureka uses fluorescent lamp (Figure 5). It is costly if compared to cove lighting in IPharm (Figure 6). Fluorescent requires a ballast to regulate electricity current through the lamp. Cove lighting is more energy efficiency compared with fluorescent. The number of light in Eureka needs to be increased at the entrance. It is very dark at night.

Figure 5: Flourescent lighitng system in Eureka building

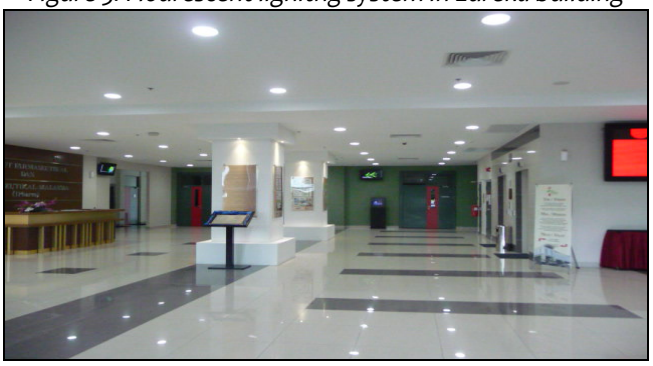

Figure 6: Cove lighting in IPharm building

Figure 7: Speed dome at ground floor in Eureka building

Figure 8: Pan Tilt zoom at the guard house in IPharm building

The intrusion detection in Eureka needs to be enhanced. The CCTV is only installed at the ground floor and some at certain areas but they do not cover the whole compound (Figure 7). This is because Eureka building is renting their space to the other offices. Eureka is not responsible to help them install the CCTV. They have to install CCTV on their own. Therefore, some areas are covered with CCTV while some are not. IPharm do not have many CCTV but its vision covers every corner of the building (Figure 8). The active fire protection system in both buildings is properly installed in accordance to UBBL [4].

CONCLUSIONS

The building security system and active fire protection system has been explained according to their functions and uses in an administration building. The four components such as perimeter control, access control, lighting system and intrusion detection are very important to ensure the safety of the occupants and to prevent intrusions. The active fire protection system is extremely crucial in cases of fire in order to minimize the loss of assets and lives. This system cannot be neglected by owners of all types of building. It is very important to help reduce injury and death. By comparison, the security system in IPharm is tighter and more advanced than Eureka. This is because IPharm is a newly constructed building and it is under the control of the Ministry. Therefore, they have more funds to install the system. While Eureka is under the control of USM, it does not have a lot of funds to install a more advanced security system. Furthermore, Eureka is an old building and less burglary happens. For the active fire protection system, both buildings complied with the requirements of UBBL. It is found that the components are suitably applied in the administration buildings. Eureka needs to make more enhancements in its building security system. IPharm only has one component that it needs to strengthen that is its lighting system.

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THE DETERMINATION OF PARAMETERS INVOLVED IN THE IDEAL GAS TRANSFORMING USING MICROSOFT ACCESS

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ABSTRACT: *A transformation is a sequence of states through which a thermodynamic system when its parameters vary from baseline values to those in the final state. All thermodynamic properties at a time system are the system state. State parameters are all measurable physical quantities that characterize the unique thermodynamic state of the system. A substance is characterized, as we know, the state variables: pressure, volume, temperature, etc. At a certain amount of substance, these three variables are a well established interdependence of thermal equation of state. To ease the study of gases have made some considerations that lead to a relatively simple model study. This so-called ideal gas, the molecules are considered material points, and the interaction forces between molecules are void. It is obvious that this case can not be met in practice, but the considerations made on this system can be extended with some corrections and within certain limits, the real gas. The application is done using Microsoft Access and was made for students to be able to easily own knowledge about the transformations simple ideal gas of this gas. Students can calculate and make conclusions can be drawn, however this program is not meant to replace the teacher but to offer a tool to study in classes, the theory that parties are not very many. The menu is affordable, intuitive and helpful. For a better understanding of the application is structured in four parts.*
KEYWORDS: *transformation isobar, isochors transformation, isothermal transformation, the parameters of state, Microsoft Access*

INTRODUCTION

Following the experiences with the constant volume gas thermometer was found that at very low pressures, tending to zero, all gases tend to behave the same way. Based on these considerations the notion of ideal gas is a homogeneous and isotropic gas whose molecules have their own volume and between them there are no interaction forces.

Ideal gas is a theoretical concept, it does not actually exist, but all gases tend to behave as the ideal gas (using the same law) when their pressure tends towards zero, as in this case, the volume of gas is very busy compared with the volume of the molecules (which becomes negligible), and greatly increase the distances between molecules and the forces of interaction between them also become negligible.

In 1661 Boyle Mariotte discovered in 1679 and experimentally verified and confirmed exactly that for an ideal gas in all possible states of an isothermal, the product of pressure and volume is constant, ie:

$$(p \cdot V)_{T=const} = \text{const.} \qquad (1)$$

For any two states 1 and 2 of the same isotherm:

$$(p_1 \cdot V_1)_{T=const} = (p_2 \cdot V_2)_{T=const}. \qquad (2)$$

In 1790 Charles found experimentally that if a given amount m of ideal gas occupies a constant volume when the pressure is proportional to the temperature, so their ratio is constant:

$$\left(\frac{p}{T}\right)_{V=const} = \text{const} \qquad (3)$$

For any two states that occupy the same volume of gas:

$$\left(\frac{p_1}{T_1}\right)_{V=const} = \left(\frac{p_2}{T_2}\right)_{V=const} \text{const} \qquad (4)$$

In 1802 Gay-Lussac has shown that the volume of an ideal gas maintained at constant pressure varies linearly with temperature:

$$V = V_0 + V_0 \cdot \gamma \cdot (t - t_0) \qquad (5)$$

where: $\gamma\left[1/^oC\right]$ *= volumetric expansion coefficient of ideal gas;*

$V_0\left[m^3\right]$ *= gas volume at the reference temperature to.*

$$\gamma = \frac{1}{273{,}15}\left[\frac{m^3}{m^3 \cdot {}^oC}\right] \text{or} \left[\frac{1}{{}^oC}\right] \qquad (6)$$

For any two states 1 and 2 volume ratio is:

$$\left(\frac{V_1}{T_1}\right)_{p=const} = \left(\frac{V_2}{T_2}\right)_{p=const} \qquad (7)$$

DESIGN AND IMPLEMENT APPLICATION

Data was stored in an Access database type, called ChimUniv. As an Access database type it includes all the items needed for the application: data tables, forms, query requests, reports, macros, modules.

Today there are applications that do not have a graphical interface through which to access the program options. Therefore, it was developed and implemented a main interface that allows accessing various options of the application, using the mouse and keyboard. The main interface has the layout presented in Figure 1.

It is noted that there are several command buttons, labeled, to be used to select various options of the program. The main menu contains a summary of this application, and skills that they need to learn the student until the end of time.

For a better understanding of the application is structured in four parts, each with several components:

- *Isothermal transformation: definition, graphical representation,*
- *Isobar transformation: definition, graphical representation,*
- *Transforming izocoră: definition, graphical representation,*
- *Ideal gas law applied problems.*

Figure 1. Main Meniu

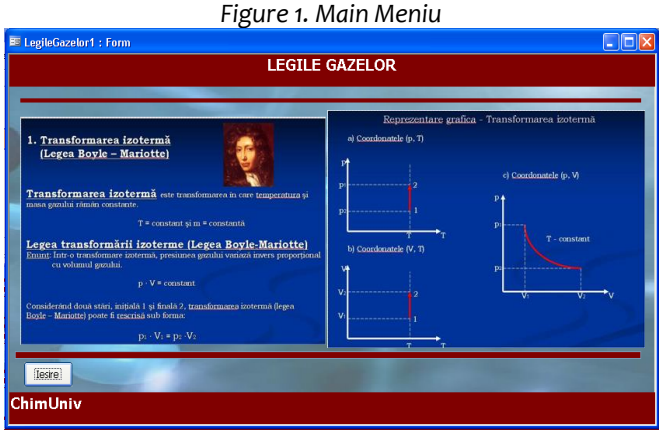

Figure 2. Isothermal transformation

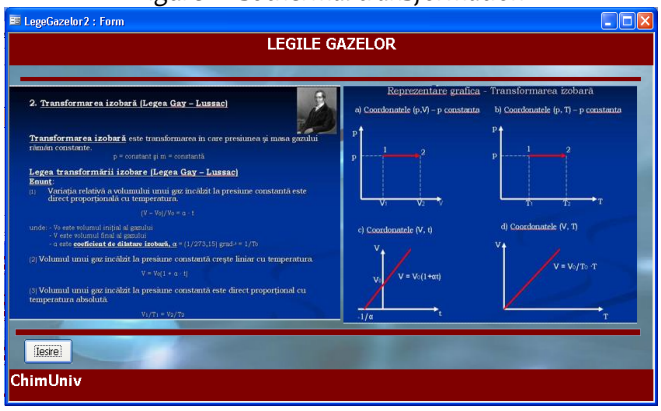

Figure 3. Isobar transformation

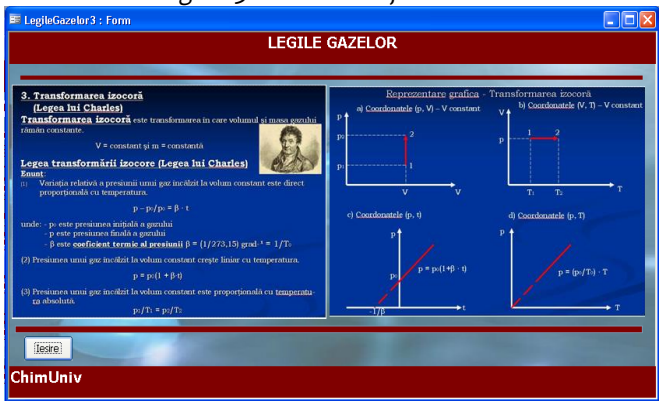

Figure 3. Isochors transformation

Figure 2 is the transformation of the isotherm shape and includes a summary of Boyle-Mariotte law and is made in the same way as the other two forms (Figure 3 and Figure 4).

Gas Laws form includes all three transformations, and moreover appears Van der Waals equation and the Clapeyron-Mendeleev equation. By activating the buttons, will open the forms that will present an example of application to each law separately. Clapeyron-Mendeleev equation in the case is five examples of problems.

Each application / problem has boxes where the student will enter data in the problem statement will be executed transformations and the application will calculate what the problem is required. Each form has a pressing „Clear" button that will clear the boxes and other data can be entered and a button"to exit" out of the application.

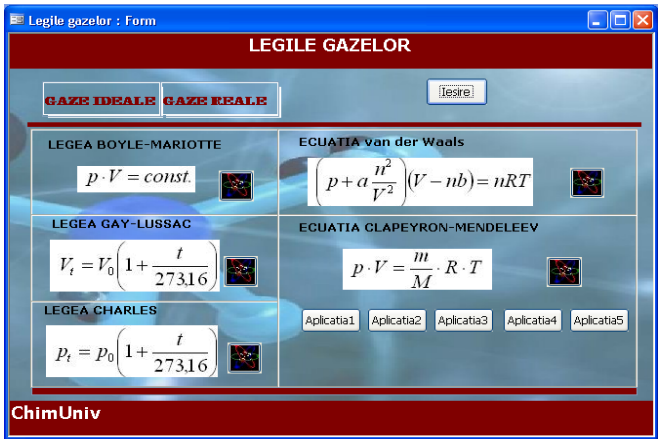

Figure 4. Application of Gas Laws

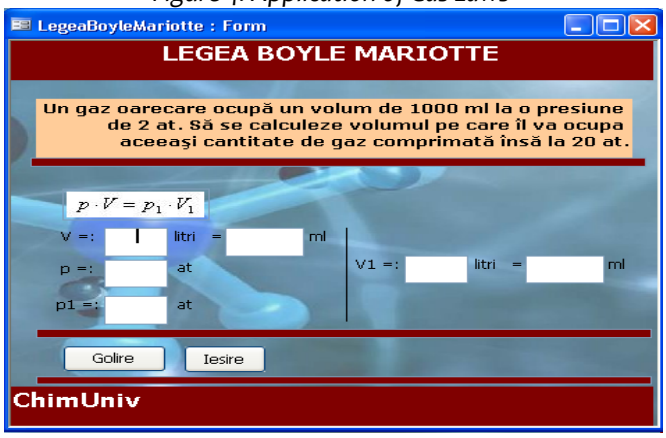

Figure 5. Application of Boyle Mariotte Law

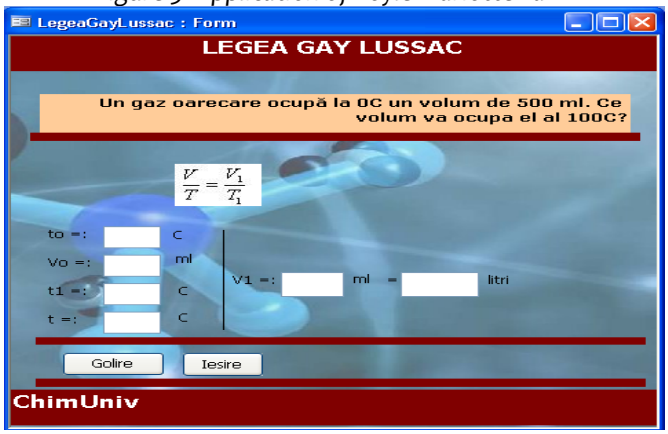

Figure 6. Application of Gay Lussac Law

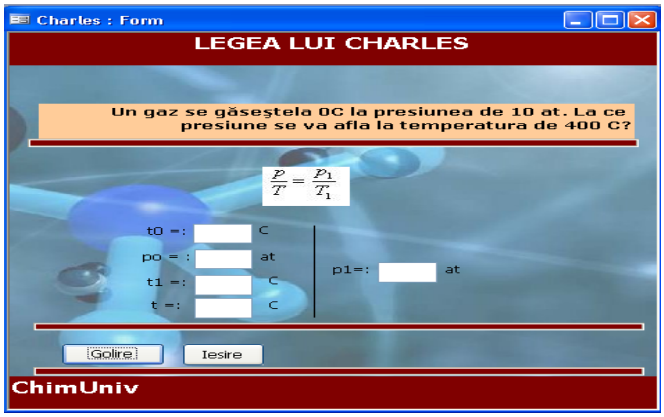

Figure 7. Application of Charles Law

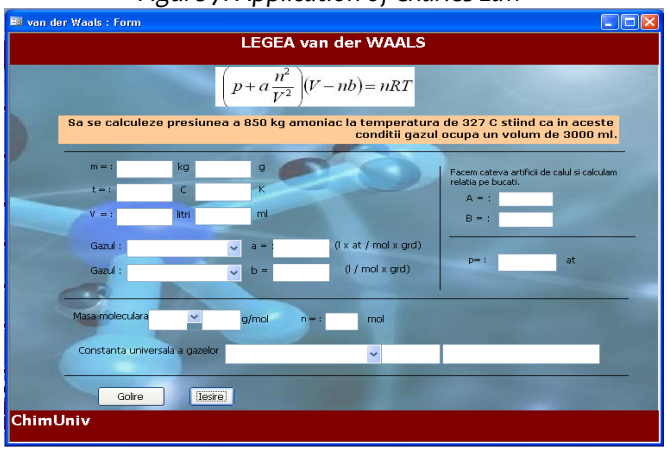

Figure 8. Application of van der Waals Law

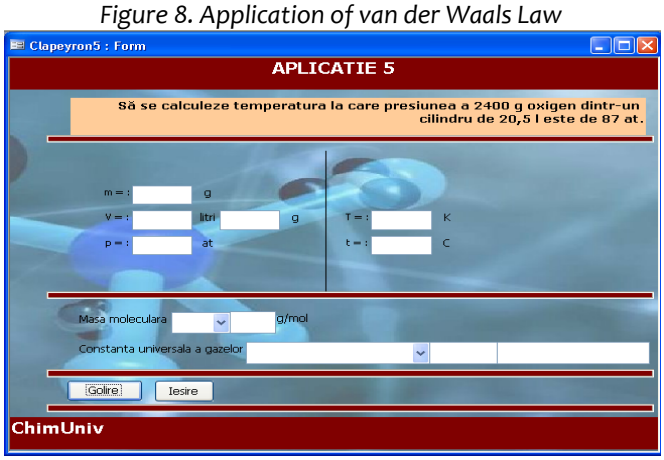

Figure 9. Application of Mendeleev Clapeyron Equation

Submitted application can run on the following conditions: - the existence of a computing system, Pentium I 200 MHz at least 32 MRAM available - there is a Windows operating system and Office 2003 package.

It can be converted and Office 97, if this software is available.

Experimental data processing by computer is faster, more complete, attractive and can help increase motivation and interest of students to study Chemistry.

CONCLUSIONS

Feedback provided by participants (pupils, students), underlines the strong impact that the use of educational software can play in teaching and learning chemistry. Such applications are considered as an alternative to the real experiment and a means to improve understanding by learners of abstract concepts.

They may increase the motivation of students to learn and to engage their interest in making science topics. Clearly, the attractiveness is enhanced lessons, the teacher is the best choice in joining the virtual real experiment.

Using educational software will increase the competence and creativity, increasing the average educational attainment and higher to increase the knowledge base of students, and generally to increase the use of information technologies in various fields activity.

Development of educational software, with the pupils / students is one way to attract those who are less interested in Chemistry.

I must mention that this application is part of my doctoral thesis (still unfinished at this point), which includes a number of such applications developed with Microsoft Access and others.

ChimUniv system development aimed at creating an easy to use for both learners, but perhaps especially for teachers, given that a very large extent, success depends on the availability of this in a manner such educational programs more attractive. Feedback is always assured.

The point at which we started in implementing this system was that the information could greatly facilitate the study of chemistry in school and university, this is because, using the computer can accumulate knowledge in a more intuitive and more attractive.

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BASIC RESEARCH IN RPM-SYNCHRONOUS NONCIRCULAR GRINDING

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ABSTRACT: *With conventional noncircular grinding the uneven shape of workpieces is created by pendular movement of a round grinding disk. In contrast with rpm-synchronous noncircular grinding the workpiece is machined with an unround grinding disk. In process the workpiece and the tool are turning with a certain rpm-ratio. With this special method it is possible to machine several types of unround shapes (e.g. all cams of a camshaft) with just one step of positioning. This paper is focused on basic research in rpm-synchronous noncircular grinding. It shows which possible applications this method offers and also their limits.*
KEYWORDS: *rpm synchronous, noncircular grinding, unround grinding, contour grinding, unround workpiece*

INTRODUCTION

With conventional noncircular grinding the uneven shape of workpieces is machined with a round grinding disk. The machine slide, where the grinding disk is mounted, moves along the x-axis in synchronization to the c-axis. The c-axis is equal to the rotation axis of the workpiece (Figure 1). One disadvantage of this process is the acceleration and deceleration of enormous masses. In sum grinding disk, support, spindle and engine often weigh more than one ton. That causes an enhanced attrition of drive components such as the thread spindle of the x-axis and affects lifetime and maintenance intervals. Furthermore the energy consumption of the grinding process is inefficient and the heat admission affects negatively on machine precision. The inertia of the moved parts restricts the maximum value of velocity, acceleration and lurch and imitates the grinding performance. In addition to that several unround shapes can just be machined in sequence.

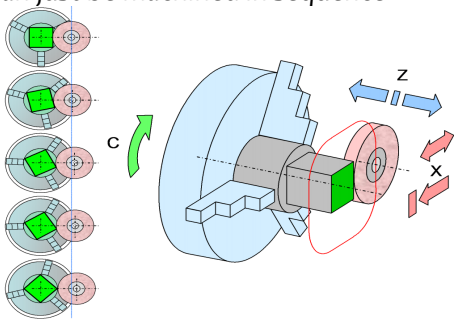

Figure 1 – Conventional noncircular grinding [1]

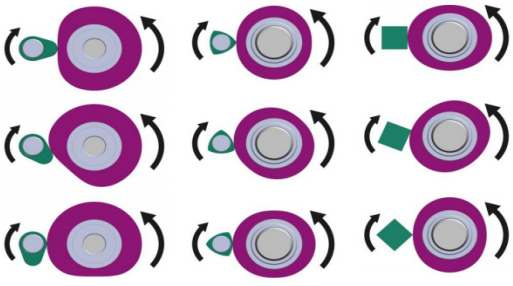

Figure 2 – Examples of workpieces with different geometric shape

With rpm-synchronous noncircular grinding the workpiece is machined with an unround grinding disk. In process the workpiece and the tool are turning with a certain rpm-ratio and the unroundness is transferred from the grinding disk to the workpiece. Rpm-ratio has not imperatively to be 1:1. Figure 2 shows the process of different workpieces with different rpm-ratios.

This method needs only a feed motion and no pendular movement. Therefore the whole grinding machine can be built significantly more compact what has great benefit to machine costs. Another big advantage of this special method is that a couple of round and unround shapes can be machined with only one feed motion. Figure 3 shows how all cams of a camshaft are machined at the same time. The bearing seats could also be machined within this step if the set of grinding disks would be extended with round disks. In addition to shorter process times there is also the positive effect that this twisted assembly of grinding disks is completely balanced.

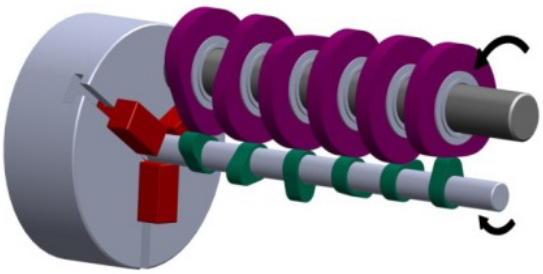

Figure 3 – Multiple machining of multi contours

THEORETICAL BASICS

As one possible solution for unround grinding Dieter Lehmann suggested in 1978 a grinding machine which has an unround grinding disk [2]. The workpiece shape is transferred from a master cam (unround diamonded dressing tool) to the grinding disk and furthermore to the machined workpiece (Figure 4). The speed of rotation is synchronized and the dressing tool has the same profile as the workpiece to be machined. To manufacture such a device there are two options: positive-process and negative-process. At positive-process an unround metal basic body with the

same shape like the workpiece is coated with a layer of diamond grains in a galvanic process.

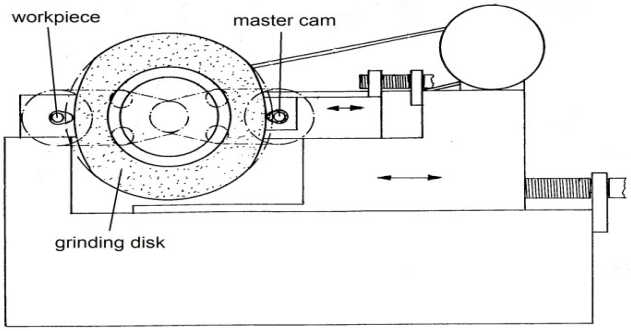

Figure 4 – Grinding machine with unround grinding disk [2]

This procedure is economic and can be realized in short time. One disadvantage is the spread in size of the diamond grains that directly influences the tool's precision. Therefore the positive-process is mainly used for prototyping. In contrast negative-process is substantial more precise. There is a form ring with a corresponding hollow space which is diamonded on its surface. Afterwards this ring is grounded.

Advantageously master cam and workpiece are turning twice fast as the grinding disk. That ensures that the balance of the disk geometry is independent from the geometry of the workpiece (Figure 5).

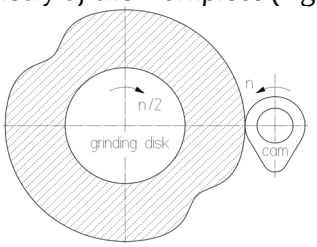

Figure 5 – Balanced grinding disk

The feed motion in radial direction takes place by reduction of the distance between disk- and workpiece axis. Special benefit of this concept is the ability to machine several shapes with one set of disks and only one movement of positioning. Parallel processing of all round and unround shapes makes this grinding machine extremely productive. One disadvantage of the described machine is the assigned rotating dressing tool for the grinding disk which is similar to the geometry of workpiece. Changes in the geometry of the workpiece can only be realized with complex changes in the geometry of the dressing tool. An alternative to the shaped dressing tool is the use of a cylindrical dressing tool which moves in radial direction by a steering cam containing the workpiece geometry (Figure 6). This is another way to shape an according unround grinding disk.

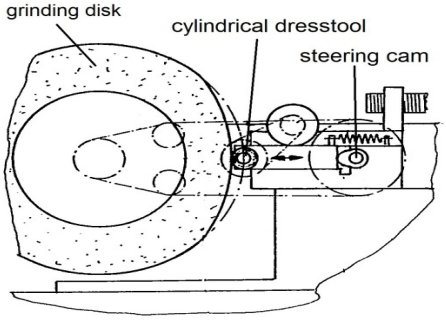

Figure 6 – Steering cam [2]

The dissertation from Holger Eichhorn [3] shows the technological process maturity and practical applicability of rpm-synchronous noncircular grinding and was verified and documented by a lot of experiments. Based on test results the capability of the process and applications where discussed and evaluated.

The invention from Roland Schmitz [4] deals with machining of workpieces with concave shapes. At traditional unround grinding with round disks its outer diameter is limited by the smallest concave radius in workpiece shape. In contrast the usage of unround disks and rpm-synchronization between components makes it possible to use disks with a greater radial extension (Figure 7). Further on an option is shown, how radial grinding forces can be balanced by the usage of 2 disks.

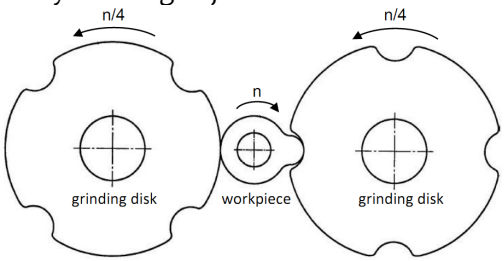

Figure 7 – Cam with concave shape [4]

DEVELOPMENTS AND ANALYSIS. SOFTWARE DEVELOPMENT

Compared with pendular grinding where the curve of the disk center has to be calculated rpm-synchronous noncircular grinding requires that the corresponding unround disk shape has to be calculated. This shape depends on workpiece profile, rpm-ratio and distance between axis of workpiece and disk.

An explicit solution can only be deduced for special rpm-ratios and workpiece profiles. In general the needed geometry of grinding disk can just be found point wise using approximation procedures. To automate this computation and to design additional user-friendly functions at the institute of production engineering from TU-Graz special software for rpm-synchronous noncircular grinding was developed in Matlab. The modules with a high claim on computational power are written in "C" and implemented in the main program. The graphical user interface is designed to operate the program with a SIEMENS SINUMERIK 840D control (Figure 8). This requires the knowledge of function of all 16 control buttons situated on the control panel.

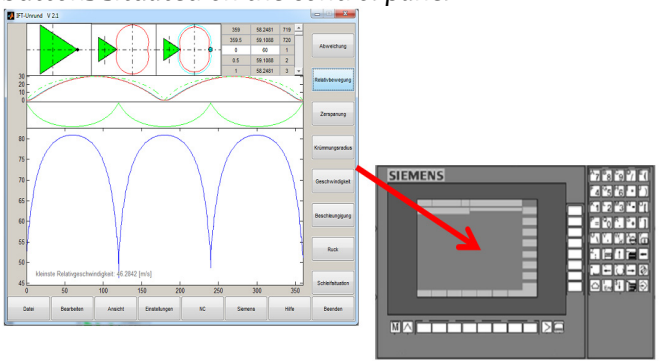

Figure 8 – Graphical user interface

Besides the main function, the computation of the disk profile, three other functions are important:

- Computing of relative velocity between workpiece and grinding disk in point of contact
- Computing of possibly deviations at machined workpiece
- Computing the dressing kinematics

RELATIVE VELOCITY BETWEEN WORKPIECE AND GRINDING DISK

At traditional unround grinding rpm and radius of workpiece normally are essentially smaller than rpm and radius of the grinding disk. To calculate the cutting speed v_c only the velocity of disk's perimeter v_g is considered:

$$v_c = v_g = d_g \cdot \pi \cdot n_g$$

At rpm-synchronous noncircular grinding, where rpm of workpiece is essentially higher, the influence of workpieces perimeter speed v_w to relative velocity often cannot be unattended. To estimate the influence of high workpiece-rpm an example is calculated below.

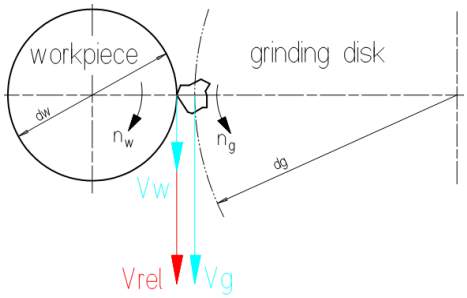

Figure 9 – Relative velocity

According to Figure 9 the equation for relative speed for direction grinding is:

$$v_{rel} = v_g - v_w = d_g \cdot \pi \cdot n_g - d_w \cdot \pi \cdot n_w \quad (2)$$

The diameter ratio is for example d_g:d_w=10:1 (e.g. 500mm:50mm). Using a rpm-ratio of n_g:n_w=1:1 this will result a relative speed of 90% of disk's perimeter speed v_g. Using common rpm- and diameter-ratios relative speed may be enough if speed directions of workpiece and disk's perimeter are aligned.

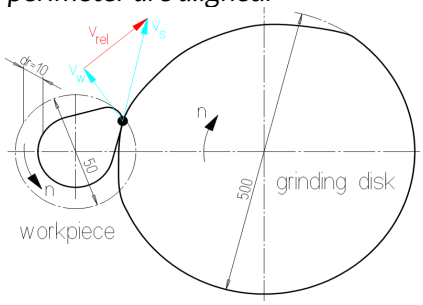

Figure 10 – Unround workpiece and grinding disk

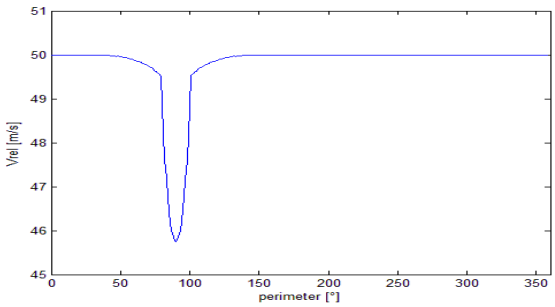

Figure 11 – Relative speed on the perimeter of the grinding wheel

If the unroundness from the surface of the workpiece and the grinding wheel is being accounted, then the relative speed varies in the point of contact. Figure 10 shows a cam, which has a radial change of the diameter with a value of d_r=10mm. This causes a relative speed on the perimeter of the grinding wheel. Its value over the perimeter of the grinding wheel is shown in Figure 11.

MACHINING VOLUME ON THE PERIMETER OF GRINDING WHEEL

The change of the grinding wheel radius does not only cause a variation of the relative speed of the perimeter of the grinding wheel, it also causes a modification of the machining volume. This modification causes an unbalanced abrasion of the grinding wheel. Areas of the grinding wheel with a high machining volume will have a higher abrasion than areas with a lower machining volume. These irregularities can be reflected in the form of dimensional inaccuracies on the grinded surface of the workpiece. To avoid this effect the dressing intervals should be shortened.

DEVIATIONS IN GEOMETRY ON MACHINED WORKPIECE

Without an additional movement in x-direction, especially at counter direction grinding, not all workpiece profile can be machined. Figure 12 shows the process of a triangular shape. The whole contour of the grinding disk just machines the edges of the workpiece. On the plane shape of the triangle there is no contact with the tool. The machined workpiece differs in that area from the target shape.

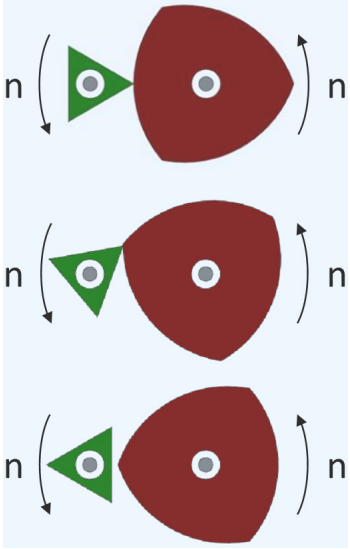

Figure 12 – Counter direction grinding

DRESSING OR MANUFACTURING AN UNROUND GRINDING DISK

With rpm-synchronous noncircular grinding a pendular movement is no longer needed just one movement of positioning is necessary. In that case an unround grinding disk is essential for machining unround workpieces. Stationary dressing tools like diamond slabs cannot be used. The needed support movements would exceed the common kinematic limit values. Besides an unround diamonded dressing tool another option for manufacturing unround grinding disks is the usage of an appropriate metal basic body coated with CBN-grains in a galvanic process. As several coating layers are required the precision decreases with every additional layer. Such a

disk is immediately ready for operation. When the disk is attrited no dressing is needed because it can be coated again.

Apart from the shaped dressing tools there is the option to dress the disk with a round and driven diamond wheel (Figure 13).

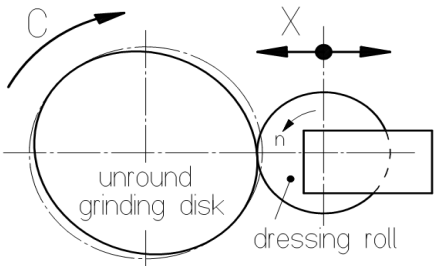

Figure 13 – Flexible dressing with a round diamond wheel

The dressing wheel oscillates in x-direction in synchronization to the disk turning. Thus it is possible to create various disk profiles very flexible. Because the dressing wheel is driven the needed relative velocity between the grinding grains and the dressing diamond will not only be influenced by the disk speed but also by the speed of the dressing wheel. Therefore the disk speed can be chosen small not to override the acceleration limit of the x-axis. This concept is similar to traditional unround grinding but instead of an unround workpiece a grinding disk is dressed by pendular movement.

UNBALANCE FORCE

When the center of gravity of a part is not congruent with its rotation axis an out of balance would be generated. The unbalance force depends on the mass of the workpiece, the angular speed and the distance between the center of gravity and the rotation axis:

$$F = m \cdot r \cdot \omega^2 \qquad (3)$$

As the force increases quadratic with the angular speed, the unbalance has to be compensated at high spindle speed with counterweights.

CONCLUSIONS

To ensure an efficient grinding process the relative speed between the acting partners in their contact area should be as large as possible. It is possible to raise spindle speed or radial differential expansion between grinding disk and workpiece. The dimension of the diameter of a grinding disk is limited by the working chamber of the grinding machine. It should be considered that it is often impossible to produce exact workpieces with counter direction grinding if the radial differential expansions of the workpiece is too large. In comparison with same direction grinding it is possible to produce concave workpieces with a grinding disk which has a larger diameter. To increase the flexibility of the grinding machine it should be equipped with a dressing support on which a powered diamond wheel is mounted (Figure 14).

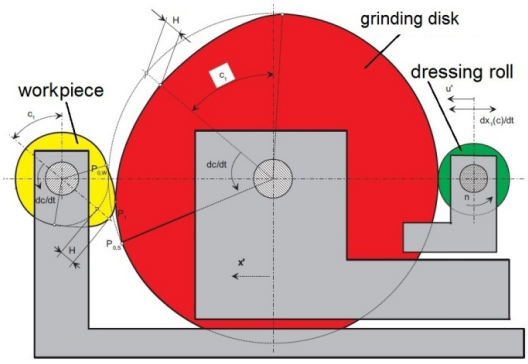

Figure 14 – Grinding machine with a dressing support [5]

With such a grinding machine it is possible to dress different shapes of grinding disks. In comparison with the traditional unround grinding operation the rpm-synchronous noncircular grinding also needs a reciprocating movement for the machining. But it is only necessary to dress the grinding disk after a certain number of machining cycles. Furthermore the moved mass of the dressing support is much lower than the mass of a moved grinding support. In the beginning it was necessary to fix the ratio with a mechanical gear between the axis of rotation from the workpiece and the grinding disk. Nowadays the ratio between these two axis can flexibly have any value with the use of an electronic gear. Using rpm-synchronous noncircular grinding costs in batch production can be reduced. Either with shorter process times because of machining several shapes with one set of grinding disks or the usage of a simpler hence more cost-effective grinding machine.

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POTENTIAL FOR INCREASE OF THE LOAD OF CUTTING MECHANISMS OF SOME WOODWORKING MACHINES THROUGH SPECIFIC APPLICATION OF SAWING REGIMES

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ABSTRACT: *The sawing regimes of some woodworking machines have been analyzed, and it has been found out that there are cases when the load of their cutting mechanisms can be increased. The period of operation for which these regimes have been established has been analyzed. When there are lower requirements for the quality of the sawn surfaces, it has been recommended to develop the sawing regimes step by step, for the whole period between two sharpenings of the cutting blades. This allows making a better use of the cutting power of the sharp cutting blades.*
KEYWORDS: *sawing regime, cutting capacity, feed rate, productivity*

INTRODUCTION

The sawing regimes of woodworking machines with mechanized feed such as band saws, circular saws, gang saws and etc. are developed on the basis of common methodology. A basic element of this methodology is establishing the feed rate in accordance with sawn surfaces' quality, tooth gullet capacity and available cutting power. A necessary condition for developing these regimes is calculating the cutting speed, the parameters of the cutting blade and the cut height (the depth of sawing).

The feed rate calculated in accordance with the available cutting power of a band saw with raker teeth has been obtained using formula (1) (Filipov 1977). (This study does not present formulas and analyses for the above mentioned machines. The results and conclusions are analogous but with the characteristic features for the machines).

$$U^{(N)} = \frac{\frac{N_p}{H} - \frac{a_\rho . p . b}{t}\pi Dn}{kb + \alpha_\lambda H}, \; m.s^{-1} \qquad (1)$$

where $U^{(N)}$ is the feed rate in accordance with available cutting power, $m.s^{-1}$;

N_p – *cutting power, W;*
H – *cut height, m;*
a_ρ – *coefficient of tooth blunting;*
p – *fictitious specific load on tooth back, $N.m^{-1}$;*
t – *band saw tooth pitch, m;*
D – *drive wheel diameter, m;*
n – *drive wheel rotation frequency, s^{-1};*
k – *fictitious specific load on tooth face, Pa;*
b – *cut width, m;*
α_λ – *coefficient of raker teeth.*

The feed rate in accordance with sawn surfaces' quality $U^{(H)}$ has been calculated using a table (Filipov 1983); the feed rate in accordance with tooth gullet capacity $U^{(O)}$ has been calculated using the parameters of the band saw and the cut height (Grigorov 1978). The calculated feed rates have been used for the graphic dependencies shown in Figure 1 for cut heights H1÷H5, thus obtaining two feed rate curve lines, $U^{(O)}$ and $U^{(N)}$, and straight lines parallel to the abscissa, restricting the feed rate in accordance with the sawn surfaces' quality $U^{(H)}$ (Obreshkov 1995; Filipov 1977).

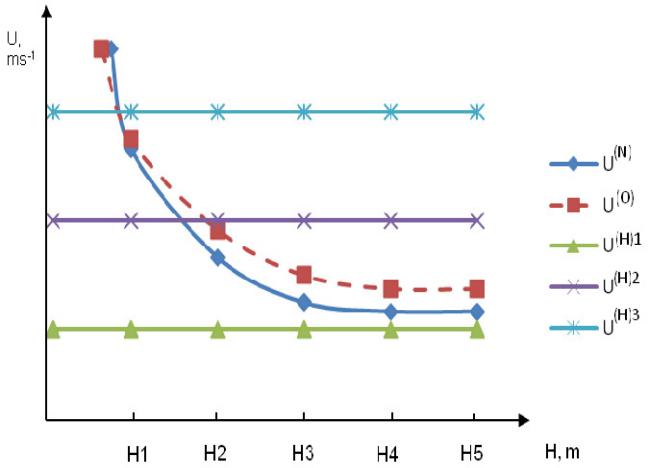

Figure 1. Graph showing the feed rate in accordance with available cutting power, tooth gullet capacity and sawn surfaces' quality

Although the research literature contains a lot of examples for developing sawing regimes using a number of features, there are some more significant characteristics for the practical use.

One of these is the period of operation of the cutting blades used to calculate the feed rate in accordance with available cutting power. Bershadsky (1992) developed models of sawing regimes for sharp and blunt teeth; another study by the same author presented sawing regimes for a band and circular saws for sawing periods of 2, 3.5 and 4 hours. Genchev (1978) established the available cutting power for a period of 0.5÷4 hours. For a band saw, Filipov et al (1983) developed a sawing regime for 4 hours of operation of the cutting blade, and Gochev (2005) recommended that this period should be 8 hours.

Very important for the establishment of the feed rate is the mutual position of its curves in accordance with tooth gullets capacity $U^{(O)}$ and available cutting power $U^{(N)}$. Because the two curves cross, according to Gochev (2005), for small cut heights, the feed rate is

restricted by the tooth gullets capacity, and, for larger ones – by the available cutting power. According to Filipov (1977) the feed rate curve in accordance with available cutting power $U^{(N)}$ should be in the entire working range above the feed rate curve in accordance with tooth gullet capacity $U^{(O)}$. In order to better utilize the potential of a cutting blade, the two curves should be close to one another. If the feed rate is established by the curve in accordance with available cutting power, there is no risk of overload of the cutting blade (Filipov 1979).

Of the three restrictions for the feed rate: the sawn surfaces' quality, tooth gullet capacity and available cutting power, the one which has the lowest value is chosen (Grigorov 1978). When the feed rate in accordance with available cutting power $U^{(N)}$ is higher than that in accordance with desired quality $U^{(H)}$, the feed rate is established in accordance with sawn surfaces' quality. In this case the motor load is below its nominal power (Filipov 1974, 1979).

Some of the sawing regimes' recommendations made above do not allow, in some cases, rational use of the available cutting power.

The aim of this study is to analyze the sawing regimes while taking into account the period of operation of the cutting blade between two sharpenings, and to investigate the possibilities for better use of the cutting power in cases when there are lower requirements for the quality of the sawn surfaces.

ANALYSIS AND RESULTS

Developing sawing regimes is performed in cases of machine construction, selection of a machine for a technological process and availability of a machine with given cutting power for which a suitable cutting blade has to be selected for a particular cut height. Let us focus on the last case.

The literature available to the author of this study does not contain a well-grounded estimate of the period of operation of the cutting blade for which the feed rate in accordance with available cutting power is calculated. This period is crucial for the position of the feed rate curve in accordance with available cutting power $U^{(N)}$ in relation to the position of the curve in accordance with tooth gutter capacity $U^{(O)}$. Grounds for this statement may be found in the analysis of formula (1). The feed rate in accordance with available cutting power directly depends on the coefficient of tooth blunting a_ρ. This coefficient is calculated in accordance with the length and time of cutting, and its lowest values are right after the sharpening of the cutting blade (Grigorov 1978). Therefore, when using formula (1) for a shorter period of operation, the feed rate curve $U^{(N)}$ will be positioned higher. At the same time, the feed rate curve in accordance with tooth gutter capacity $U^{(O)}$ will not change its position with regard to this period because it is calculated using the parameters of the cutting blade and the cut height (Filipov 1977).

The analysis made so far shows that the statement that the two feed rate curves $U^{(N)}$ and $U^{(O)}$ should be close to one another (Filipov 1977) is possible only at the given moment of time for which the calculation is made. At another moment of time between two sharpenings of the cutting blade, the feed rate curve $U^{(N)}$ will change the height of its position. Two possibilities follow: (1) a feed rate curve $U^{(N)}$ calculated for blunt cutting blades, for example for 4-hour period of operation; and (2) a feed rate curve $U^{(N)}$ calculated for sharp cutting blades, for example for 1-hour period of operation. The changed positions of the feed rate curve $U^{(N)}$ for both cases are shown in Figure 2 and Figure 3 for periods of operation of 1, 2, 3 and 4 hours. The feed rates for these periods are, respectively, $U^{(N)1}$, $U^{(N)2}$, $U^{(N)3}$ and $U^{(N)4}$.

In the first case, the feed rate curve $U^{(N)4}$ is close to the feed rate curve in accordance with tooth gutter capacity $U^{(O)}$, and is positioned below it. The feed rates for the first three hours $U^{(N)1}$, $U^{(N)2}$ and $U^{(N)3}$ which are positioned above it allow a higher feed rate, but the restriction of the curve in accordance with tooth gutter capacity does not allow it. This shows that, if sawing is performed using feed rate curve $U^{(N)4}$, for the period of time to the third hour, the motor works below its nominal power.

In the second case, the increase of the time of operation leads to curves $U^{(N)2}$, $U^{(N)3}$ and $U^{(N)4}$ which are positioned lower on the graph, and the feed rate decreases. As Figure 2 and Figure 3 show, the second case can be applied because the motor is loaded all the time.

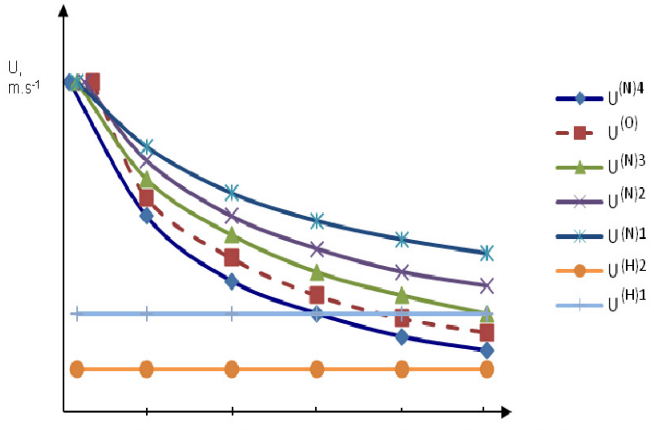

Figure 2. Graph showing the feed rate in accordance with tooth gullet capacity and available cutting power of a motor loaded below its nominal capacity

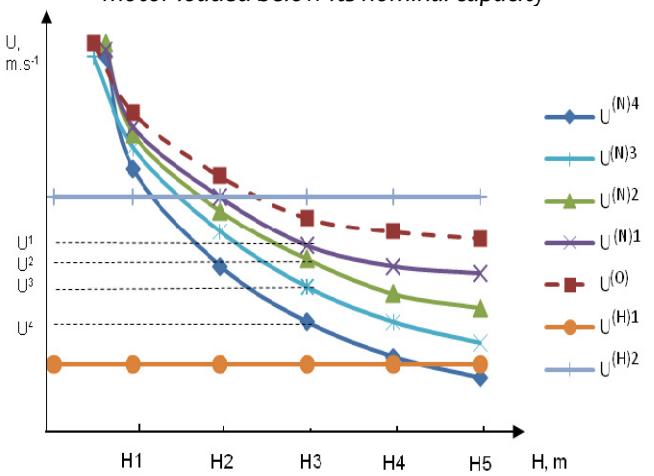

Figure 3. Graph showing the feed rate in accordance with available cutting power, tooth gullet capacity and sawn surfaces' quality of sawing regimes developed step by step

In the practical work, very often the feed rates in accordance with tooth gutter capacity $U^{(O)}$ and available cutting power $U^{(N)4}$ cannot be close to another (Figure 3). The reason for this is that the parameters of the machine do not match the parameters of the cutting blades which cannot always be chosen in the best possible way. In some cases obtaining cutting blades for a particular working regime is not economically justifiable.

The performed analysis has provided the grounds for suggesting that sawing regimes should be developed step by step. This involves calculating the feed rate in accordance with available cutting power for 1, 2, 3 and etc. hours of operation of the cutting blade (or other intervals). As a result, several feed rate curves $U^{(N)}$ are obtained; these correspond to the respective time of operation and can be used in the practical work.

The effect of developing sawing regimes step by step for distanced feed rates in accordance with tooth gutter capacity and available cutting power can be seen on Figure 3, for example, for a work piece with a cut height of H3. The feed rate established using the traditional method of feed rate curve $U^{(N)4}$ for 4 hours of operation is U_4. This feed rate should be used for 4 hours. If the four feed rate curves are used, the productivity will increase significantly as $U^1>U^2>U^3>U^4$.

Sawing regimes developed step by step can be applied only in cases when there are lower requirements for the quality of the sawn surfaces. In Figure 1, these are the restrictive straight lines $U^{(H)2}$ and $U^{(H)3}$ and in Figure3 - $U^{(H)2}$. In case of high quality requirements, i.e. lower feed rate restricted by $U^{(H)1}$, this restriction should be met.

For achieving the highest productivity, the feed rate curve in accordance with available cutting power for the sharpest cutting blades should be close to the curve in accordance with tooth gullet capacity.

CONCLUSIONS

1. Feed rates in accordance with tooth gutter capacity and available cutting power can be close to one another only for the moment of time for which they are calculated during the sawing regime.
2. As a result of the blunting of the cutting blades, the feed rate curve in accordance with available cutting power changes its position, which allows to make the suggestion that sawing regimes should be developed step by step.
3. The suggested step-by-step development of the sawing regimes when there are lower requirements for the quality of the sawn surfaces, and there are distanced feed rates in accordance with tooth gutter capacity and available cutting power, allows working with higher feed rates and better loading the motor when working with sharp cutting blades in comparison to the traditional sawing regimes.

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NEWEST APPROACH TO MODELING HYSTERESIS IN THE FORCE-CONTRACTION CYCLE OF PNEUMATIC ARTIFICIAL MUSCLE

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ABSTRACT: *Electric, hydraulic and pneumatic drives are widely used in industrial environment. In robotics different types of pneumatic actuators - e. g. cylinders and pneumatic motors - can be found commonly to date. A less well-known type is that of the so-called pneumatic artificial muscles (PAMs). Different designs have been developed, but the McKibben muscle is the most popular and is made commercially available by different companies, e. g. Fluidic Muscle manufactured by Festo Company. This paper presents the static model of PAM and our newest model for the force generated by Fluidic Muscle. The accuracy of this new model for the hysteresis loop is analysed by mathematical methods of statistics.*
KEYWORDS: *Fluidic Muscle, Static Model, Hysteresis, MS Excel Solver. Correlation*

INTRODUCTION

The working principle of different pneumatic muscles is well described in [1.], [2.], [3.], [4.], [5.] and [6.]. PAM's have various names in literature: Pneumatic Muscle Actuator, Fluid Actuator, Fluid-Driven Tension Actuator, Axially Contractible Actuator, Tension Actuator, etc. [3.], [4.] and [7.].

Most types of PAM's consist of a rubber bladder enclosed within a helical braid that is clamped on both ends. A PAM's energy source is gas, usually air. The muscle will expand radially and contract axially when inflated, while generating high pulling forces along the longitudinal axis. The tensile force depends on the contraction and the pressure of actuator (Figure 1). This feature is totally different from pneumatic cylinders, because a cylinder develops a force that depends on the applied pressure and piston surface area and independent from displacement [4.]. Typically, the air muscle can contract by about 25 % of its initial length.

In the force-contraction cycle hysteresis can be observed. Chou and Hannaford in [2.] report hysteresis to be substantially due to Coulomb friction, which is caused by the contact between the bladder and the shell, between the braided threads and each other, and the shape changing of the bladder.

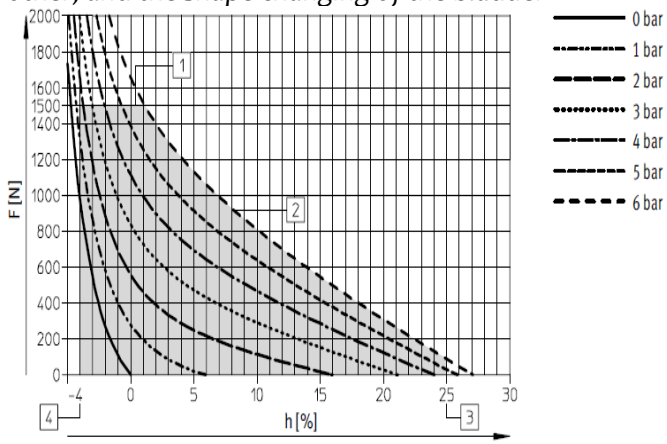

Figure 1. Isobaric force-contraction characteristics of Fluidic Muscle with inner diameter of 20 mm [8]

where: 1 - Maximal force, 2 - Maximal operating pressure, 3 - Maximal deformation (contraction), 4 - Maximal pretensioning.

Many researchers have investigated the relationship of the force, length and pressure to find a good theoretical approach for the equation of force produced by pneumatic artificial muscles, e. g. [2.], [3.], [5.], [9.], [10.] and [11.]. In most cases, significant differences have been noticed between the theoretical and experimental results. [12.] proves the accuracy of fitting using mathematical method of statistics (correlation index R = 0.998-0.999), only, but it is valid for SAM (Shadow Air Muscle) made by Shadow Robot Company.

The layout of this paper is as follows. Section 2 (The Study) is devoted to illustrate the static models on the basis of professional literature and our new force models. Section 3 (Results and Discussion) presents comparison between the measured and theoretical data for the hysteresis loop. Finally, section 4 (Conclusion) gives the investigations we plan.

For this study Fluidic Muscle type DMSP-20-400N-RM-RM (with inner diameter of 20 mm and initial length of 400 mm) produced by Festo Company is selected.

THE STUDY

The general behaviour of PAM with regard to shape, contraction and tensile force when inflated depends on the geometry of the inner elastic part and of the braid at rest (Figure 2), and on the materials used [3].

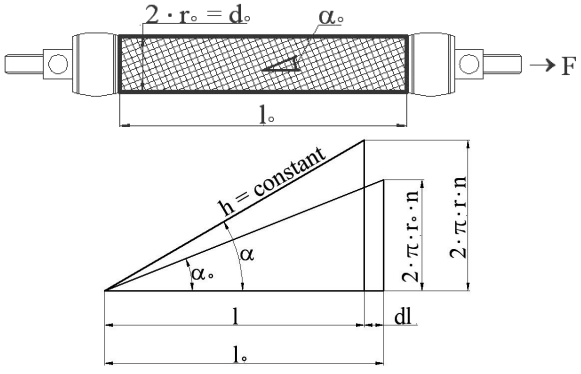

Figure 2. Geometry parameters of PAM

where: F the pulling force,
r_0 the initial inner radius of PAM,
l_0 the initial length of PAM,
α_0 the initial angle between the thread and the muscle long axis,
r the inner radius of the PAM when the muscle is contracted,
l the length of the PAM when the muscle is contracted,
α the angle between the thread and the muscle long axis when the muscle is contracted,
h the constant thread length,
n the number of turns of thread.
Typical materials used for the membrane construction are latex and silicone rubber, while nylon is normally used in the fibres. Figure 3 shows the materials of Fluidic Muscles.

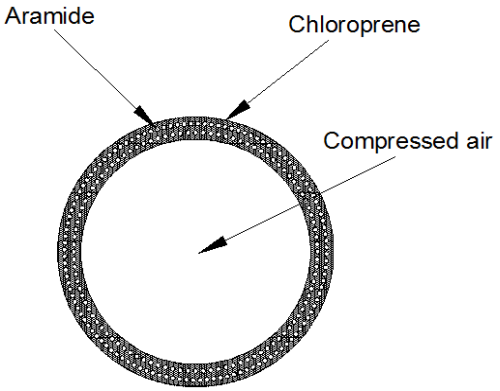

Figure 3. Materials of Fluidic Muscles

Good description of the general static model of PAMs can be found in [2.], [3.], [5.] and [13.]. On the basis of them the force equation is found:

$$F(p, \kappa) = r_0^2 \cdot \pi \cdot p \cdot (a \cdot (1 - \kappa)^2 - b) \qquad (1)$$

where: $a = \frac{3}{tg^2\alpha_0}$, $b = \frac{1}{\sin^2\alpha_0}$, $\kappa = \frac{l_0 - l}{l_0}$ *and*

p the applied pressure,
ϰ the contraction.
Equation 1 was modified by Tondu and Lopez [5.] and Kerscher et al. [11.] with correction factors ε and μ:

$$F(p, \kappa) = \mu \cdot r_0^2 \cdot \pi \cdot p \cdot (a \cdot (1 - \varepsilon \cdot \kappa)^2 - b) \qquad (2)$$

Significant differences between the theoretical and experimental results using equation 1 and equation 2 have been proved in [13.] and [14.]. To eliminate the differences new approximation algorithms with six and five unknown parameters has been introduced for the force generated by Fluidic Muscles:

$$F(p, \kappa) = (a \cdot p + b) \cdot e^{c \cdot \kappa} + d \cdot p \cdot \kappa + e \cdot p + f \qquad (3)$$

$$F(p, \kappa) = (p + a) \cdot e^{b \cdot \kappa} + c \cdot p \cdot \kappa + d \cdot p + e \qquad (4)$$

Equation 3 can be generally used with high accuracy for different Fluidic Muscle independently from length and diameter under different values of pressure and equation 4 can be used with high accuracy for Fluidic Muscle with inner diameter of 20 mm, only.
The unknown parameters of equation 3 (a, b, c, d, e and f) and equation 4 (a, b, c, d and e) can be found by Solver in MS Excel 2010.

RESULTS AND DISCUSSION

Our analyses were carried out in MS Excel environment. Tensile force of Fluidic Muscles under different values of constant pressure is a function of muscle length (contraction) and air pressure.
The force always drops from its highest value at full muscle length to zero at full inflation and position. The hysteresis in the force-contraction cycle is shown in Figure 4.

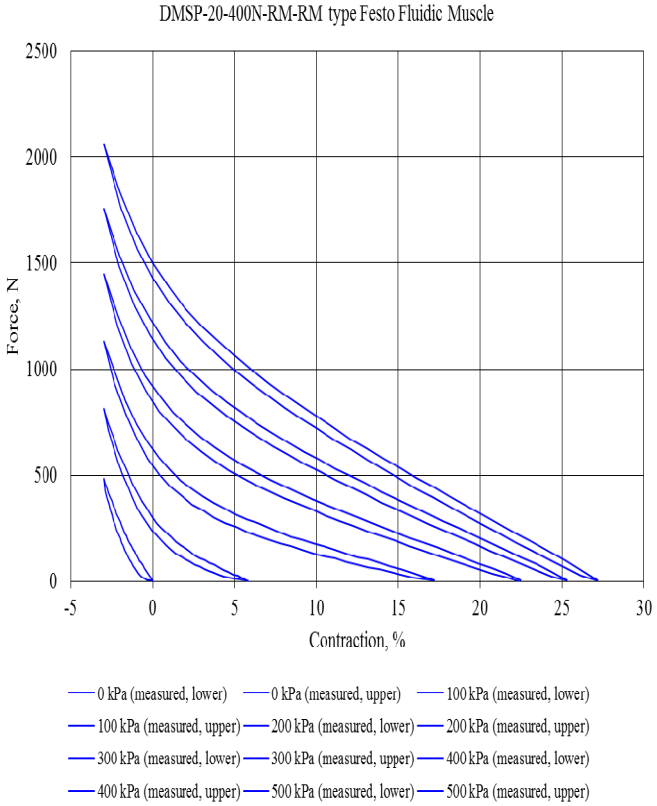

Figure 4. Hysteresis in the tension-contraction cycle

Firstly, the measured data and force model using equation 4 were compared. The unknown parameters of equation 4 were found using Solver in MS Excel. Values of these unknown parameters are shown in Table 1.

Table 1. Values of unknown parameters of equation 4

Parameters	Values	
	Upper	Lower
a	274,794472	235,183308
b	-0,3262381	-0,3803548
c	-9,07369268	-9,0612216
d	296,3161451	293,793153
e	-254,042379	-282,57012

The accurate fitting of equation 4 for the hysteresis loop can be seen in Figure 5.
Figure 6 and Figure 7 illustrate the relationship between the measured force and calculated force. The R^2 = 0.9993 → R = 0.9996 correlation index and R^2 = 0.9991 → R = 0.9995 correlation index prove the tight relationship between them.

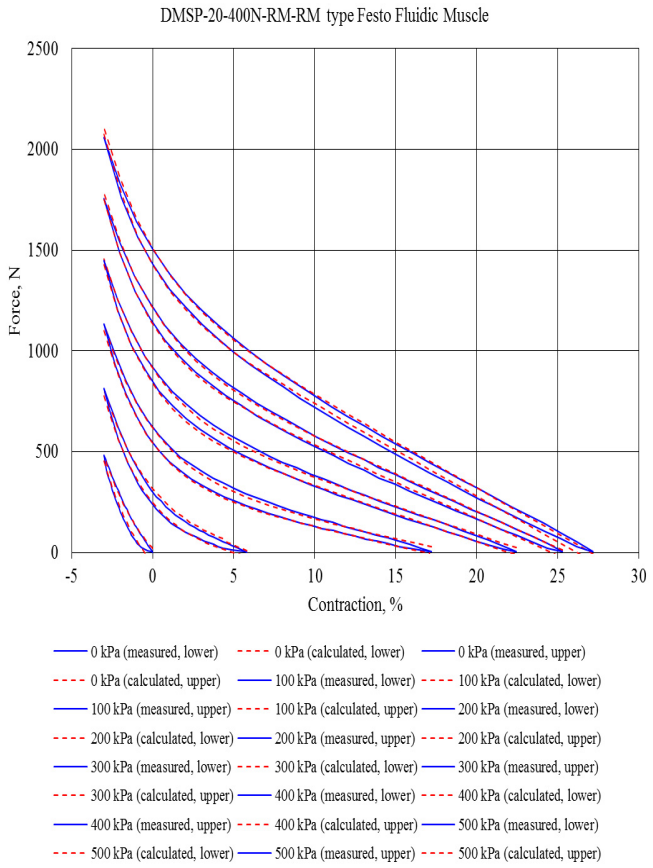

Figure 5. Approximation of hysteresis loop using equation 4

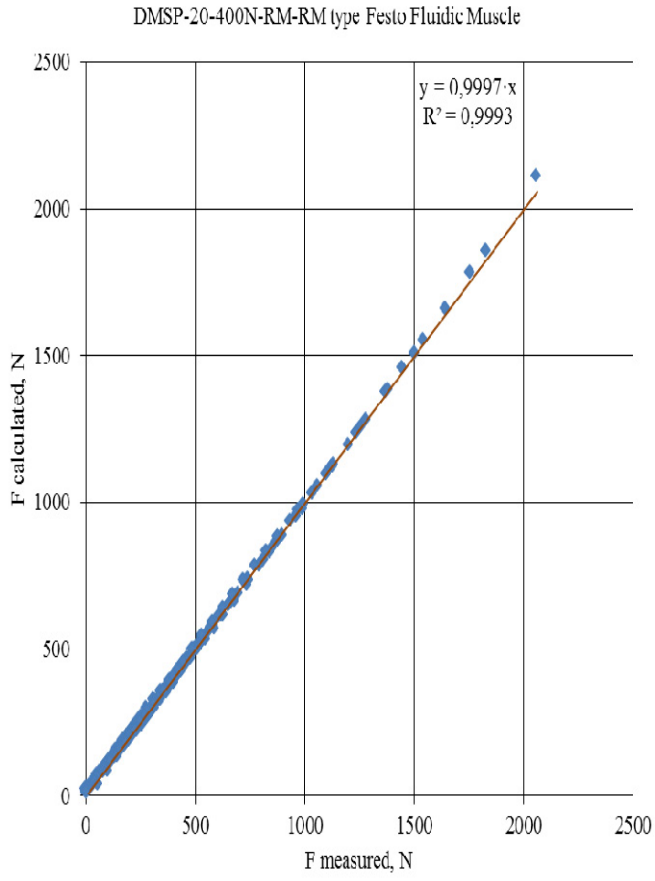

Figure 6. Relationship between the measured force and calculated force (upper)

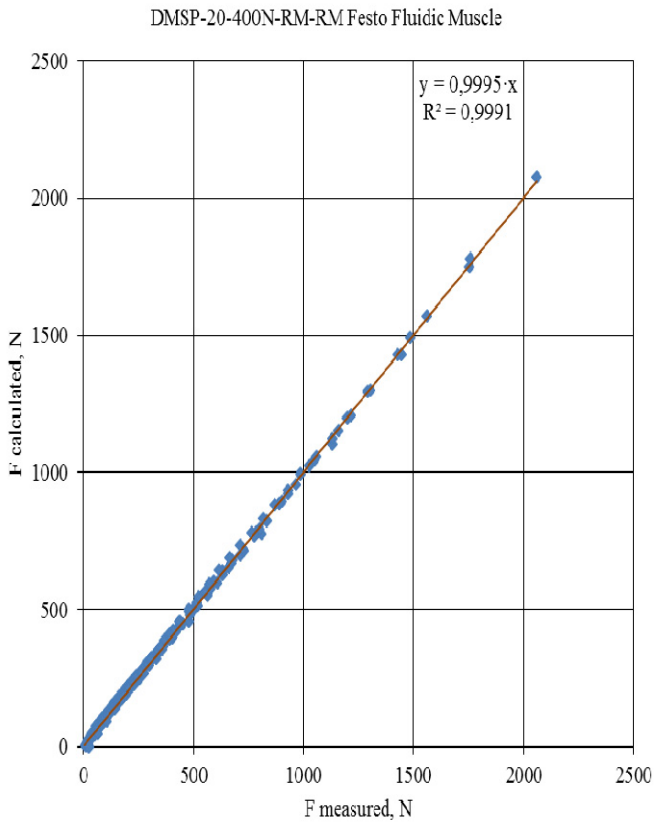

Figure 7. Relationship between the measured force and calculated force (lower)

CONCLUSIONS

In this work a new function for the force generated by Festo Fluidic Muscle was introduced and the accuracy of this approximation algorithm was proved. The investigations were carried out in MS Excel environment. Our main aim is to develop a new general mathematical model for pneumatic artificial muscles applying our new models and results.

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THE COMPARISON OF PERFORMANCE AND AVERAGE COSTS OF ROBOTIC AND HUMAN BASED WORK STATION FOR DISMANTLING PROCESSES

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ABSTRACT: *The main objective of this study was to compare human and robot performances for a simple dismantling operation by conducting a time study and cost evaluation. The dismantling task consisted of separation of a battery from a mobile phone (MP). Two work stations were analyzed and compared, one robotic and one human. The robotic work station was schematically designed and evaluated in simulation in order to achieve the dismantling times and costs. The human dismantling work station was tested in laboratory conditions. On the basis of calculating the average costs of dismantling of the battery for one mobile phone we can conclude that in the assumed conditions the robotic work station is a more efficient dismantling work station (1.20 eurocent per MP), and the human dismantling work station is less efficient.*
KEYWORDS: *average costs, dismantling processes, human performance, robot performance*

INTRODUCTION

One of the instruments for promoting productivity and flexibility in industrial dismantling seems to be by increasing mechanisation and automation [1]. More than 50 percent of the dismantling tasks concern disconnection of joints through the processes of releasing, dismounting, unscrewing etc. These jobs make up more than 50 per cent of the time. These processes are critical, as they represent a high number of alternatives and negative influencing factors. The performance of industrial dismantling therefore seems to be dependent on highly flexible automation [2]. The experience of some dismantling companies proves that an automation level can be achieved in an economically acceptable way [3,4].

For the analysis of dismantling processes we use in our study simulation and experiments [5,6]. The virtual reality and 3D modeling can be also very powerful tools for creating realistic simulation models of the processes [7,8].

METHODOLOGY

Our study compares the costs of a dismantling operation (separation of the battery from a mobile phone) at a robotic work station and at a human work station. One of the studies [9] dealing with the comparison of a assemble work station with a human operator and with a robot-based work station is based on an analysis of the time and costs of performing a simple assemble operation. Analogous to this study, our approach to the comparison of a robotic work station (alternative 1) and human work station (alternative 2) is also based on an analysis of the times needed to perform the operations (dismantling), and on an analysis or comparison of the total costs of separating the battery from a mobile phone. [10,11]

The first alternative (robotic work station) simulates the condition where the manipulation objects (MO) are freely placed on the line conveyor strand by means of a simple-design batcher (Fig. 1). The only monitored condition is MO batching at an exact time interval – line cycle. The direction and position on the conveyor strand is not monitored; this is ensured by a camera system working with a conventional robot. The robot receives instructions from the camera subsystem in the form of data flow, and calculates and adjusts the angle and the position of the mobile phone on the conveyor strand. After grabbing it the robot moves the phone towards the dismantling work station, where automated dismantling is carried out by means of special preparations and work units adjusted to work with the particular MO type. After separating the battery and the cover, the robot grabs the MO and places it on the conveyor strand at the required position and angle. Further dismantling into smaller parts therefore does not require MO positioning and directing, which reduces the costs and complexity of solutions for the next work stations. This manipulation and technological scenario is assessed from the point of view of time in the analytical part, on the basis of which the annual performance of the work station is determined, and the individual pieces of the work station equipment and other types of costs related to that work station are assessed [6].

The second alternative refers to a manual dismantling work station. This work station, as shown in Fig. 3, consists of an input bin (simpler than in the case of robotic work stations, with passive operation), a line conveyor strand and a dismantling table. The average time needed to separate the battery from one mobile phone is determined experimentally by means of a time study (chromometering). The study takes into account the experience factor by averaging the time of an inexperienced worker and of the minimum dismantling time attainable by a worker (measured as actual dismantling time). The study also takes into consideration the factor of mobile phones diversity and the resulting differences in the dismantling times. Since our time study (chronometering) did not

consider presence of a conveyor strand, in order to ensure a better comparison with the robotic work station alternative we experimentally determined the time needed to grab the MO, move it from the conveyor and place it to the dismantling work station and back. The resulting average time is subsequently used to calculate the annual performance of one dismantling worker. In respect of this alternative, the work station equipment and the other types of costs related to these costs are assessed as well. [12,13]

These two alternatives are compared from the economic point of view in the final part of this study based on the average costs of separating the battery from a mobile phone, calculated as proportion of the total annual costs (including investment and operation costs) and work station performance indicated as the number of dismantled batteries from mobile phones per year. [14,15]

ANALYSIS OF THE PERFORMANCE AND COSTS OF A ROBOTIC WORK STATION (SIMULATED DISMANTLING). DISMANTLING WORK STATION DESIGN AND DESCRIPTION

Undirected separated objects of dismantling – discarded mobile phones enter the line whose main inter-operational transport unit is the conveyor. The first automated cell within the line is the so-called battery dismantling cell, being the most dangerous object of manipulation and dismantling [5,16,17].

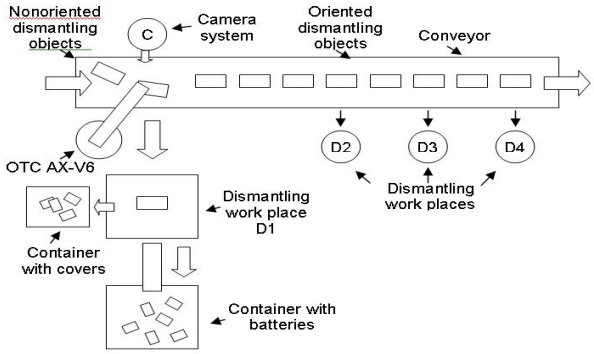

Fig. 1. Robotic work station for mobile phones dismantling

The robotic cell (Fig. 1) has the following manipulation and technological scenario:

1. Stopping the conveyor driven by a servomotor or stepper motor.
2. Image recording in real time and its evaluation by means of the Omron ZFV Monochrom camera system (Fig. 2).
3. Sending the data about the position and direction of the manipulation objects on the conveyor to the control system of OTC AX-V6 robot (Fig. 2).
4. Taking the right position using the scanning subsystem data.
5. Grabbing the object of manipulation with a special gripper.
6. Directing and moving the object of manipulation to the D1 dismantling work station.
7. Releasing the object of manipulation from the gripper.
8. Separation of the cover and battery at the dismantling work station.
9. Placing the battery into the container.
10. Grabbing the dismantled cover and placing it in the covers container.
11. Grabbing the rest of the object of manipulation and placing it on the conveyor at the right direction.
12. Starting up the conveyor.
13. One - cycle conveyor operation.

Table 1. Time simulation of the individual steps of the manipulation and technological scenario

Step	1	2	3	4	5	6	7
Time (s)	0.3	1.2	0.0	1.7	0.3	2.5	0.2
Step	8	9	10	11	12	13	ΣTime
Time (s)	1.9	0.1	0.1	2.5	0.3	1.0	12.1

Table 2. Investment costs of a robotic work station as per components and cooperating equipment

Dismantling line component	Input bin	5-year AX-V6 robot	Special gripper	Dismantling work station with containers	Conveyor
Estimated price/costs (€)	2300	27800	2000	35000	4500

Dismantling line component	Camera system	Estimated installation costs	Total costs	Estimated annual costs*
Estimated price/costs (€)	1200	3000	75800	3032

(Note.: *The estimated life-cycle of the equipment is 25 years)

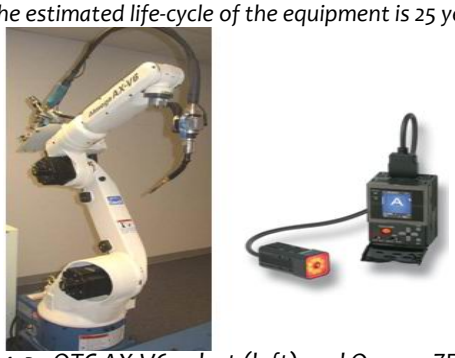

Fig. 2. OTC AX-V6 robot (left) and Omron ZFV Monochrom camera system (right)

The OTC AX-V6 robot is a high-speed, precise motion manipulator primarily intended for welding applications. It can also be used for mounting and dismantling types of applications, which requires replacement of the technological head with a grabbing head.

The working cycle of a dismantling work station was simulated with the robot. The output information is listed in Table 1. It is highly probable that this data does not differ from actual values of a working robot within a line's working cell.

ANNUAL WORK STATION PERFORMANCE

The time simulation of the individual steps required for separating the battery from a mobile phone (Table 1) shows that the total number of batteries separated from mobile phones would be 595042 per year (2000 hours * 3600 sec. / 12.1 sec).

AVERAGE ANNUAL COSTS OF THE WORK STATION

Two types of costs are considered in the calculation of the average annual costs: investment costs (Table 2) representing the price of the work station and the installation costs and operating costs, including electric energy consumption, maintenance and repairs.

The following procedure was followed in the calculation of the operating costs:

The electric energy consumption of the robot is approximately 2.6 kW. The price for 1kWh is 0.0859€ (KLASIK M tariff for small- and medium-sized enterprises from the local electricity supplier VSE), including VAT; the monthly payment is 0.83€. Hence, the monthly electrical energy consumption of the robot attains 36.56€, which is 439€ (12*36.56€) of the annual electric energy costs. The input bin with an energy input of 500W will consume 80 kWH per month, which represents annual electric energy costs of 83€. The conveyor is driven by 300W servomotor. The estimated costs of energy consumption for operating the conveyor in accordance with the set manipulation scenario are 14€. The annual electric energy costs are 536€.

The maintenance of the OTC AX-V6 robot counts with average annual costs of approx. 2500€. This amount includes inspection costs (inspection of the manipulation equipment once in two years, and inspection of the wiring system once in a year), diagnostics and planned maintenance. As far as the assisting equipment is concerned, such as dismantling work station and input bin, the estimated maintenance costs are the following:

- dismantling work station - 700€ per year,
- input bin - 400€ per year.

The total annual costs of maintenance are 3600€.

Hence, the total operating costs (the total of energy costs and costs of maintenance and repairs) attain 4136€ per year.

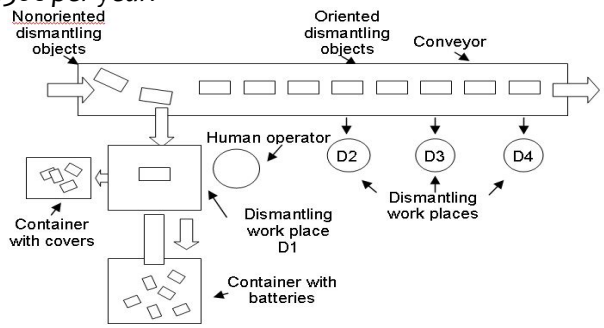

Fig. 3. Work station for manual dismantling of mobile phones

ANALYSIS OF THE PERFORMANCE AND COSTS OF MANUAL DISMANTLING WORK STATION (EXPERIMENTAL DISMANTLING)

– Dismantling Work Station Design and Description

The manual dismantling work station (Fig. 3) is designed similarly as the robotic work station, and the differences are described in the methodological part.

ANNUAL WORK STATION PERFORMANCE

The calculation of the annual work station performance is based on the available working hours of a one-shift operation and average time of separating the battery from a mobile phone, determined experimentally.

The available (nominal) working hours of one worker in 2008 is 2000 hours [18].

The procedure for calculating the average time of separating the battery from a mobile phone, which is the main subject of our study, is the following:

First, we conducted a time study (we measured partial dismantling times) of the same mobile phone type with two operators (volunteers). The measurement methods in respect of the two operators differed. As for the first operator, the total duration of the individual dismantling operation including time for determining the method of dismantling was measured. As for the second operator, the actual time of the operation (physical job) was only measured, excluding the time for considering the dismantling method. Based on this data we could determine the limit times (minimum and maximum time) from the point of view of operator's experience. The maximum time represents the condition of an inexperienced worker, whereas the minimum time can be achieved by an experienced (trained) worker. On the basis of these values, the first average time was calculated. The results of this time study are provided in Table 3.

Next, we measured the actual dismantling time of nine mobile phones of different brands in order to eliminate the differences in dismantling times resulting from different phone designs. To measure the times, we chose such mobile phone types which had been used most frequently according to telecommunication operators' information, and their number would therefore be the highest in the actual dismantling process. The average time calculated from the total of times of the first two operations (taking off the external cover and battery) measured under study [9] for nine different phones is 00:03.84 seconds. All the dismantling operations were performed by the same operator and without the use of any tools.

The third step was to calculate the average time of battery separation from a mobile phone. The calculation of the average time of dismantling a mobile phone takes into account the data measured in the previous two steps in the following way: the mean average of the times measured in step 2 is used, reflecting the average time with different types of mobile phones. This average time equals 3.84 seconds. From Table 3 data, the index of operator's average experience was calculated, which represents the percentage increase of the time of a worker with average experience against the minimum possible time of dismantling (actual dismantling time). This index equals 4.2958716 (00:18.73/00:04.36). The resulting average time of separating the battery from a mobile phone (calculated as the average time calculated from the first two dismantling operations with different phone types multiplied by the index of operator's average experience) is 16.50 seconds, rounded up (3.84 seconds * 4.2958716) or 0.00458 hours.

For better comparability of the two alternatives, we also experimentally studied the time needed to grab, move and place the MP from the conveyor to the dismantling work station and back. The time per one operation (grabbing, moving and placing the MP from the conveyor to the dismantling work station and back) determined by measuring the time of ten such operations is 3 seconds. This time was added to the average time of battery separation from one mobile phone. The resulting average time equals 0.00542 hours.

Table 3. Time study of dismantling a Siemens 150 mobile phone [19,20]

Operation	Operator 1 –without any experience (maximum dismantling time)	Operator 2 – (minimum dismantling time)
Taking off the external cover	00:12.2	00:01.17
Taking off the battery	00:20.9	00:03.19
Total	00:33.1	00:04.36
Average time	00:18.73	

The average annual performance of a worker (number of batteries separated from mobile phones per year and worker), based on our calculation of the average time of separating the battery from one mobile phone (taking into account 3 seconds for moving the MP from the conveyor and back) is 369004 pieces (2000/0.00542).

AVERAGE ANNUAL COSTS OF A WORK STATION

Analogous to the previous alternative, the investment costs will first be determined for this work station counted over one year of the equipment's life-cycle. The prices/costs of the equipment of which this work station consists were set as follows: the estimated price of one simple input bin is 400€. The price of a simple dismantling table was determined on the basis of the information from REGAZ SK s.r.o. at 1000€ [21]. The bin and the table require no maintenance and their estimated life - cycle is 25 years, and can even be more. The estimated price of the conveyor, as in the previous cases, is 4500€ and its life - cycle is 25 years.

The total investment costs per dismantling work station equal 6100€, which is 244€ per year in the case of a 25 - year life - cycle (6100/25).

When determining the operating costs of the manual dismantling work station, the total annual labour costs are taken into account, as well as the conveyor's operating costs (or energy consumption costs) at the amount of 14.00€, since this alternative counts with the use of a conveyor.

The total annual labour costs/costs per dismantling worker are determined as follows: first, the total monthly costs per one dismantling worker are calculated as the sum of the average gross monthly salary of an employee working in the industrial production sector in Slovakia (SKK 22093 (Source: Slovak Statistical Office) and of insurance payments paid by employer (36 % of gross salary in 2008, rounded up) [8]. The total monthly costs per one dismantling worker are 997.36€. Hence, the total annual costs per one dismantling worker are 11968.32€ (997.36€ * 12 months).

CONCLUSIONS

The comparison of the individual work station from the point of view of average costs of separating the battery from a mobile phone under assumed conditions suggests that the costs of the manual work station (3.31 eurocents per MP) are approx. 2.7 - times higher compared to the robotic work station (1.20 eurocent per MP).

According to our assumptions, the performance of the manual dismantling work stations attains 62 % of the annual performance of the robotic work station.

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SEMI CIRCULAR MICROSTRIP LINE FED PRINTED MONOPOLE ANTENNAS FOR UWB COMMUNICATION

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Abstract: *In this paper we have investigated Microstrip line fed semi circular printed monopole antenna, which is basically printed microstrip antenna with etched ground plane for UWB applications. In particular we have simulated circular patch monopole antenna and then after etched some part of the radiating patch in order to make semi circular antenna with good performance for UWB communication. While doing simulation study, a simple rectangular microstrip line is used for feeding the printed monopole antenna. Finally the simulated antenna is having frequency bandwidth under -10dB return loss is ranging from 2.8 GHz to 15 GHz. This semi circular printed monopole antenna works well for the whole UWB frequency band 3.1-10.6GHz.*
Keywords: *UWB, semicircular, printed monopole antenna, Microstrip line*

Introduction

Ultra-Wideband (UWB) commonly refers to signal or system that either has a large relative bandwidth (BW) or a large absolute bandwidth [1]-[4]. Such a large BW offers specific advantages with respect to signal robustness, information content and/or implementation simplicity. But such systems have some fundamental differences from the conventional narrowband systems. The Federal communications Commission (FCC) has designated the 3.1 to 10.6 GHz band with Effective Isotropic Radiated Power (EIRP) below -40dbm/kHz for UWB Communications [1]-[2].

Some UWB antennas are much more complex than other existing single band, dual band and multi-band antennas [5]-[6]. Most of the UWB monopole antennas are investigated till today is non-planar as in and due to its protruded structure they cannot be integrated with integrated circuits and they are fragile. Few researchers have also studied printed monopole Antennas [3]-[4].

Ansoft High Frequency Structure Simulator (HFSS) simulation software has been employed for obtaining the simulation results.

Geometry Of Printed UWB Monopole Antennas And Simulation Results. Modified Circular UWB-Monopole Antenna

This modified UWB monopole antenna is designed directly from the circular Patch UWB-Monopole antenna with some modifications in the patch shape as shown in Fig. 1(a). This proposed UWB-monopole antenna is designed on a substrate with 4.4 relative permittivity and 1.6 mm thickness and with a semicircular patch. The simulated UWB antenna is illustrated with the dimensions using FR4 substrate. After doing an extensive simulation study, we have fixed the dimensions of UWB monopole antenna and the value of "g" is 0.8mm. The patch has been reshaped from a circular to semicircular to make the antenna compact [5]-[6]. By reducing the patch size the antenna impedance matching was affected, the impedance matching was restored my adjusting the value of 'g'. By reducing the size of the patch the antenna efficiency was reduced slightly but a large bandwidth has been obtained which greater than the UWB bandwidth. After extensive simulation the 'g' value has been fixed [7]-[8].

The final optimal dimensions of the UWB-monopole antenna are:

- *Dimensions of Patch: Radius =12mm &*
- *Thickness =0.035mm*
- *Dimensions of Substrate: W = 46 mm, L = 52mm & Thickness =1.6mm.*
- *Dimensions of Ground: W = 46mm, L = 26.2mm & Thickness =0.5mm.*
- *Dimensions of Microstrip line: W=2.6 mm, L = 27.5 mm & Thickness =0.035mm.*

where "g" is gap between the ground plane and patch.

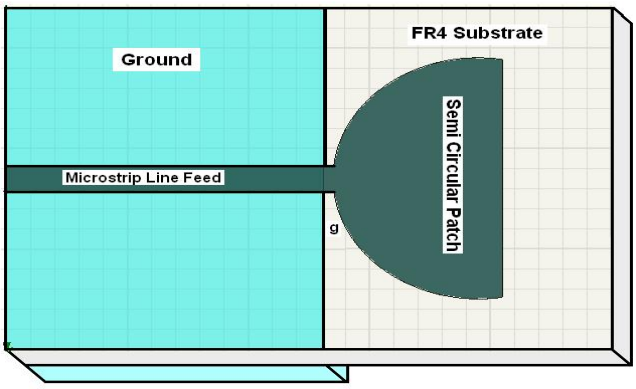


Fig. 1(a): Geometry of Semi circular Patch UWB Antenna.

At a particular values of g, the antenna impedance, bandwidth (f_{low} is the lower start frequency of the antenna BW, f_{high} is the higher end frequency of the antenna BW and antenna BW is considered for those frequency range where the s_{11} is below -10dB) and radiation efficiency are tabulated. Here the gap (g) between the circular patch and the ground plane below is the most crucial parameters for getting a huge BW. Mainly this "g" is served as a proper

impedance matching technique in order to get the antenna impedance equal to 50Ω and maximize the antenna radiation efficiency, as we can see from Table-I. And all other antenna parameters like Antenna accepted and radiated power, Maximum radiation intensity and peak gain are tabulated.

Table I

g, mm	F_{low} ,GHz	F_{high}, GHz	Antenna Impedance, Ω	P_{acc}, W	P_{rad}, W	Max U, W/Sr	Peak Gain	η, %
0.5	2.8	12.4	50	0.92	0.81	0.11	1.51	88.23
0.8	2.7	17.2	50	0.91	0.80	0.12	1.55	87.88

Note that modified Semi-circular Patch UWB-Monopole antenna is having better performance and good Bandwidth than the conventional circular Patch UWB-monopole antennas. The H-plane radiation pattern and E-plane radiation pattern on the other hand is purely omni-directional pattern throughout the Band of frequencies.

The simulated plot of Antenna return losses Vs frequency of antenna is shown in Fig. 1(b). , it can be seen that the bandwidth below -10dB ranges from 2.8 GHz to 15 GHz which includes the UWB bandwidth i.e. from 3.1GHz to 10.6 GHz .So this antenna operates as UWB antenna.

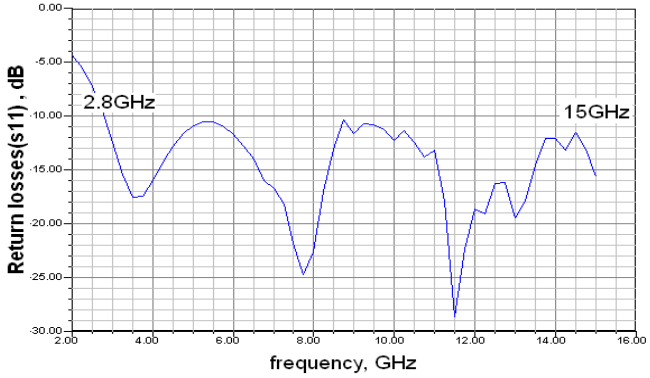


Fig. 1(b): s_{11} versus frequency plot (BW is from 2.8GHz to 15 GHz).

From the Fig.1(c) (i.e. the plot of antenna impedance Vs frequency), we can see the real part of antenna impedance is exactly 50 Ω at 3.1GHz and 7.9GHz where the imaginary part of the antenna impedance equals zero. Throughout the bandwidth of the UWB antenna, the real part of the antenna impedance varies from 25 Ω to 90 Ω whereas the imaginary part of the antenna impedance is in the range -32 Ω to +25 Ω that is not a major variation of the antenna impedance.

The simulated E-Plane radiation patterns(vertical plane or vertical cut of 3D radiation pattern) of the UWB antenna with a circular patch, with a 'g' value 1mm i.e. the separation between the ground plane and the patch at different frequencies are shown in the figure below. The radiation pattern is a function of (9,φ) of electric field vector and E-planes are measured at fixed value of "9" ,varying the value of "φ" from 0 degrees to 360 degrees.

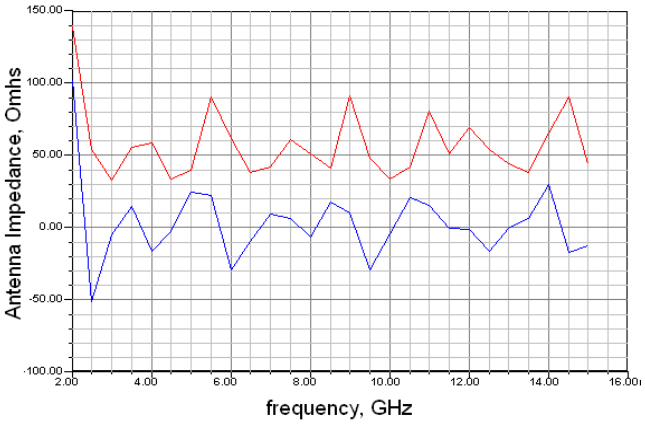
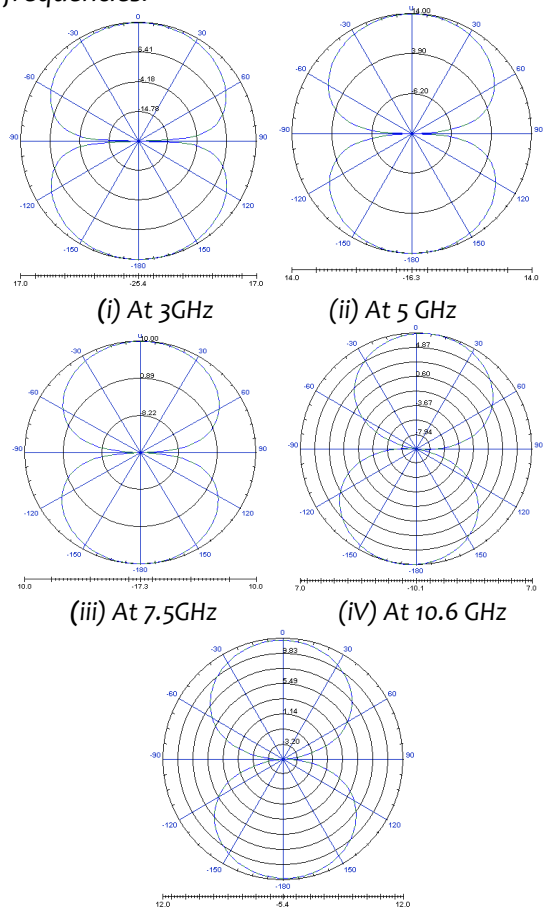


Fig. 1(c) : Antenna impedance versus frequency (real part → red color and imaginary part → blue color) of circular Patch UWB monopole Antenna.

The E-Plane radiation patterns of the UWB antenna with a circular patch and with a separation of 1mm between the ground plane and the patch at different frequencies are shown in the above figure. It can be observed that the E-Plane pattern is like a doughnut or '8' shaped at 3GHz frequency and is almost same with a little distortion at 5GHz, 7.5 GHz, 10.6 GHz and 12 GHz frequencies.



(i) At 3GHz *(ii) At 5 GHz*

(iii) At 7.5GHz *(iV) At 10.6 GHz*

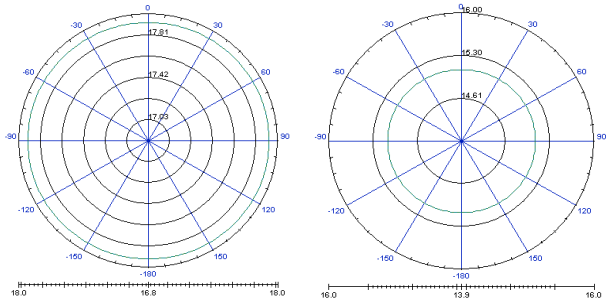
(V) At 12 GHz

Fig. 1(d): E-plane radiation patterns at different frequencies.

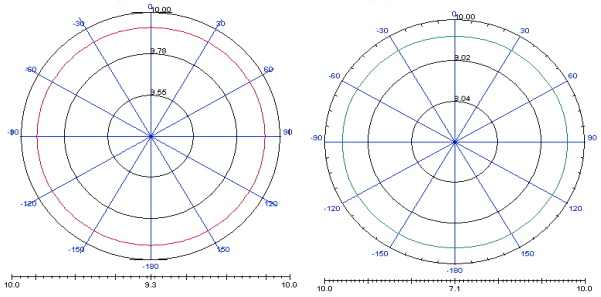
The simulated H-Plane radiation patterns(horizontal plane or horizontal cut of 3D radiation pattern) of the UWB antenna with a circular patch, with a 'g' value 1mm i.e. the separation between the ground plane and the patch at different frequencies are shown in Fig. 1(e). The radiation pattern is a function of (9,φ)

of electric field vector and H-planes are measured at fixed value of "φ" ,varying the value of "θ" from 0 degrees to 180 degrees in both clock wise and counter clock wise directions.

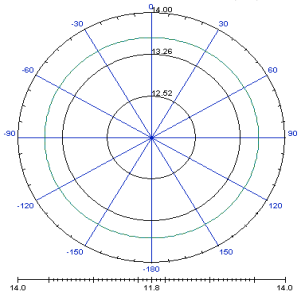
The H-Plane radiation patterns for the UWB antenna with a circular patch and a separation of 1mm between the ground plane and patch are shown in the above figure. It is observed that the H-plane patterns are almost omni directional at 3.1 GHz, 5 GHz, 7.5 GHZ, 10.6 GHz and 12 GHzs. Finally the 'g' value was fixed at 1mm after extensive simulation meanwhile the antenna impedance was perfectly matched. The H-plane radiation was omni directional (circular) throughout the band of frequencies.



(i) At 3 GHz (ii) At 5 GHz



(iii) At 7.5 GHz (iv) At 10.6 GHz

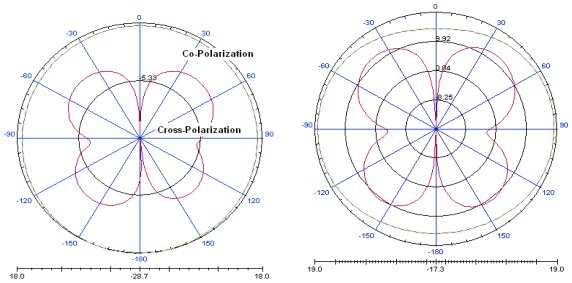


(v) At 12GHz

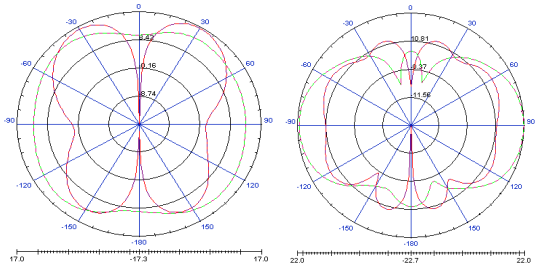
Fig. 1(e): H-plane radiation patterns at different frequencies.

The simulated polarization plots of the UWB antenna with a circular patch at different frequencies within the band of frequencies are show the Fig. 1(f), basically polarization is the orientation of the lines of electric flux in an electromagnetic field (EM field).

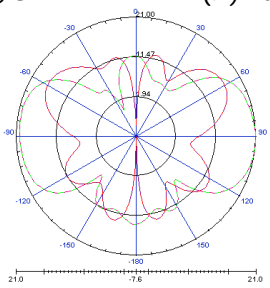
The polarization pattern is a function of (θ,φ) of electric field vector, in the above plots indicates co-polarization (dashed lines) and cross polarization in solid line (pink). Initially co-polarization was high at the lower resonant frequencies i.e. from 3GHz to 5 GHz and the cross polarization was slightly less, as the frequency increases i.e. from 7.5 GHz the cross polarization is increasing to a considerable extent at 10.6GHz and 12GHz.



(i) At 3GHz (ii) At 5 GHz

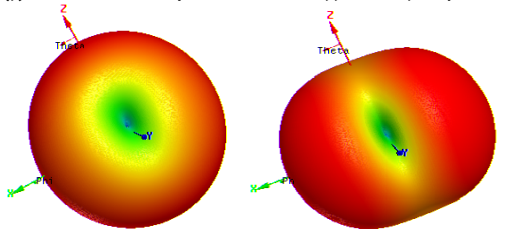


(iii) At 7.5 GHz (iv) At 10.6 GHz

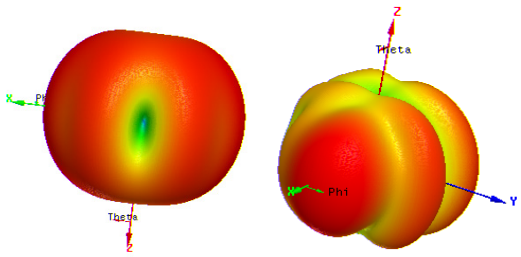


(v) At 12 GHz

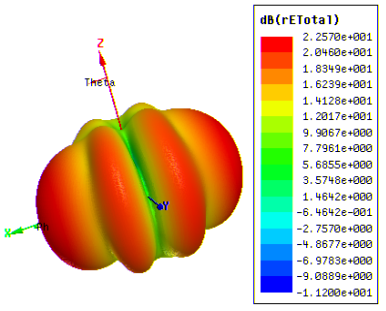
Fig. 1(f): Polarization patterns at different frequencies.



(i) At 3 GHz (ii) At 5 GHz



(iii) At 7.5 GH (iv) At 10.6 GHz



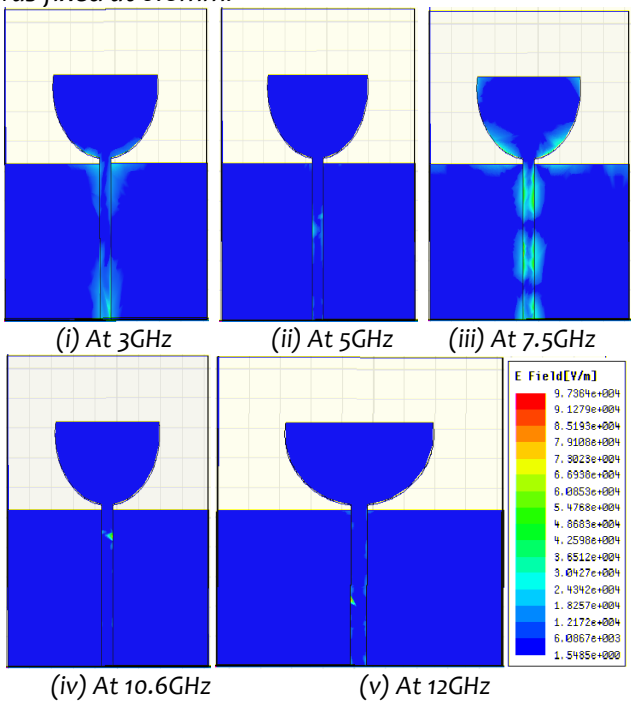
(v) At 12GHz

Fig. 1(g): 3D Radiation Plots at different frequencies.

The simulated 3D radiation patterns of the proposed antenna at 3, 5, 7.5, 9, 10.6 and 12 GHz are shown in the Fig. 1(g). The radiation pattern looks like a doughnut,

similar to that of a dipole pattern, at the first resonant frequency i.e. 3GHz. At the second resonant frequency i.e. at 5GHz and the third resonance frequency i.e. at 7.5GHz the radiation pattern is somewhat like pinched doughnut (i.e. omni directional). As the frequency moves toward the upper end of the bandwidth the radiation pattern is some what slightly distorted as it reaches higher frequencies (i.e.10.6GHz and above)

The transition of the radiation patterns from a simple doughnut at the first resonance to the complicated radiation patterns at the higher resonances indicates that this antenna must have gone through major changes in its behavior but it had omni directionality, this was possible because of the partial ground plane i.e. 'g' the gap between the ground plane and the patch which was a major factor for perfect impedance matching of the antenna, due to the proper impedance matching the antenna has very less reflections. As the impedance matching was good the radiation power and radiation intensity were very high. After extensive simulation study the 'g' value was fixed at 0.8mm.



(i) At 3GHz (ii) At 5GHz (iii) At 7.5GHz

(iv) At 10.6GHz (v) At 12GHz

Fig. 1(h): Current distribution plots at different frequencies

The simulated current distribution patterns of the UWB antenna at different resonances are depicted in the Fig.1(h). It can be observed from the figure that the current distribution at 3GHz is indicating a first order harmonic, at 5GHz its indicating second harmonic. As frequency increases the current distribution becomes more complicated indicating to a third order harmonic at 10.6GHz and fourth order harmonic at 12GHz.

At the first resonance the current is oscillating and having a pure standing wave pattern along most part of the edges of the patch. So the patch acts as oscillating monopole, but the variation of current becomes more complicated at higher frequencies. The antenna operates in a hybrid mode of traveling waves and standing waves at higher frequencies, but the ground plane on the other side of the substrate cannot form good slot with the patch to support traveling waves. Therefore the impedance matching becomes worse for the traveling wave dependent modes at higher frequencies.

CONCLUSIONS

In this paper, we have investigated semicircular printed UWB monopole antenna with huge bandwidth, which is basically a printed microstrip antenna with the etched ground plane. Printed UWB monopole antennas are less fragile, planar and can be integrated with the integrated circuits unlike monopole antennas which have non-planar or protruded structures above the ground plane. In particular, we have simulated semicircular UWB monopole antenna directly from the circular printed UWB antenna and it has higher efficiency. The E-plane radiation the printed monopole antenna is in the form of 8 shapes and it is slightly tilted at higher frequencies. The H-plane radiation pattern has omni-directional patterns throughout the frequencies of the BW. It has been observed that such monopole antennas are suitable for UWB operations.

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CONNECTIONS BETWEEN PRODUCTS AND CONTEXTS – KEY DRIVERS FOR THE DESIGN OF A PRODUCT

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ABSTRACT: *According to the recent economic situation, the actual business model will not be sustainable for a long time. In this paper we want propose a design methodology, which leads the possibility to influence people behaviours through the products. The aim of this paper is to underline the role of the designer, as director of the process, in order to coordinate involved actors and actions. This approach suggests a result, namely a product, which uses the local resources preserving material and cultural tradition and furthermore understanding the relationships between the costumer and his territory. The link between the product and its context defines a "surplus value" which characterizes the design process as "sustainable". According to that, the final aim should be a "customised product" defined through a muldisciplinary approach, where the role of the designer is creating a dialogue among all the different actors involved in the definition of the product.*
KEYWORDS: *sustainability, territory, relationships, muldisciplinary, industrial product*

BACKGROUND

Since the second half of the last century the scientific community was able to document, with an increasing deepening, the dramatic effects which human beings' activities wield on natural systems to solve their needs [1].

According to that, the Living Planet Report 2010 [2] pointed out that the ecological footprints of countries are causing an increasingly impressive environmental deficit.

Every day the International scientific community describes the effects of the human impact on the earth's natural system that still remains the only source we have and that is the base of the entire world economy and our wellness [3].

The actual economic and financial crisis is a huge and serious problem, but our ecological deficit is much more worrying than any other crisis we went through, also because environmental problems are probably one of the biggest reasons of the increasing of the economic crisis.

The world economy has grown with a massive rate in the last sixty years. The gross world product (GWP), has reached 69,000 billion of dollars in 2008, and already in that year there was a soft deflection in the annual growing percentage, due to the current economic crisis [4].

In the 1950 the gross world product was approximately of 6,600 billion of dollars and, since then, in sixty years we have almost tenfold.

By comparing these figures, it seems not plausible believe in a continuous and endless growth of the GWP.

As pointed out by the economist Jean Paul Fitoussi in his speech at the East-Forum 2010 in Rome, the sustainability is a complex concept formed by economical, social and environmental dimensions.

These three aspects have to be considered in a complementary manner, they cannot be in competition, and so it is not possible take into account only the economical part [5].

According to that, the economical and environmental crisis can be seen as two aspects of the same phenomenon.

Thinking about the nature, it's interesting underline as, contrary to our economic model, all the earth's natural systems can renew themselves, generating life.

According to that, the ecologist Eugene Odum called the natural systems: life-support systems. He also described the whole earth as an ecological unit, formed by living and non-living parts, which together interact to form a stable entity [6, 7].

Our dominant culture leads us to neglect, and often to ignore, processes and functions performed by the nature. Each time we use it for our welfare, we probably weak or damage its resistance and resilience, and we difficulty understand that, in this way, we are reducing our chances of development for the future.

As ecologists have affirmed, humanity is closely dependent to processes, features and services provided by natural systems.

The humanity-health is therefore linked to the health of ecosystems and biodiversity, which are the basic constituents of natural systems.

As human beings, we are also a component of natural systems: without them we would not be able to evolve, and survive.

Despite this, people are heavily altering functioning and diversity of ecosystems: this is reflected in significant impacts on wellbeing, economy, wealth, and happiness of society. Because of that, urgent and concrete actions to reverse the negative trend are required.

The challenge we face today has very significant proportions and the only hope we have to win is to involve everybody.

It is humanity's duty figure out how the current 7 billion of population (the number is increasing and will

be approximately close to 10.6 billion in 2050) can live in this planet with an appropriate lifestyle, without causing the devastation of natural systems [8] (United Nations, 2010).
The aim of this paper is showing a possible way for facing the crisis by starting from a co-operative approach in the product's design process.

METHODOLOGY

This paper is based on the application of the Systemic Design methodology, namely with the acronym SD further in this paper. This approach underlines the importance of making better use of material and energy flows, in order to model our production and energy systems looking at the nature's rules [9].
This concept is also asserted in principles of Industrial Ecology theory: effluents of one process serve as the raw material for another process; the industrial ecosystem would function as an analogue of biological ecosystems [10].
Furthermore, according to the SD methodology, material and energy flows should be opened, in order to decrease environmental impact and resources depletion.
In particular, according to its principles (Figure 1), the SD:

- *considers the waste of a system, namely output, as resources, namely input, for another system*
- *argues that each system starts from relationships among its constituent parts*
- *underlines that each system should be self-sufficient as much as possible, in order to naturally led to balance, and furthermore to preserve, itself alone*
- *assumes the relevance of the local context as resource base*
- *takes into account, during the design process, the environmental, social, cultural and ethic context as well as the subject of the project.*

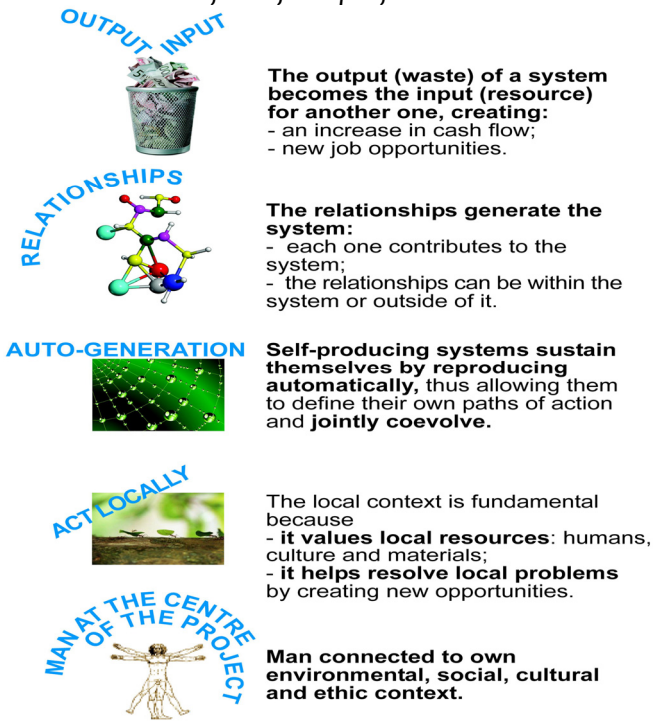

Figure 1: Systemic Design principles

In this paper the applied methodology stresses the relevance of connections and relationships among the elements of a system, which consequently underline the importance of a multidisciplinary approach in the design process.
According to that, the inter-connections among system's components are important as well as the dialogue among the participants in the process.
Therefore, a model based on systemic principles takes into account exchanges of material and energy among the involved elements; this is why it is possible to say that it is strictly influenced by the rules of the natural system.
It is a matter of fact that every natural system can be described with flows. In Nature nothing evolves in a static way: everything is linked and interacts with its own surrounding. Indeed, the design challenge for our century is finding the way to link as much as possible the elements of a system, trying to find a solution according to them [1].

RESEARCH AIM

The aim of the research is think about the consequences of the human's daily activities on the territory.
By starting from that concept and focusing the study on the design process, it is really important take into account strong relationships among human beings and their surroundings.
During a historical evolution, a territory is defined in time and space by behaviour of its inhabitants and its local peculiarities.
Hence, each specific geographical area is defined by different resources, which during centuries have been used from human beings in order to reach their needs.
So that, the inhabitants of different contexts have developed a specific "know-how", strictly connected with defined territories.
Besides, during years the human abilities in doing things have lead a "material culture" characterized by social and cultural aspects dependent on territorial qualities.
Summarizing, a design process based on the local characterizations, has to take into account different aspects of a territory, which can be summarized in: available resources, "know-how" and "material culture" [9](Figure 2).

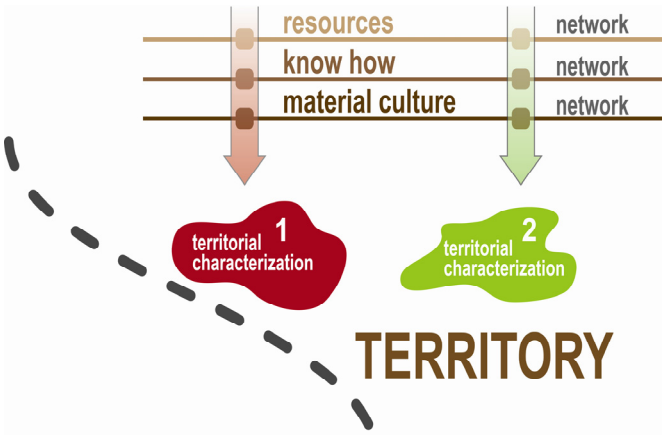

Figure 2: Local resources, know-how and material culture define the characterization of a territory

Because of the suggested approach promotes the interdependency between the product and its context, it is possible to forecast some relevant effects which influence the territory in different fields (Figure 3).

- *Economy: the use of territory's resources leads the growth of the local economy.*
- *Culture: thanks to this approach, each territory will be defined by different expertise, strictly related to the "material culture" of its inhabitants.*
- *Market: the preference for of a small-scale economy will avoid problems caused by a large-sale logistic.*
- *Environment: a production method based on the local available resources will produce fewer products with high quality, without affect the environmental balance.*
- *Quality: the quality-level of a product will be guaranteed by its local-identity.*

Moreover the application of this method will consequently enhance the wellbeing level of a place and its inhabitants.

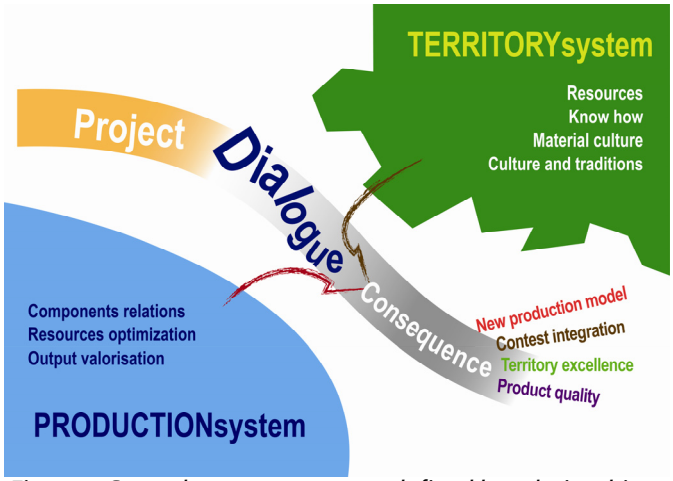

Figure 3: Several consequences are defined by relationships between the product and its territory

CONCLUSIONS

In this paper the authors have described a design process based on the strictly relationships between the product and its surroundings, and furthermore the possibility of guiding customers toward a sustainable approach, in term of economical, social and environmental values.

By starting from the natural systems' concept of the interaction among the elements of a system, it becomes clear that a product has to be related to its territory, in order to use the available resources and to preserve its "know-how" and culture.

The customer, who hopefully will understand the relevance of connections between the product and its territory, will be also able to appreciate these characteristics as a "surplus value" of the product itself.

The inter-dependency between the product and its surroundings, defined by multiple social, cultural, economical and environmental factors, point out that every earth's zone define as many products.

Consequently, by applying a systemic approach that considers the product as a "system" connected with several other related elements, a "customized product" would be preferable instead of a "standard one".

A systemic and holistic approach like the SD methodology, is based on the co-operation among the actors of the process. Because of that, the designer should take the role of expertise's coordinator, in order to show common points among the elements of the system; to point out possible hidden connections among the product and the other related systems and furthermore to explain interconnections among the participants' expertise.

Thanks to a systemic approach, the designer is able to show interactions among components and also wide the boundaries of a product that will be influenced by several factors, from social to environmental areas (Figure 3).

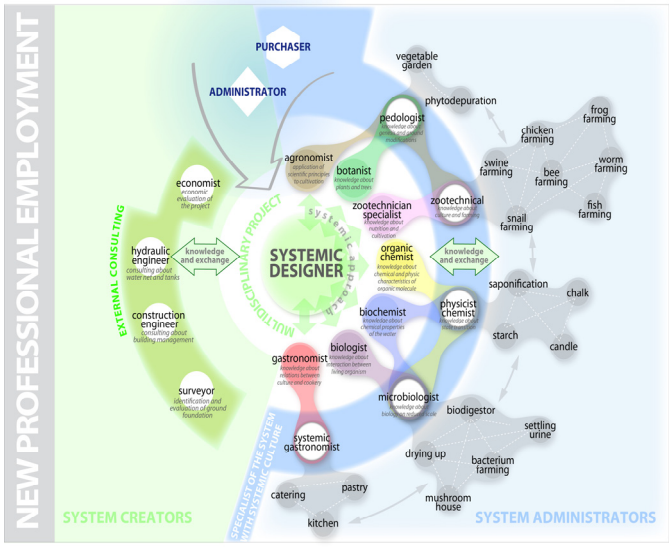

Figure 3: The role of the systemic designer, case study of a jail in Turin, Italy. Project of some students of the Master course "Systemic Design", Politecnico di Torino, 2011-2012

The straightness of the social, cultural and environmental factors shift the industrial approach from a "linear model", characterized by the competition among parts, to a "systemic model", defined by the co-operation among stakeholders.

In this process multiple disciplines and seemingly unrelated aspects of design are integrated in a manner that permits synergistic benefits to be realized [11].

FUTURE RESEARCH

We introduced a method for the development of products that are highly connected with the local characteristics.

However the practical-aspects have not been analyzed in this paper. Because of this reason, possible future developments can be:

- *The analysis of the role of the consumer, which should be educated in order to appreciate the "surplus value" of a product connected to the territory.*
- *The development of a "consumption model", based on the valorization of local values and territorial aspects.*

- The application of this methodology in a case study, in order to study the real consequences that this approach causes to the products' design process.

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REMOTE CONTROL OF INDUSTRIAL ROBOT

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ABSTRACT: *The aim of this article is basic overview of actual situation in principles of industrial robot programming and introduction of simple extended remote control principle. Remote control is realized by serial communication port and software in C# programming language. It is used for positioning articulated robot with 5 DOF Mitsubishi RV-2AJ. These industrial robots are usually used for student education to teach robot programming languages. Introduced software provides simple interface to robot program only by mouse control or import trajectory of movement from external position list file. We can set two movements types PTP and CP interpolated linear movement. Remote control software of robot can be used for many special task; we tested reliability by drawing equipment.*
KEYWORDS: *Industrial robot, remote control, robotics*

INTRODUCTION

Continuous advancements and rapid developments of electronics, computing, network and web technologies have been much concerned in recent period of time. The emerging technologies including teleoperation, communication and control via web, visual servo control and so forth, have induced high motivation and demand towards the researchers who belong to conventional control and robotics [1]. Standardized industrial robots are usually limited to control by robotics programming languages. This is an area where can started some research in alternative control by another principles or remote control.

INDUSTRIAL ROBOT PROGRAMMING PRINCIPLE

Due to the highly proprietary nature of robot software, most manufacturers of robot hardware provide their own software. While this is not unusual in other automated control systems, the lack of standardization of programming methods for robots does pose certain challenges. For example, there are over 30 different manufacturers of industrial robots, so there are also 30 different robot programming languages required. Fortunately, there are enough similarities between the different robots that it is possible to gain a broad-based understanding of robot programming without having to learn each manufacturer's proprietary language. The most used industrial robot programming languages are MOVEMASTER, MELFA BASIC 3, 4 (MITSUBISHI), V+, KUKA-KRL, RAPID (ABB), VAL (Staubli), KAREL (Fanuc). New standardized robotic language is "Industrial Robot Language" - IRL (DIN 66312), but there is a lack support from robot producer support [3].

MISTSUBISHI RV-2AJ INDUSTRIAL ROBOT DESCRIPTION

There are described basic features of used industrial robot in our research. The RV-2AJ is 5-axis compact arm design coupled with its enhanced motion controller and servo amplifiers, rated at 2 kg with a 3 kg maximum payload, 410 mm reach, 2100 mm/sec Speed, +/- 0.020 mm repeatability. A main body weight of less than 20 kg and AC servomotor reduces all axis outputs to less than 50 W. Control unit is based on 64 bit CPU RISC/DSP. Used industrial robot with control system and teach pendant is shown in the Figure 1.

Figure 1. Mitsubishi RV-2AJ, CR1 control unit, teach pendant

DESCRIPTION OF REMOTE CONTROL PRINCIPLE

This remote control design of the industrial robot was applied because its ability to be easily modified and used in other application. Another reason, why we decided to use Assembly Industrial Robot Mitsubishi RV-2AJ [6] was that the robot has been accessible in our department and is available on many universities in education system. In addition, the industrial robot is enough precise for different special task, measuring, drawing manipulating with small parts. Next advantage is auxiliary DOF in effector which can be used to setup angle, position or load during special operation in comparing to standard linear manipulator. The system consists of industrial robot RV-2AJ, control system CR1, extended device and external control application in programming language C#. Figure 2 shows block communication scheme of device.

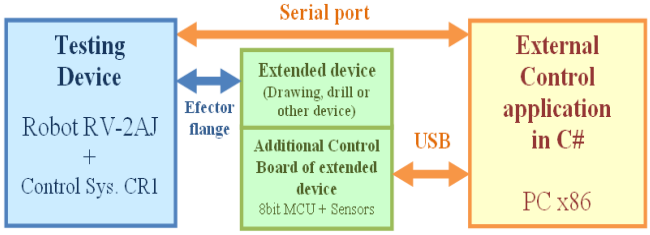

Figure 2. Communication scheme of Remote industrial Robot control system

Control Unit CR1 [7] provides serial port for communication with external application. Addition Control board can send extra information about extended device status from many sensors by

USB/UART interface. Figure 3 left shows simulated trajectories of testing device for 1 or 2 joint together, Figure 3 right shows first testing of generated trajectories on real device with drawing holder in scale 5:1 to real device. The speed of industrial robot is possible to modify before the program was executed for CP and PTP separately. Testing of final position robot movement is tested by loop. Precision of whole system is derived from industrial robot, repeatable precision is ± 0.02 mm.

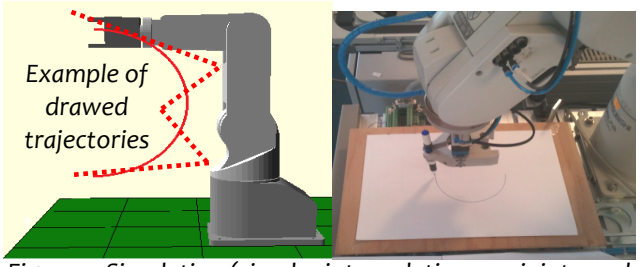

Figure 3. Simulation (circular interpolation one joint – red line, linear interpolation two joints together – dotted line), testing of remote control by drawing accessories

SOFTWARE PART OF SOLUTION

Principle of trajectory programming for standard industrial robot is primarily based on before known number of Points (Positions). These points are stored to robot memory through teach pendant console. Program is created offline and is loaded to control system by serial port. We need faster and dynamic method for create Robot program and Points definition. That was a main reason for development of new external Robot control application. Our program provides dynamic robot programming. This possibility is defined trajectory by selecting Point in graphic area adapted to Robot workspace. There is possible dynamically change number of cycles. Principle of remote control Robot is using internal system command for control system and command for Robot.

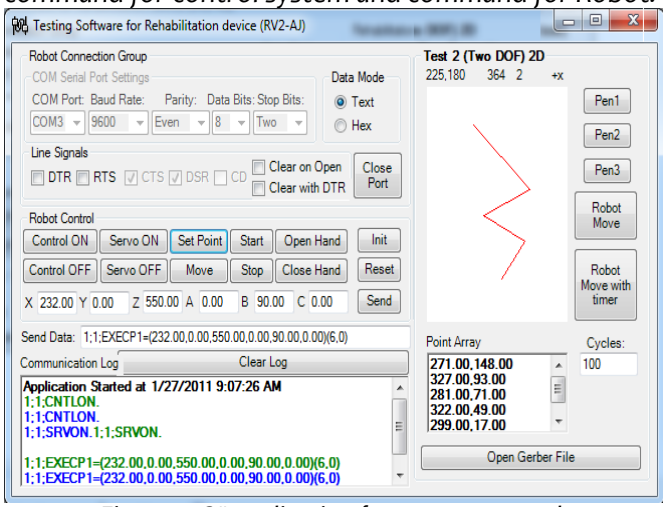

Figure 4. C# application for remote control of industrial robot

There is described minimal sequence for testing device: robot control system activation "1;1;CNTLON." and servomotor enable command "1;1;SRVON.". After the initial activation is done, we can use classical commands for robot programming MelfaBasic4, but with command prefix "EXEC", for example. "1;1;EXECMOV P1". The control program is working remote, that is reason why we must get periodically information about control and robot state, "1;1;STATE". Request for actual control system state is sent every 100 ms. The Figure 4 shows control application for remote robot control.

CONCLUSIONS

The main task of this article was to introduce simplified system of remote programming for industrial robot. Introduced remote control doesn't need any additional modification in current hardware of industrial robot only addition of serial port connected computer and grip pen for testing. Solution can be used as first step in industrial robot programming education because many of these industrial robots are established on the different universities. Reliability check of testing system was done with simulation program and trajectories were checked with drawing jig scaled in XY plane. The Current solution only log robot state to text file during movement in fixed interval. Next works on the solution will be implementation database to store complex data (robot state, sensor data) from testing process for next result processing. Next works on the project can be extending remote control by camera vision system.

Acknowledgments

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RE-UTILIZATION OF MOLDING SANDS PREPARED WITH SYNTHETIC RESINS BY CLAY ADDITIONS, WITHOUT COMPLEX RECLAIM OPERATIONS

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ABSTRACT: *There is poor information in the literature written on this theme, regarding the re-utilization without regenerating operations of the moulding sands prepared with synthetic resins. In practice, these methods have a lot of difficulties regarding the separation of moulding sands with organically bonding agents in comparison with the sands prepared with non-organically agents. The re-utilisation of moulding sands based on resins without technological regenerating processes is not to be applied in the practice of the preparation with resins. Therefore is intended a re-utilisation of these moulding sands, with non-organically bonding agents (clay), replacing thus, partly, with new sand. The industrial foundry practice showed that this method could be applied with good results to any type of mould based on the organically bonding agents.*
KEYWORDS: *foundry processes, molding sands, synthetic resins, non-organically bonding agents (clay), re-utilization*

INTRODUCTION

In the specialty literature there are just a few articles regarding the re-utilization without reclamation of molding sands with synthetic-resins. This situation cannot be explained through the hardships regarding the separation of the molding sand with organic binder from the molding sand with inorganic binder, because all the references regarding the thermal reclamation processes confirm that the two qualities of molding sand are separable at rapping.

To adopt some complex reclamation installations, used for all kinds of molding and core sands, in our foundries with medium modernization and partially mechanized, would be conditioned by the economical and financial problems. From these aspects we can start any calculus regarding the efficiency and profitability in foundries, this being precisely the reason that experts in these arias try, in any way, to utilize and re-utilize all the starting materials they have, in order to obtain the highest efficiency for the installations, equipments and aggregates existing in foundries, with a minimal financial effort and without decreasing the quality of cast pieces.

The re-utilization of molding sand prepared with organic binder, especially with synthetic resins, without any reclamation operation, is not particularly used in practice for a new resins molding preparation. For these reason it is attempted, in our foundries, as a new technological method, the re-utilization of these molding sands, using the inorganic binders (clay, bentonite and/or sodium silicate) instead of the synthetic resins. Practically, it is attempted to obtain a sample of molding sands re-used with synthetic resins and an inorganic binder, the molding used replacing the new sand from the composition of the freshly prepared mixture.

PRESENTATION OF THE WORKING METHOD

The most common flaws in foundries are adhesions that occur in the ferrous alloys pieces, which require more manual labor in the cleaning sectors for their removal. In order to prevent adhesion appearances, especially the chemical ones, predominantly at the steel pieces cast, there are two technological possibilities:

- *To add, at the preparation of the molding sand, some materials that create a decreasing atmosphere at the metal – mould contact surface, in this way preventing the formation of basic oxide in liquid metal or even the reduction of the already formed oxides. As a reduction material one can use coal, mazout or Diesel oil*
- *To use some basic refractory or neutral materials in the sample molding sand, materials that don't interact with the basic oxides from the cast liquid alloy.*

Due to the fact that basic refractory materials are more expensive, their purchase by the foundries is only a technology foresight for the future. In these conditions, the first method remains as a possibility to avoid the appearance of adhesion, explicitly the utilization in the prepared moldings of the organic materials that produce a film with reduction gases at the metal – mould contact surface.

In the performed researches used molding sands, binders with synthetic formaldehyde resins were utilized. Such molding sand has in its composition, if it is well sorted, only acid refractory material (SiO_2) and a quantity of synthetic resin that didn't burn during the previous cast, but it is still sufficient to produce the reduction gas film. It can be stated that the used molding with synthetic resins has a superior quality than the new sand, because the used mould also contains the organic material necessary to produce the reduction gas film.

Research were done regarding the re-utilization of molding sand with synthetic resins, adding as a binder organic material (clay), witch is an classic binder and is normally found in any of our foundries. In this paper

are presented the data regarding the laboratory experiments performed in order to realize this study, as well as a series of graphic representations of the permeability of the analyzed molding sands.
Also, tests were done in order to determine the compressive strenght resistance of the molding sands bound with various clay, bentonite or sodium silicate percentage. The tests take into consideration the various degrees of the humidity for the laboratory prepared molding sands.

MOLDING SANDS WITH SYNTHETIC RESINS RE-UTILISED AFTER CLAY ADDITIONS

The material obtained from moulds with synthetic resins, degraded before casting (that are not introduced in the casting process), as well as the moulds that participated in the casting, served as support for the pieces obtained in this way. These used mixtures were re-used in the casting processes, without any reclamation operation necessary, only a simple addition of organic binder, in different percentages and at a certain humidity degree, after an initially crushing. All operations are realized with the equipment already existing in the foundry, regardless of the mechanization level.
During experiments, resins molding sands were prepared, mechanically degraded (crushed) before the cast, witch haven't been introduced in the casting process. This unburned moulds have been crushed in a mixer, and clay with binder was added to the sand resulted from this operation, in order to prepare a sample mixture. There were also used molding sands ready for casting, but unused in it, because at the laboratory analyses they presented a higher content of binder and didn't meet the plasticity conditions.

METHODS

The clay content influence over the molding properties was studied on separate laboratory prepared mixtures, in witch the clay content was gradually increased. In this way, there were prepared experimental mixtures with 5%, 10%, 15%, 20% and 25% clay as a new binder. For every different content of the clay there were tests performed with 3...15% water content.
In order to comparatively study the results there were also performed studies regarding the properties of the molding sands based on the new sand bound with clay.

RESULTS AND DISCUSSIONS ON THE COMPRESSIVE STRENGHT STRENGTH

In Figure 1 the graphics of the resistance variation at the compressive strength is presented in green (undried) state, for the molding sands based on crushed moulds, for different clay percentage.
Figure 2 render the graphics of the resistance variation at the compressive strength, in wet state, for different clay percentage.
For comparison, in Figure 3, respectively in Figure 4 the graphics of the resistance variation at the compressive strength are presented in green (undried) state and in dried at 200° C for the mould sands based on new sand bound with different clay percentage.

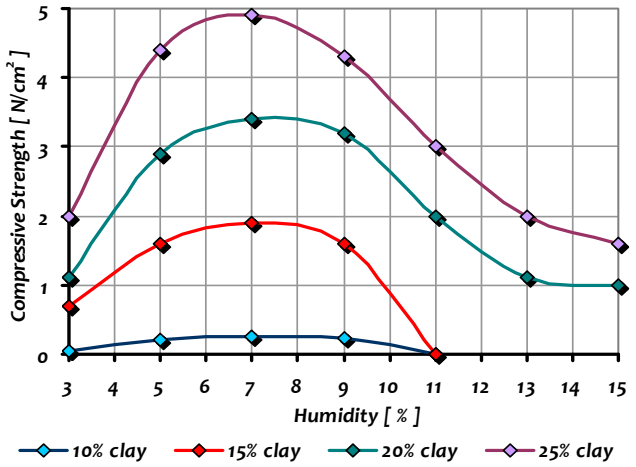

Figure 1. The resistance variation at the compressive strength, in green (undried) state, for the molding sands based on crushed moulds, for different clay percentage (5%, 10%, 15%, 20% and 25% clay)

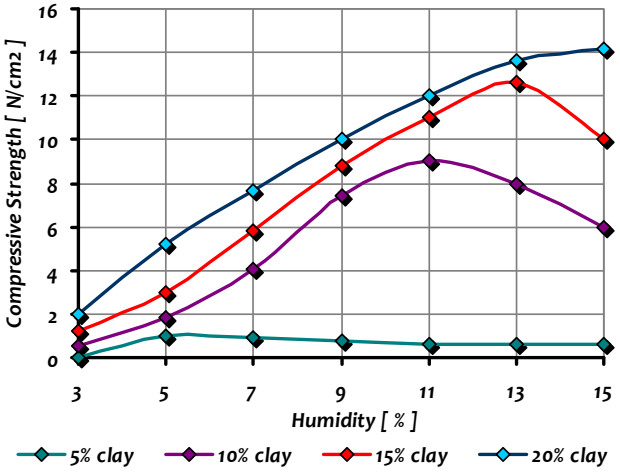

Figure 2. The resistance variation at the compressive strength, in wet state (3...15%), for different clay percentage (5%, 10%, 15%, 20% and 25% clay)

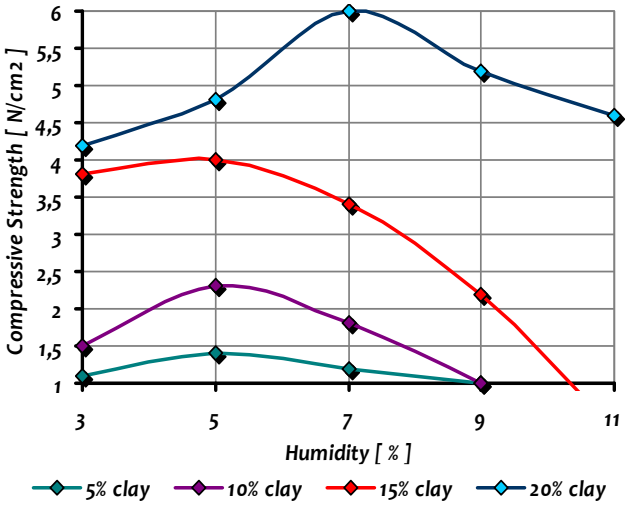

Figure 3. The resistance variation at the compressive strength in green (undried) state for the mould sands based on new sand bound with different clay percentage (5%, 10%, 15% and 20% clay)

In Figure 5 the graphics of the resistance variation at the compressive strength is presented, in green (undried) state, for the mould sands based on used mould sand (totally burned), for different clay percentage.

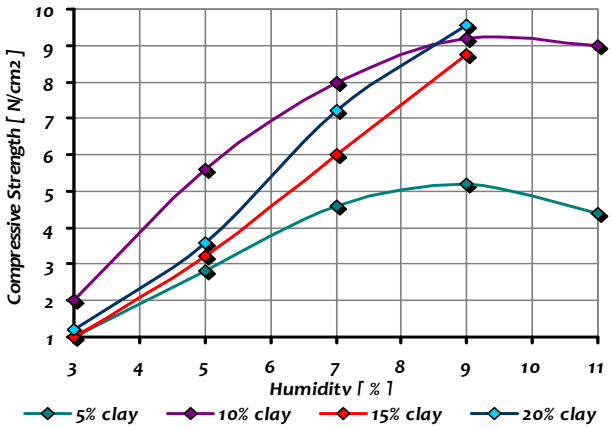

Figure 4. The resistance variation at the compressive strength are presented in dried at 200° C for the mould sands based on new sand bound with different clay percentage (5%, 10%, 15% and 20% clay)

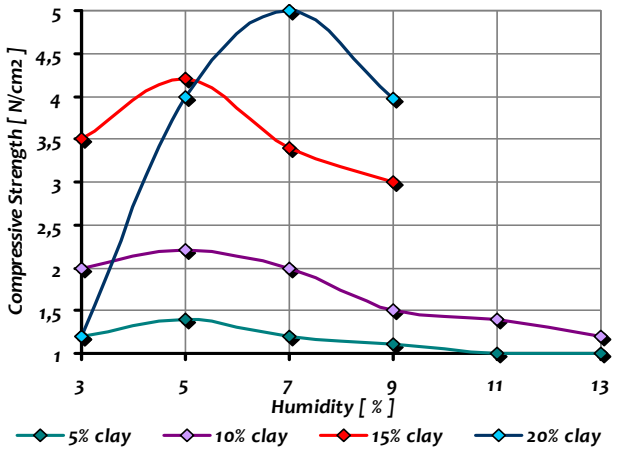

Figure 5. The resistance variation of the compressive strength, in green (undried) state, for the mould sands based on used mould sand (totally burned), for different clay percentage (5%, 10%, 15% and 20% clay)

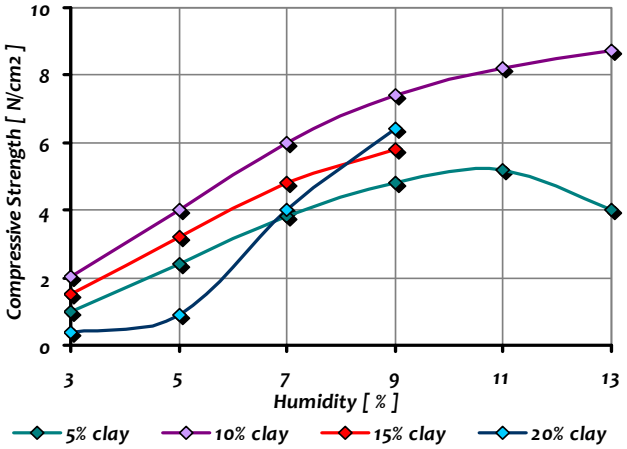

Figure 6. The resistance variation at the compressive strength, in dry state, for different clay percentage (5%, 10%, 15% and 20% clay)

Figure 6 render the graphics of the resistance variation at the compressive strength, in dry state, for different clay percentage.

RESULTS AND DISCUSSIONS ON THE PERMEABILITY

In Figure 7 the graphics of the permeability variation is presented in green (undried) state, for the molding sands based on crushed moulds, for different clay percentage.

The Figure 8 renders the graphics of the permeability, in wet state, for different clay percentage.

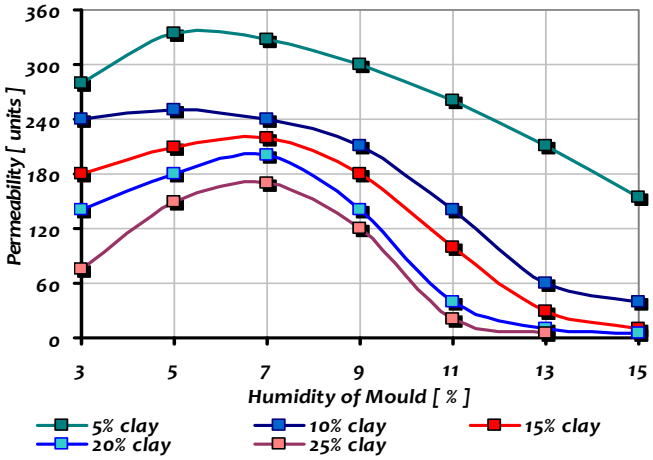

Figure 7. The permeability variation in green (undried) state, for the molding sands based on crushed moulds, for different clay percentage (5%, 10%, 15%, 20% and 25% clay)

For comparison, in Figure 9, respectively in Figure 10 the graphics of the permeability are presented in green (undried) state and in dried at 200° C for the mould sands based on new sand bound with different clay percentage.

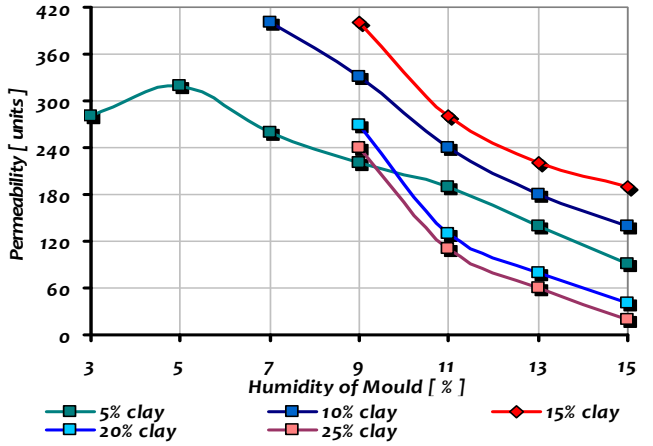

Figure 8. The permeability, in wet state, for different clay percentage (5%, 10%, 15%, 20% and 25% clay)

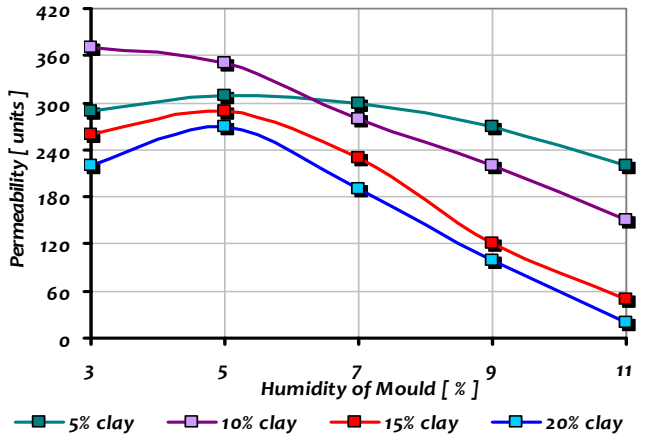

Figure 9. The permeability in green (undried) state for the mould sands based on new sand bound with different clay percentage (5%, 10%, 15% and 20% clay)

The Figure 11 renders the graphics of the variation of the permeability is presented, in green (undried) state, for the mould sands based on used mould sand (totally burned), for different clay percentage.

The Figure 12 renders the graphics of the permeability, in dry state, for different clay percentage.

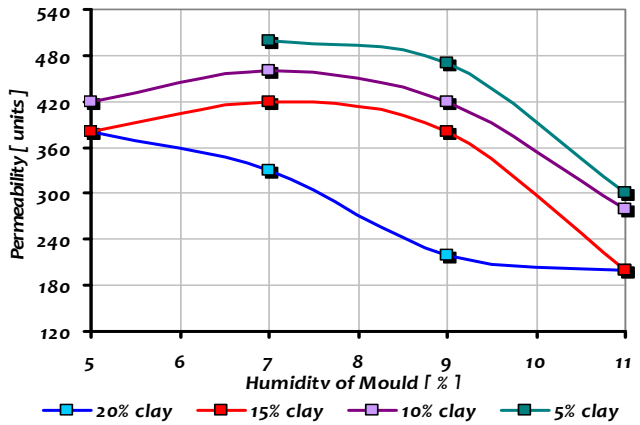

Figure 10. The permeability in dried at 200° C for the mould sands based on new sand bound with different clay percentage (5%, 10%, 15% and 20% clay)

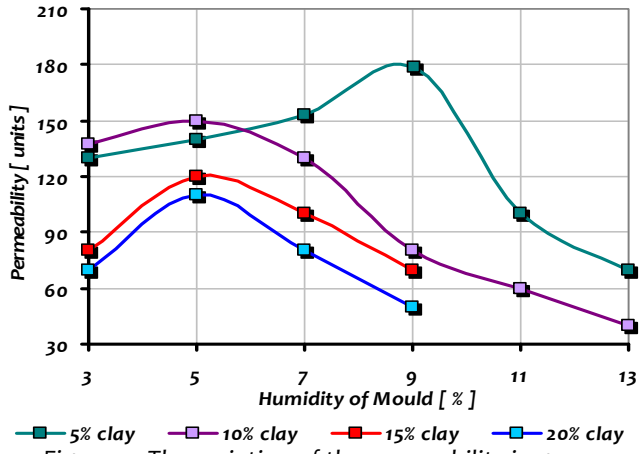

Figure 11. The variation of the permeability in green (undried) state, for mould sands based on used mould sand (totally burned), for different clay percentage (5%, 10%, 15% and 20% clay)

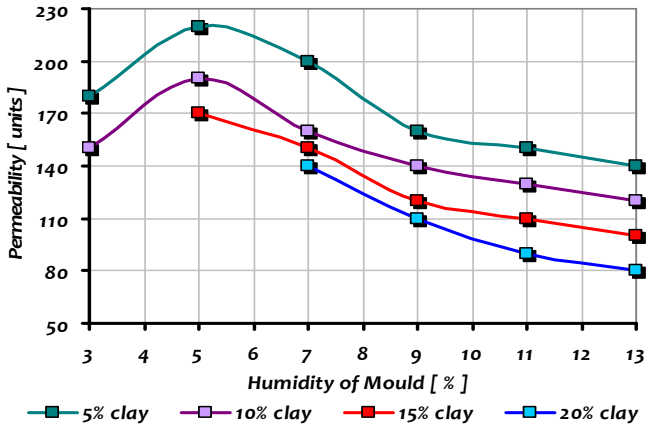

Figure 12. The permeability, in dry state, for different clay percentage (5%, 10%, 15% and 20% clay)

CONCLUSIONS REGARDING THE RESULTS

We can conclude the following:

- *Researches performed in order to obtain a sample mixture, starting from a mould sand based on synthetic resins and bound with clay at the re-utilization, were extremely conclusive regarding the compressive strength resistance, in both green (undried) and dry state;*
- *Results were also conclusive regarding the second characteristic studied – mould sand permeability;*
- *Mould sands, based on granular material obtained fro moulds with synthetic resins, as a basic refractory material and an organic binder (clay) can be used as a sample mixture for both green (undried) moulds, as well as for dry moulds for steel, iron and non-ferrous alloys castings;*
- *Starting from the economical calculation performed in our foundries, the cost of the studied molding mixture is lower then the one obtained from the mixture based on new sand and inorganic binders;*
- *The good results obtained in the laboratory stage recommended these experimental processes for the industrial practice of the molding sectors from our foundries, as well;*
- *The industrial practice proved that the surface of the cast iron pieces in the moulds made from these mixtures is superior to those cast in moulds based on new sand and inorganic binders;*
- *Mould sands, based on granular material obtained fro moulds with synthetic resins, as a basic refractory material and other classic organic binders (bentonite or sodium silicate) can be used in steel, iron and non-ferrous alloys foundries.*

All these lead to the successfully implementation in our foundry practices of these molding technologies, without any used mixture reclamation operation necessary.

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SIMULATION OF THE RESULTING INTENSITY DISTRIBUTION BY MULTI-BEAM INTERFERENCE OF AN ULTRA-SHORT PULSE LASER

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ABSTRACT: *During the last years, the self-cleaning surface structures of lotus flowers have been reproduced in numerous ways on textiles or paints and other surfaces to reduce sensitivity against pollution which, in turn, allows a reduction of water- and detergent consumption. Unfortunately, some of these techniques suffer from wear or are potentially biohazardous due to the small particle size. We present a method to produce nanostructures on surfaces by multi-beam interference of ultra-short laser pulses. Intensity distributions of various configurations have been simulated and show the feasibility of the suggested process.*
KEYWORDS: *lotus-effect, multi-beam interference, nano-structures, ultra-short pulse laser*

LOTUS-EFFECT

Lotus-effect is the self-cleaning ability of natural surfaces. It is named by Barthlott und Neinhuis [1] after the Lotus-plant, which shows selfsame characteristics. Nearly every ecosystem contains examples of this lotus-effect. Neinhuis and Barthlott did a very complete listing of the natural occurrences [1, 2].

The effect is based on two principles [3]:

Examples in nature show a hydrophobic surface, the so called cuticula, which consists in most cases of wax. This layer increases the interface tension between the leaf and the water droplet. As a consequence, the contact angle between surface and water droplet increases, too. It has been shown that it is possible that such wax layers may erode during plant growth, leaving plant surfaces almost smooth and without water-repellent properties [1].

The other main effect is based on the two-part surface structure:

Burlings (papillae) are placed on the cuticula. The burlings extend to a height up to 5 µm or 10 µm and placed at a distance between 10 µm and 15 µm next to each other. These papillae exhibit finer structures on their surfaces, where the actual nano-structure is superimposed by means of wax crystals. Usually, these crystals show diameters in the order of 100 nm [1].

Several studies have proved that a correlation between the existence of a two-part surface structure and the super-hydrophobic behavior exists. On the other hand, it has been shown that examples in nature exist, which exhibit one-part surface structures in the nanometer range with excellent super-hydrophobic behavior [4, 5].

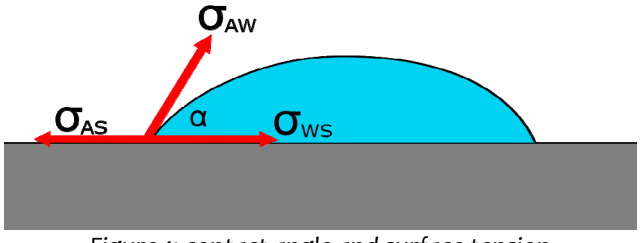

Figure 1: contact angle and surface tension

In any case, the contact area between water droplet and surface is minimized as well as adhesive forces. As a consequence, water droplets on the surface take a more or less spherical from. The contact angle between droplet and surface is used to characterize the hydrophobicity of surface structures.

The relation between surface tension and contact angle is characterized by the Young-Equation [6] (cf. Figure 1):

$$\cos(\alpha) = \frac{\sigma_{AS} - \sigma_{WS}}{\sigma_{AW}} \qquad (1)$$

This equation needs to be extended by the factor r for rough surfaces.r is the ratio between the real (rough) surface area and the area projected from the drop.

$$\cos(\alpha) = r \cdot \frac{\sigma_{AS} - \sigma_{WS}}{\sigma_{AW}} \qquad (2)$$

According to Onda [7], this equation loses its validity for fractal surfaces due to the fact that the right side of the equation increases much faster than one for larger values of r.

The contact angle has to be deduced form the effective surface tension between the fluid and the fractal surface, retrospectively between air and the fractal surface.

$$\cos(\alpha) = \frac{\alpha_{f13} - \alpha_{f12}}{\alpha_{23}} \qquad (3)$$

Onda also showed approximation formulas for the effective surface tension of fractal surfaces, which have been experimental verified. As described by Öner et al. [8], the wettability of surfaces is influenced by contact angle hysteresis, too. The difference between advancing and receding contact angles is important for hydrophobicity, since static contact angle measurements are not able to describe hydrophobic behaviour of surfaces in detail.

ENVIRONMENTAL IMPACT

It is clear that hydrophobic surfaces where pollutants can be removed easily or don't adhere at all have the potential to reduce usage of detergents dramatically.

On the other hand, production processes of hydrophobic surfaces will influence the environment, too.

The expected impact can be divided in two main parts: First at all, usage of materials which exhibit a lotus-effect will definitely influence the environment. Additionally, production processes with its unknown threats in environmental contamination have to be evaluated thoroughly. The process proposal presented here has a chance to influence both.

ENVIRONMENTAL IMPACT OF THE LOTUS EFFECT

The self-cleaning ability of surfaces will of course result in a reduced number of cleaning processes. The lotus-effect itself doesn't depend on any detergents. Therefore, water consumption as well as detergent consumption can be decreased substantially. Furthermore, in the case of outdoor applications where surfaces will be cleaned by rain water it is supposable that cleaning processes can be skipped completely.

The first stage of the presented project aims to produce plastic films with this self-cleaning ability. In further stages it is also planned to adopt the process to textile structures or even fibers. It is intended that the required structures should be produced by means of an ultra-short laser system.

In principle, the structuring off almost any material should be possible. Prior to that, a thorough understanding of the impact of different features and their shape and size is required. Additionally, an adequate laser source in terms sufficient pulse energy and duration and frequency is needed.

ENVIRONMENTAL IMPACT OF THE PROCESS

The conventional way of a hydrophobic finishing - for example for textiles - is a treatment with hydrophobic particles like fluorocarbons or silicon oils [9]. Such processes suffer from some disadvantages:

- *wash resistance of the finish is very limited or can just be guaranteed with large expenses [9]*
- *used chemicals are critical under an ecological as well as under an biological point of view [10]*
- *need of an own process, in case of textiles after the fiber production or after the textile assembly*

Therefore some environmental issues can be avoided if the lotus-effect is used instead of conventional chemicals. Most existing lotus-effect applications rely on a coating of the textile with a finish which contains the nano-particles.

Although no chemicals like fluorocarbons or silicon oils are needed any more, the nano-coating itself is also not harmless: Especially handling of the dry coating can be hazardous.

The danger originates from the particles itself: Due to the small particle size in the nanometer range, the particles are able to penetrate the respiratory system up to the lungs. This is on one hand dangerous cause some particles cannot be removed from the lungs and can therefore cause an immunoreaction. One the other hand, if particles are able to reach the blood circuit, they can evoke systematic damages in other organs [11].

Till now, biological threats which originating from a large scale usage of nanoparticles is not completely understood and especially long term effects cannot be judged. Additionally, nanoparticles can accumulate in the environment with almost unknown implications in the future.

In fact, the evaluation of the environmental impacts of nanoparticles is subject of numerous recent studies (e.g. [12,13, 11]).

The process described here offers the possibility for the production of hydrophobic surfaces without the need for dangerous chemicals and without the need for manipulation of potentially dangerous nanoparticles. The nano-scaled structure will be produced directly onto the surface of the sample and emission of nanoparticles occurs during the use of the product over long periods on low concentrations is avoided.

Moreover, it is expected that the process can be integrated into existing production lines easily. As a result, pollution of the environment is minimized as well as energy consumption of the process. In addition to advantages mentioned already, economic feasibility will be increased, too.

PROJECTED EXPERIMENTS

As already mentioned, an ultra-short pulse laser system will be used for experiments. The laser beam will be divided into several independent beams and interference between different beams will be used to produce the desired structures. The experimental set-up is described below.

The periodic structures for the lotus-effect will be fabricated by the ablation of material caused by interference of laser radiation. Therefore the laser beam will be divided by optical elements into at least two partial beams which will be recombined at the surface of the material.

From basic electromagnetic theory it is known that the total field strength of a combination of different electromagnetic fields is the sum of single field strengths. There sulting superposition of the field strengths of partial beams and since the intensitv is proportional to the square of the field strength, $I \propto E^2$, the intensity includes interference terms:

$$E = \sum E_{o,i} \cdot e^{-i(\vec{k}_i \cdot \vec{r} - \omega \cdot t + \phi_i)} \qquad (4)$$

The resulting field strength and therefore the resulting intensity distribution depend on the wave vectors. Therefore the easiest way to manipulate the resulting structures is to change the angle between partial beams. Further manipulation can be achieved by change of the phase relations or the polarization of the partial beams [14].

Beam separation into two or more partial beams can be done by optical elements like mirrors or grids. Beam guidance is done by mirrors; phase relation of the partial beams can be done with beam delay slides. Figure 2 and Figure 3show an example of a three-beam interference with the resulting intensity.

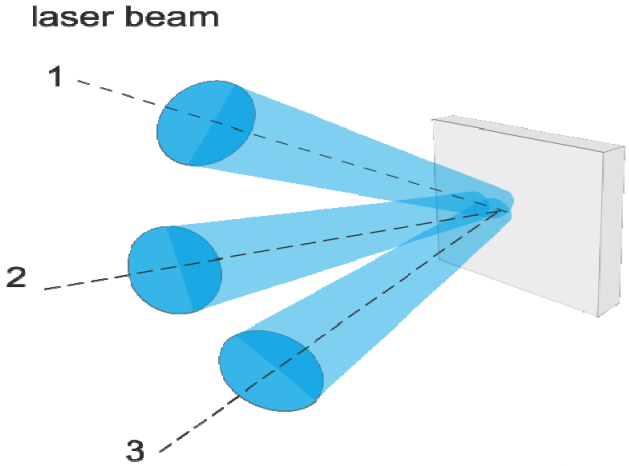

Figure 2: interfering beams under an angle of 120°

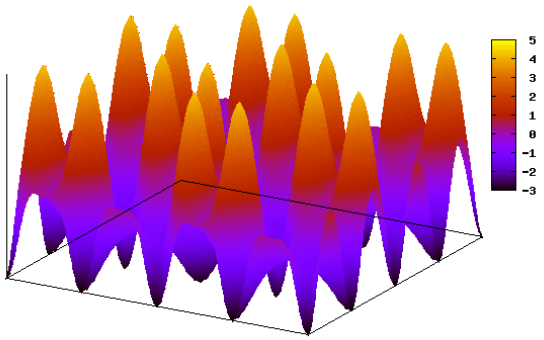

Figure 3: related intensity distribution

TWO-BEAM INTERFERENCE

First experiments will be done with a two-beam interference set-up. These experiments will help to identify the main parameters of the optical system and the laser system used for experiments. They will also help to find suitable methods for the evaluation of the produced structures.

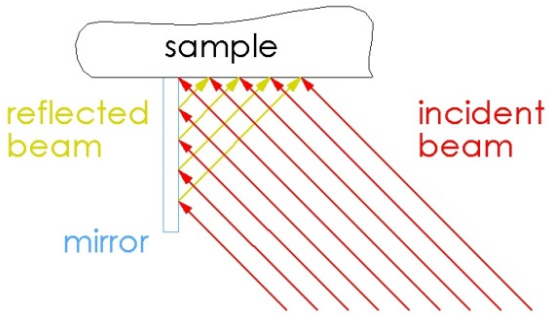

Figure 4: setup of Lloyds mirror

The easiest way of a two-beam interference is Lloyds mirror [14, 15], where a part of a beam interferes with its own reflection. Figure 4 shows the principle set-up. In general, every two beam interference results in a line shaped pattern. The production of grid shaped patterns can be achieved by two exposures, with a rotation of the sample in between.

A simulation of resulting interference pattern can be found in the simulation section.

MULTI-BEAM INTERFERENCE

There are innumerable ways to establish multi-beam interference e.g. with the use of grids, mirrors and beam delay slides in order to change angle and phase relation of partial beams [16], or by the use of a prism, where the incident beam will be divided into four partial beams which interfere at the sample surface, according to Wu et al. [17, 18].

Independent of the solutions used, the diameter of the partial beams has to be as large as possible to provide a huge treatment area. It has been shown by Fucetola et al. and Byun that processing of areas in the range of some mm² up to cm² [19,15] is possible.

The model presented in this paper is based on the so called diffractive variable delay generator (DVDG), presented by Klein-Wiele and Simon [14]. It consists mainly of two diffractive beam splitters followed by an aperture.

Two gratings, which are placed perpendicular to each other act as beam splitter. When the distance between them is adjustable, it is also possible to manipulate the phase relation between the two beam pairs. The angle between the partial beams results of the diffractive elements and the aperture.

The simulation section takes a more detailed view on this solution.

ULTRA-SHORT PULSE LASER

The experiments will be done with a laser with pulse duration in the sub picosecond range and a pulse frequency up to one MHz. Its fundamental wavelength is 1064 nm. SHG and respectively THG modules offer the possibility of emission of the second or third harmonic wavelength, what results in minimized interference pattern sizes. The raw beam diameter is about 1 mm with a beam divergence of 2.5 mrad.

SIMULATION

This section shows the expected interference pattern of the Lloyds mirror setup and the diffractive variable delay generator. The simulationswere done with the open source software Scilab, Version 5.3.3.

Both models include the parameters of the previously mentioned laser. Especially the wavelengths of 1064 nm, respectively 532 nm and 354.7 nm have been simulated.

LLOYDS MIRROR

The angle between sample and beam propagation direction has been defined with 45° in one simulation and 60° in the other. As the model is symmetric, the angle between mirror and beam propagation direction is the same.

A larger angle decreases the distance between the characteristic lines, a smaller increases it and also results in a lower intensity, as the exposed area increases.

The model consists mainly of two beams which propagate in the x-y layer at an angle of 90°, respectively 120°.The resulting intensity distribution has been calculated as the square of the sum of the electrical field $\vec{E}$.

$$E = E_1 \cdot e^{-i\cdot\vec{k}_1\cdot\vec{r}} + E_2 \cdot e^{-i\cdot\vec{k}_2\cdot\vec{r}} \quad (5)$$

$$I \propto E1^2 + E1^2 + 2E1E2\cos[(k1 - k2)r] \quad (6)$$

Amplitudes E_1 and E_2 were set constant to 1. The position vector goes from 0 to 5 µm in x- and y-direction; z-direction was set to 0. The considered wavelengths are inserted into the calculation through

the wave vector k, as its absolute value was set to $\frac{2\pi}{\lambda}$.

Figure 5 to 7 show the resulting intensity distribution with the first, second and third harmonic wavelength and an angle of 90° between incident and reflected beam:

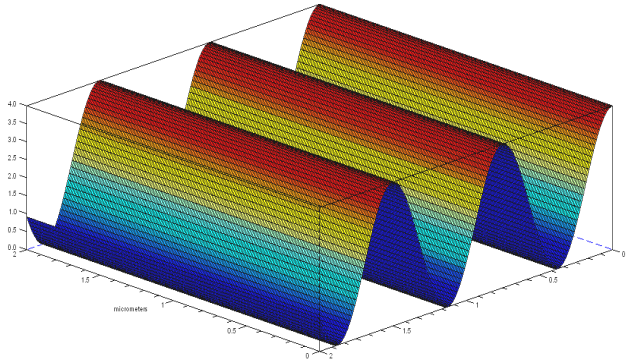

Figure 5: 90°, λ=1064 nm

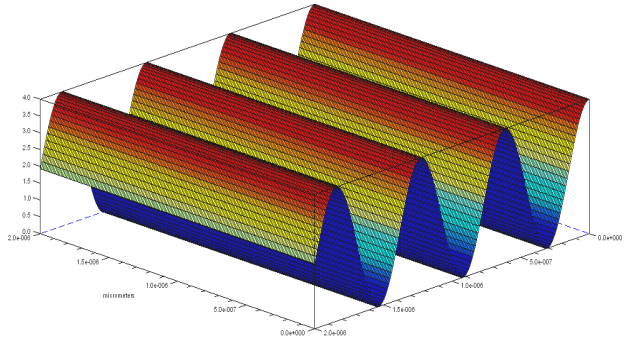

Figure 6: 90°, λ=532 nm

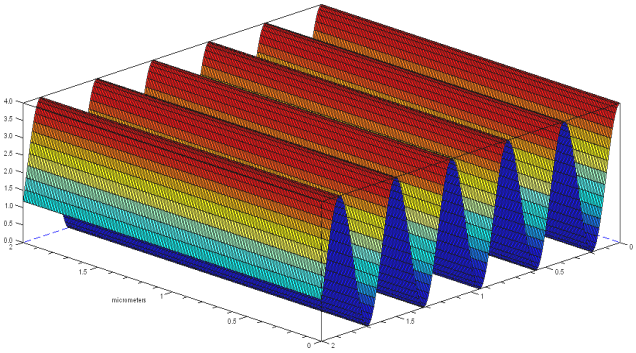

Figure 7: 90°, λ=354.7 nm

Figure 8 to 10 show selfsame with an angle of 120° between the partial beams.

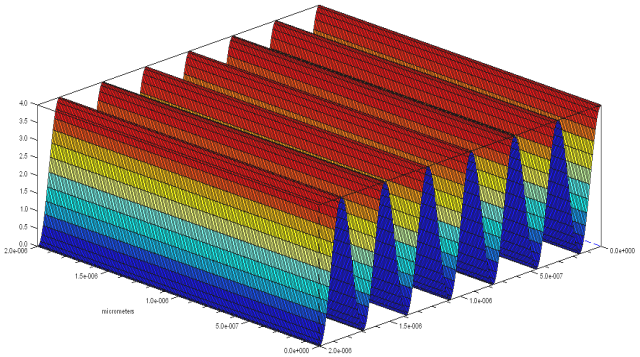

Figure 8: 120°, λ=1064 nm

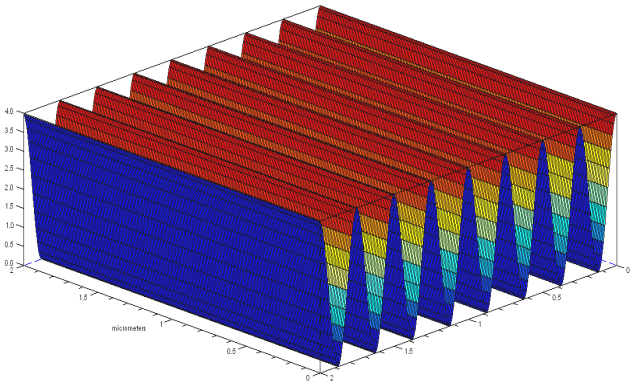

Figure 9: 120°, λ=532 nm

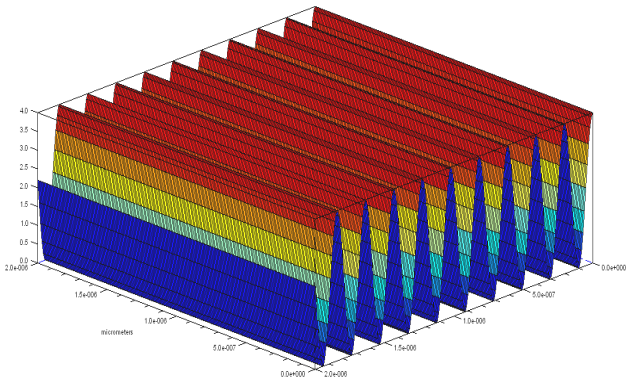

Figure 10: 120°, λ=352.7 nm

DIFFRACTIVE VARIABLE DELAY GENERATOR

The second model shows the possibilities of the diffractive variable delay generator.

At the beginning, the simplest experimental set-up has been simulated: two perpendicular pairs of beams without phase shift. First simulation has been done with an angle of 90° between the partial beams of each pair, the second simulation with an angle of 120°. Both configurations have been simulated with the first three harmonic wavelengths. Resulting intensity distribution includes between all four involved beams.

$$E = E_1 \cdot e^{-i\cdot\vec{k}_1\cdot\vec{r}} + E_2 \cdot e^{-i\cdot\vec{k}_2\cdot\vec{r}} + E_3 \cdot e^{-i\cdot\vec{k}_3\cdot\vec{r}} + E_4 \cdot e^{-i\cdot\vec{k}_4\cdot\vec{r}} \quad (7)$$

$$I \propto E^2 \quad (8)$$

Figures 11 to 13 show the resulting intensity distribution with an angle of 90° between the partial beams with the first three harmonic wavelengths:

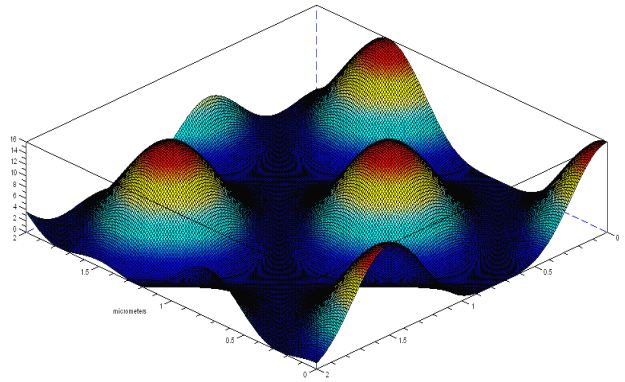

Figure 11: 90°, λ=1064 nm

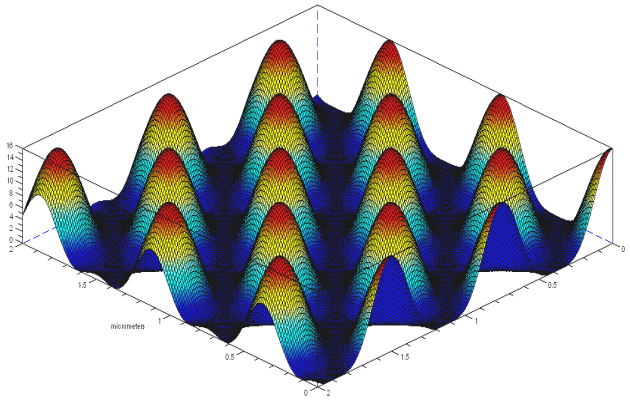

Figure 12: 90°, λ=532 nm

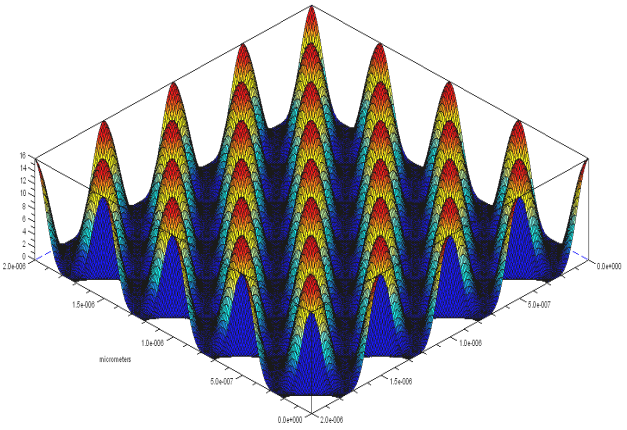

Figure 13: 90°, λ=354.7 nm

Figures 14 to 16 show simulation results with an angle of 120° between partial beams:

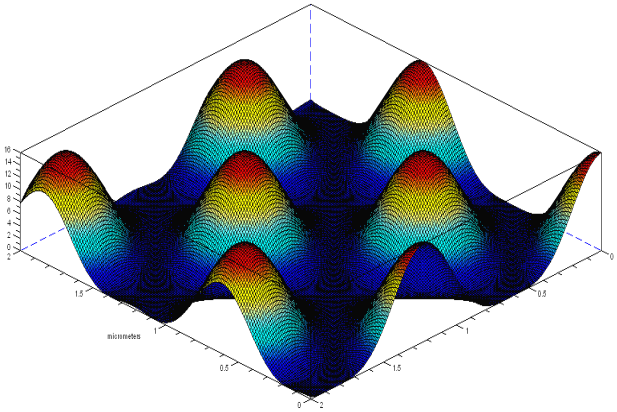

Figure 14: 120°, λ=1064 nm

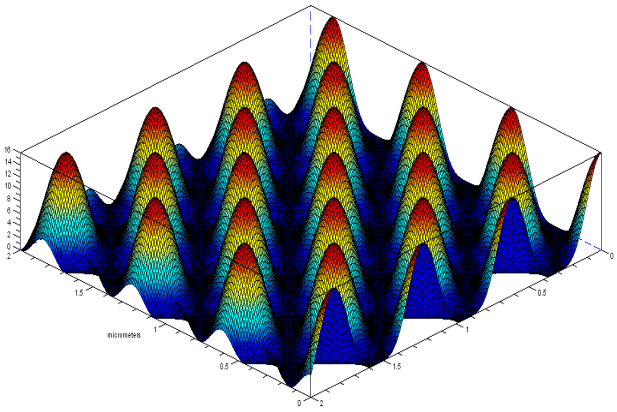

Figure 15: 120°, λ=532 nm

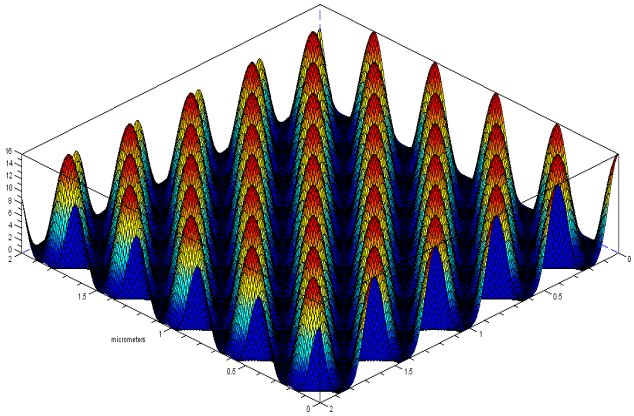

Figure 16: 120°, λ=354.7 nm

DISCUSSION AND OUTLOOK

First simulations show the feasibility of the fabrication of nanostructures in order to create a lotus-effect by multi-beam interference of ultra-short laser pulses.

As the simulation results with Lloyds mirror indicate, it seems possible to produce line-like structures with a width of about 100 nm, depending on wavelength and interference angle. A rotation of the sample after the exposure and a subsequent exposure should induce a grid shaped structure with a mesh size of about 100 nm x 100 nm. The model has to be extended to demonstrate this.

Simulation results achieved based on the model of the diffractive variable delay generator indicates that the fabrication of a grid with a mesh size of 200 nm x 200 nm in one step is possible. As a next step, the model will be extended by a phase shift between the two beam pairs, as Klein-Wiele and Simon [14] have shown a strong dependency of the pattern on the phase relations.

The model can also easily be extended by additional partial beams, which results in different features of the pattern.

Further simulations are necessary to estimate possible structures and their consequences on the wetting behaviour of samples. Additionally, the model has to be extended by material properties and absolute values of the optical intensity to clarify the dimensions of the resulting structures. Optical elements also have to be included to estimate the size of exposed area. Till now, polarization states as well as intensity distributions of real laser beams are not considered in simualtions presented here. Additional work has to be done to include all mentioned features. Nevertheless, results indicate a promising possibility for the production of nano-sized structures.

As next step, experimental verification of simulation results is of utmost importance. Based on these first experiments, a rough calculation of expected costs and energy consumption has to be done to estimate ecological as well as economic benefit.

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USE CA SYSTEMS IN INDUSTRY

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ABSTRACT: *This article describes the use computer supported systems in practise. CA systems supported activities in all stages of production – from design region and construction, through production and finally mounting, storage and expedition. These systems represent very effective tool in region before-production and production stages in this time. They represent tool which can increase company´s market position.*
KEYWORDS: *CA technologies, CAD/CAM systems*

INTRODUCTION

Manufacturing companies are under the influence of strong home and foreign competition which still increase with globalization of market industry. This situation is forcing producers to adapt to new situations and react for requirements of clients. Flexibility is subject to production flexibility on the market, shortening production cycle of products but with increasing product quality, the same prize and cost reduction. For these requirements individual subjects must introduce CA technologies which are important for performance difficult requirements on the product, his quality and function, requirements for increased productivity, increased claims on the production system flexibility, fast change of production assortment. They are use in different sector of industry and different levels of management. In this time on the market are a lot of CA systems which have important influence on the industry production. The most common computer aided systems are CAD/CAM systems.

CAD SYSTEM

*CAD (**C**omputer **A**ided **D**esign) systems represent computer design or computer aided design components, computer aided design models and computer aided of design documentation. It is the equipment for geometric and mathematical modelling components and their characteristic.*

CAM SYSTEM

*CAM (**C**omputer **A**ided **M**anufacturing) systems represent systems for the preparation of data and programs for management the Numerical Control Machine for automatic production of mechanical components, the all report and for the electronic circuit. When we apply Cam systems, we use mainly geometric and other data which were obtained in the computer design stage components or the all product by CAD system.*

CAM as complex computer aided manufacturing includes these activities:

- *Controls of entry to manufacturing*
- *Plan of manufacturing*
- *Collection of production data*
- *Monitoring of production process*
- *DNC, CNC and NC control*
- *Robots and manipulators*
- *Flexibility transport system*
- *Manufacturing units*
- *Management tool*

CAD/CAM SYSTEM

- *Sign of system used for production when design of product and production management is by the computer*
- *Originally developed for engineering*
- *Now is by computer aided system design with integrated and production component*
- *He represents the first real integration between CA systems, mainly between CAD and CAM systems. Sometimes is uses abbreviation CADM (**C**omputer **A**ided **D**esign and **M**anufacturing). System CAD/CAM integrates modelling component and his construction design, technological design documentation in the form NC programs and operation control of production into a single computer system*
- *The benefits this integration system is his ability to solve complex and difficult tasks. Integration parts of CAD/CAM system is product model and the internal database system*
- *The term CAD/CAM represents technology which use numerical computer to perform certain functions in before-production stages and in the production itself. This technology represents the integration of the preparation and production processes in all industrial activities*

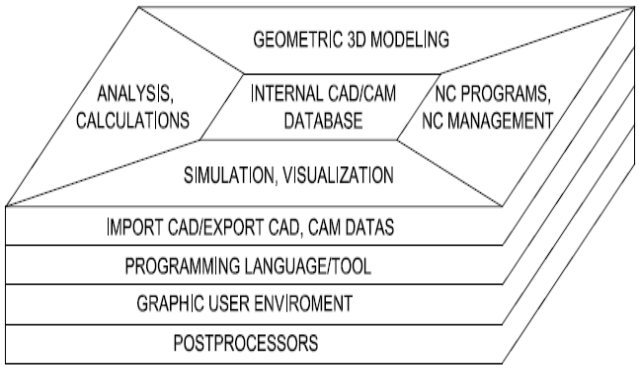

Figure 1. Scheme of CAD/CAM system

Benefits of the deployment CAM/CAD systems:

- *Shorten product development cycle*

- Simplify and speed up calculations, possibility of making the complex calculations
- Simplify and speed up construction of technical documentation
- Possibility of the construction the simple complex, creation of the complex shapes and whole report used for the montage and making of the installation producers
- Generate CL data and making of the NC programs – the system application is presented to model the shape of the product that was created in an environment and then technological parameters are assigned and they are necessary to generate tool paths. The exit can be directly control the program for a particular type of machine or CL data and postprocessors are modified NC program format for the particular control system.
- Analysis and simulation of the products under load and use, but simulation and optimization of the machining process, too.
- This system can be use as a control mechanism to detect functional or errors of the proposed mechanism. When propose design has errors, is there possibility fast and effective adjustments.
- Choice and effective use of the materials.
- Minimize of the errors which are caused by human

These privileges are sufficient to guarantee for the use CAD/CAM systems in the individual companies.

The most important represents in the group CAD/CAM systems are:

- Creo Elements/Pro
- NX Unigraphics
- Catia

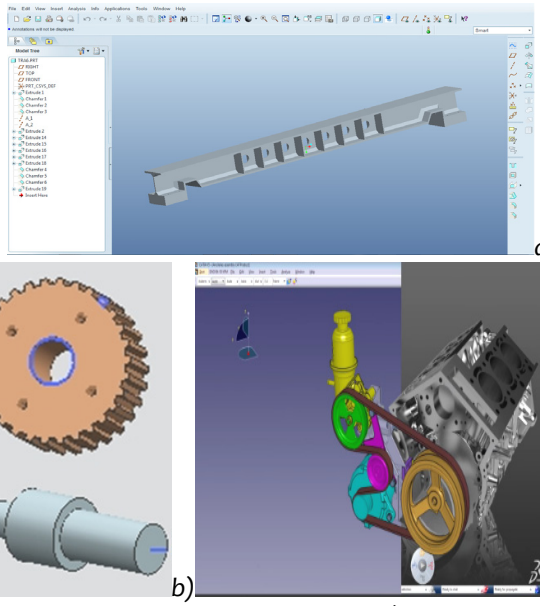

Figure 2. Examples of possible systems a) Creo Elements/Pro b) NX c) Catia

CONCLUSIONS

Nowadays production subjects cannot be a long successfully without a technically advanced system, his fast and effective development and production. Just because is needs an effective introduction of the CA technologies.

This article describes the functioning integration CA systems – CAD and CAM systems. Using these systems represent the important factor of successful and the future a business from shortening production cycle of product, through his design and finally his transport to the customer with the small cost. And from the company and her reacts to the effective and flexibility production for the requirements on the customers, too. For these requirements are important CAD/CAM systems and the other CA systems, which represent the important tool for increasing productivity, the rationalization of work, increase accuracy and reducing the cost of the production in the business.

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COMPUTATIONAL FLUID DYNAMIC ANALYSIS OF MISSILE WITH GRID FINS

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ABSTRACT: *This paper presents the results of a study demonstrating an approach for using aerodynamic coefficients for a missile with grid fins. A grid fin is an unconventional lifting and control surface that consists of an outer frame supporting an inner grid of intersecting planar surfaces of small chord. The calculations were made at a mach number of 0.2 and angle of attack 0° for a missile with grid fins. The simulations were also successful in calculating the flow structure around the fin in the separated-flow region at the higher angles of attack. This was evident in the successful calculation of the nonlinear behavior viscous computational fluid dynamic simulations to calculate the flow field and for that fin, which showed negative normal force at the higher angle of attack. The effective angle of attack is negative on either part of the entire top grid fin for the higher angle of attack. The modeling of unconventional grid fin missile is done in CAD software called CatiaV5. The meshing of geometry is in a pre processor called Gambit. And the solving and post processing is done in a solver called Fluent.*
KEYWORDS: *aerodynamic coefficients, grid fin, CatiaV5, Fluent*

INTRODUCTION

Over the years much of the research efforts are directed to improve the aerodynamics of flows in the unconventional grid fin missile by conducting experimental and theoretical studies. This led to the formulation of empirical models, which established a relationship with parameters like Mach number, pressure, aerodynamic coefficients to the overall performance of the missile [1]. But due to the growing demand for high performance and reliable unconventional grid fin missile more fundamental approach viz. evaluation of flow fields, aerodynamic coefficients and species concentration throughout the domain of interest is needed. Hence the development of computational methods for predicting flow fields in unconventional grid fin missile has evolved. Investigations have been carried out earlier through experimental, theoretical and CFD methods by many investigators in this particular area [4].

The Guidance system is that part of a missile which decides when, and by how much, the control system must change the trajectory of the missile. A system which evaluates flight information, correlates it with target data, determines the desired flight path of a missile.

GRID FINS

Grid fins have some advantages over conventional, planar fins. One advantage is the ability to maintain lift at higher angles of attack since grid fins do not have the same stall characteristics of planar fins. Another is the very small hinge moment, which can reduce the size of control actuator systems. Since curvature of the grid fins had little effect on their performance, folding down the fins onto the missile body is a storage design advantage [10]. The main disadvantage was higher drag than that of planar fins, although techniques for minimizing drag by altering the grid fm frame cross-section shape were demonstrated (Miller and Washington 1994). These studies also showed that grid fins experience a loss in control effectiveness in the transonic regime due to flow choking in the individual cells [9].

DESIGN CHARACTERISTICS

Conventional "planar" control fins are shaped like miniature wings. By contrast, grid fins are a lattice of smaller aerodynamic surfaces arranged within a box. Their appearance has sometimes led them to be compared to potato mashers or waffle irons.

Grid fins can be folded against the body of a missile more easily than planar fins, allowing for more compact storage of the weapon; this is of importance for craft which store weapons in internal bays, such as stealth aircraft. Shortly after release, the fins are swiveled into place for use as control surfaces [7].

In the case of the MOAB, grid fins allow the weapon to fit inside a C-130 cargo bay for deployment while the craft is in flight. Grid fins have a much shorter "chord" (the distance between leading and trailing edge of the surface) than planar fins, as they are effectively a group of short fins mounted parallel to one another. Their reduced chord reduces the amount of torque exerted on the steering mechanism by high-speed airflow, allowing for the use of smaller fin actuators, and a smaller tail assembly overall.

Their small chord also makes them less prone to stall at high angles of attack, allowing for tighter turns. Grid fins perform very well at subsonic and supersonic speeds, but poorly at transonic speeds; the flow causes a normal shockwave to form within the lattice, causing much of the airflow to pass completely around the fin instead of through it and generating significant wave drag. However, at high Mach numbers, grid fins flow fully supersonic and can provide lower drag and greater maneuverability than planar fins [7].

DESCRIPTION OF THE GEOMETRY

Missile has been designed by using Catia v5 and the implementation of grid fins with the missile carried

out carefully. Planar fins are totally different from grid fins, which include various lattice arrangements that classified in to following categories. i) Baseline lattice grid fin ii) Coarse lattice grid fin iii) AFIT lattice grid fin. It is believed that the AFIT design would be better than the other lattice grid fins because this layout doubles the area of the cells in the main body of the fin while retaining a similar shape. The geometry of missile is shown in the below figure1&figure2 respectively.

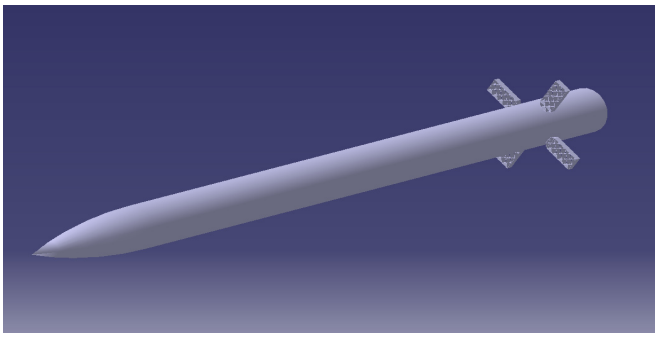

Figure 1. 3D view of the missile

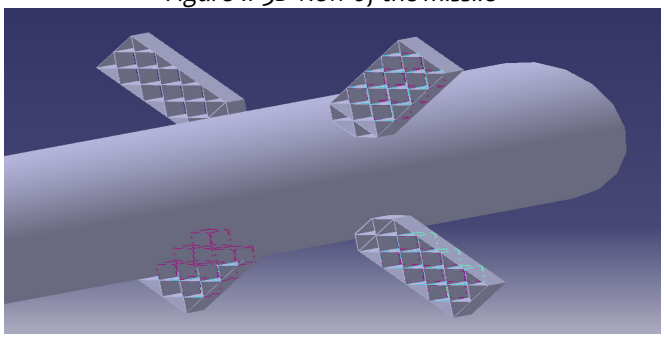

Figure 2. Enlarged view of fins on miss

The mesh has been generated for the missile as well as its domain in terms of various mesh nodes and that is shown in the below figure 4, 5,6,7,8 respectively.

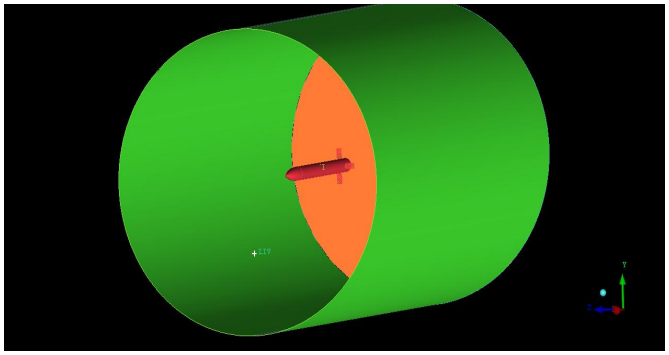

Figure 3. 3D view of missile with domain in ICEM CFD

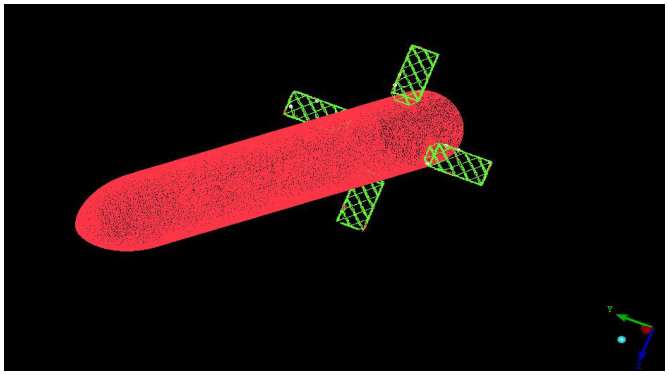

Figure 4.Triangle mesh on missile surface

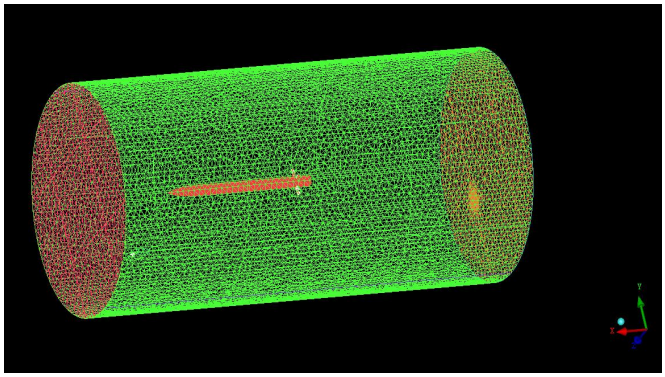

Figure 5. Surface mesh on domain

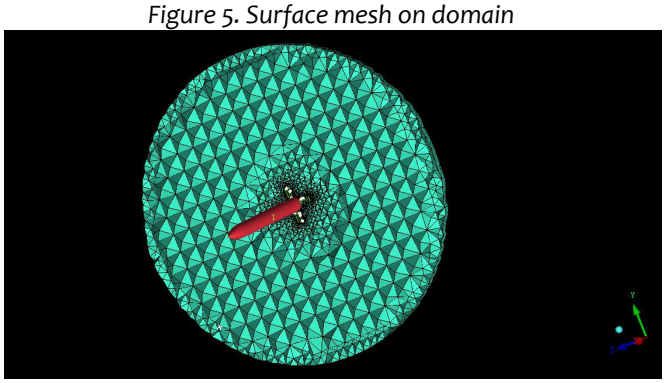

Figure 6. Tetrahedral mesh cut plane on x -axis on domain

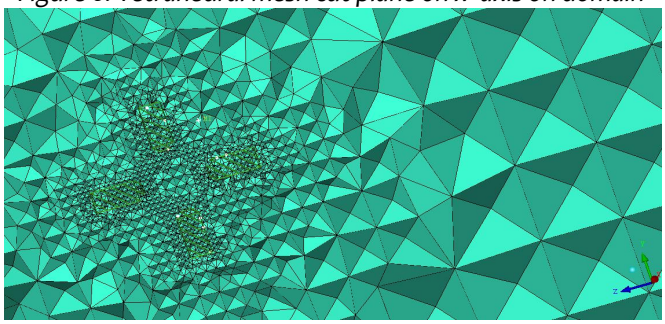

Figure 7. Enlarged view of Tetrahedral mesh cut plane on fins

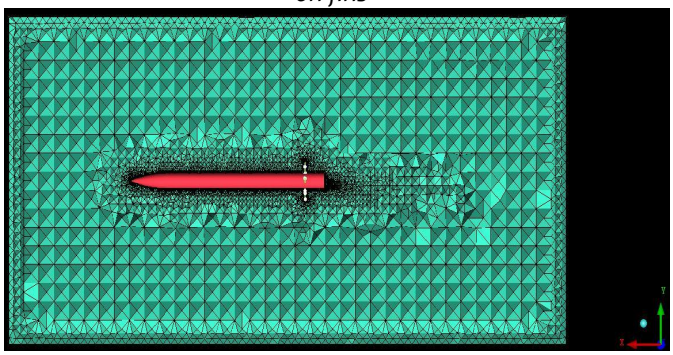

Figure 8. Tetrahedral mesh cut plane on z -axis on domain

DESCRIPTION OF MESHING

The missile geometry created in Catia V5 is imported into ICEM CFD for meshing by using suitable file acceptance format. Surface mesh on missile and fins are created as initiative process. The triangle elements are used for this surface meshing and then whole domain is meshed using tetrahedral cells [8]. The quality of meshing found to satisfactorily by checking criteria like quality, aspect ratio etc. A three-dimensional unstructured tetra grid (mesh) has been generated using the tetra meshing feature of ICEM CFD. The mesh size is 2 million cells; the grid is refined in the near wall regions using prism cells. The three

dimensional view of the full grid in ICEM CFD is shown in the figure below.

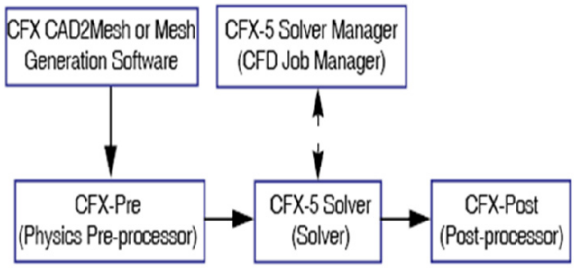

Figure9. The Structure Of CFX

Thus, the tetrahedral mesh for missile geometry is created using ICEM CFD. The tetrahedral elements are used for easy meshing as it is unstructured and requires less time to complete. Total elements: 1711046 and Total nodes: 287557.Thus both constitutes nearly 2 million cells. Then the mesh file is export to suitable solver.

DESCRIPTION OF SOLVER

CFX is a general purpose Computational Fluid Dynamics (CFD) code, combining an advanced solver with powerful pre and post-processing capabilities. The next-generation physics pre-processor, CFX-Pre, allows multiple meshes to be imported, allowing each section of complex geometries to use the most appropriate mesh [11].

CFX includes the following features:

i. *An advanced coupled solver which is both reliable and robust.*
ii. *Full integration of problem definition, analysis and results presentation.*
iii. *An intuitive and interactive setup process, using menus and advanced graphics.*
iv. *Detailed online help.*

The Structure of the CFX is illustrated in the below figure9 and which explains the steps involvement in the process. The mesh file is to be imported in to CFX solver and boundary conditions were made and that has been shown in the figure 10, 11, 12 respectively.

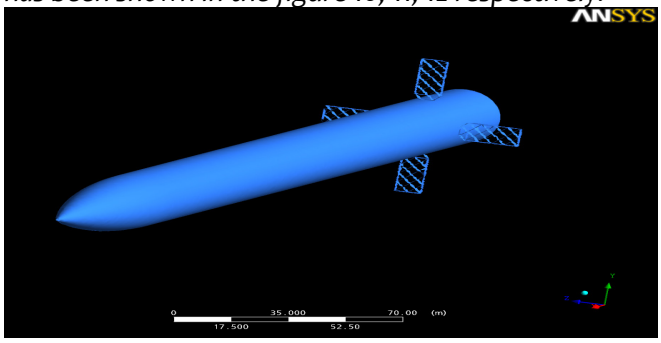

Figure 10. Missile geometry in CFX

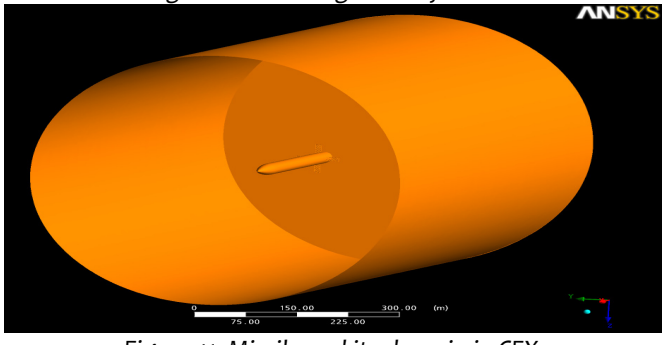

Figure 11. Missile and its domain in CFX

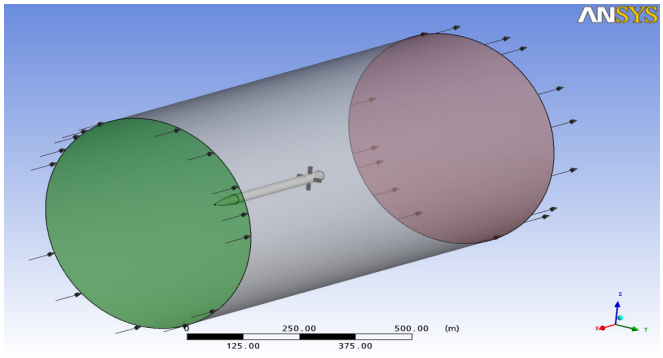

Figure 12. Boundary conditions

The following boundary conditions are used in this analysis.

1) For inlet, Velocity = 75 m/s. Static temperature = 300K.

2) For outlet, Static pressure = 0 Pa.

For missile and other parts of flow domain are considered as adiabatic wall (i.e.) no transfer of heat The various contour for velocity and pressure has generated with respect to boundary layer condition that is shown in thefig13,14,15,16,17,18 respectively .

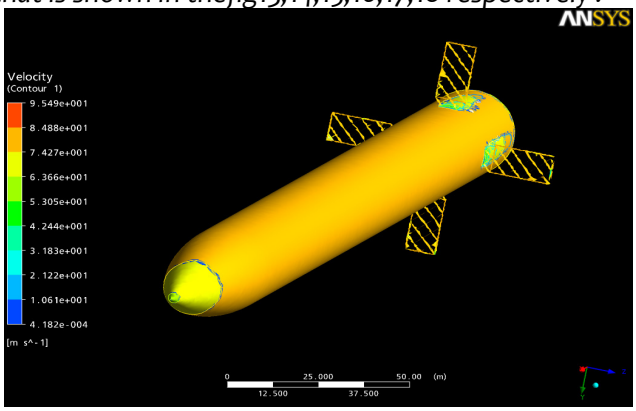

Figure 13. Velocity contour on Missile

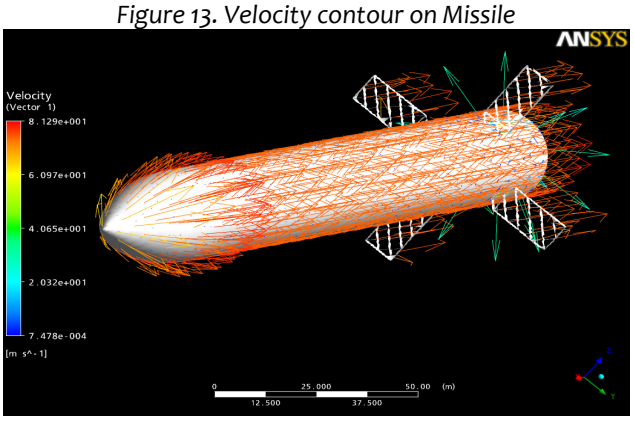

Figure 14.Velocity vector on Missile

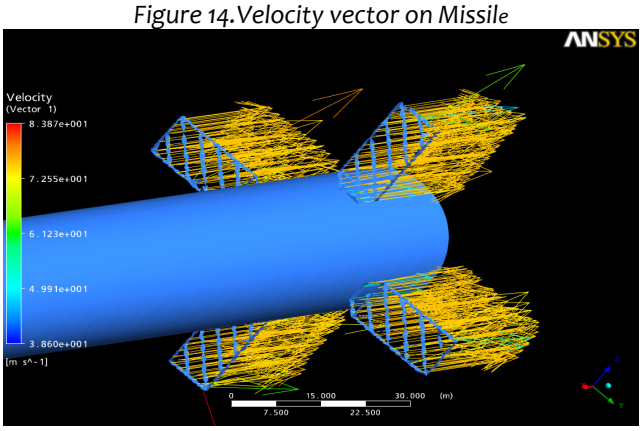

Figure 15.Velocity vector behind fins

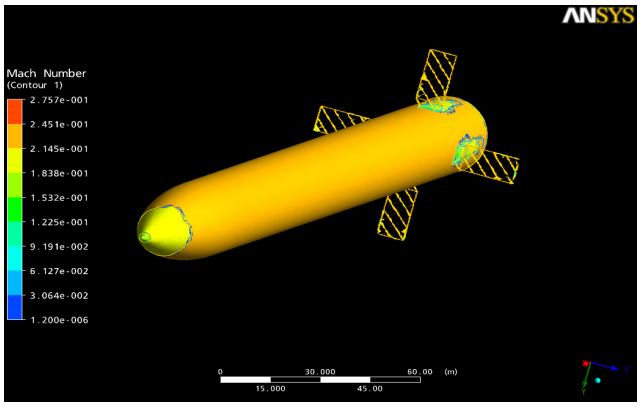

Figure 16. Mach Number contour on Missile

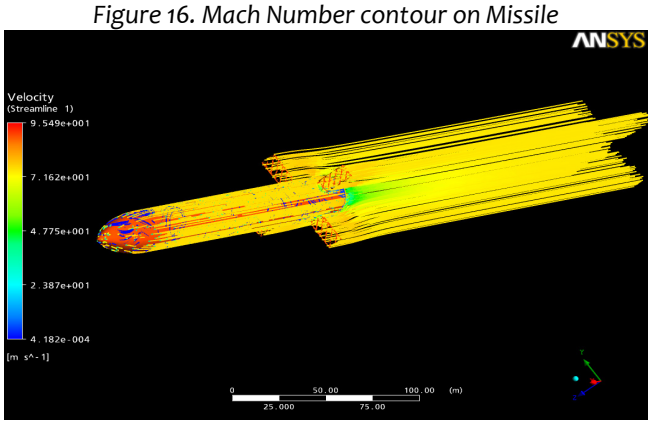

Figure 17. Stream Line Plot

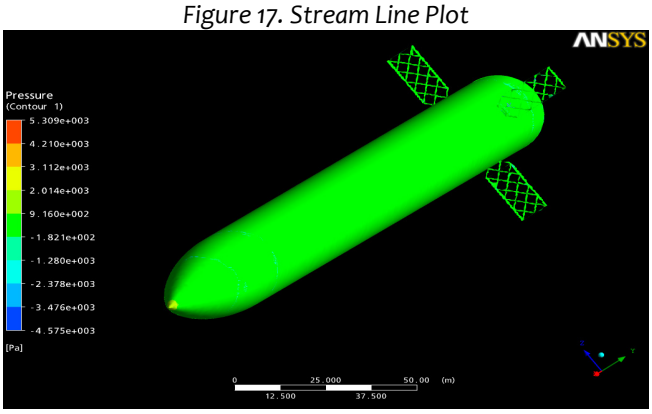

Figure 18. Static Pressure Contour On Missile

CONCLUSIONS

The velocity contour shows color which differs from region to region. The maximum velocity acceleration due to the presence of fins and the body dimensions were indicated in leading edge (front side-yellow color) and the ones which has maximum velocity decelerations were indicated in trailing edge(backside-blue color)as shown. Stream plot is drawn over the missile with grid fin to view the flow visualization for zero angle of attack. The average mach number over the missile is 0.21(i.e) subsonic as per as assumption. Thus, the flow over missile is found to be satisfactory.

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APPLYING OF STATISTICAL MODEL IN DETERMINING THE MINIMAL NUMBER OF OBSERVATIONS FOR CALCULATING CREDIT DEFAULT RATE

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ABSTRACT: *The important aspect related to both banks' and other financial institutions' performances is the analysis of the clients' obligations fulfillment through applying various mathematical models. Furthermore, the main purpose of the models is estimation of the possibility of default (default rate). Moreover, it is important for the users of the model to posses data related to possibilities' accuracy. There are various ways for testing the accuracy related to the default possibilities, and in this paper the minimal number of observations will be presented. Thus, simple statistical operations will be presented, important for gaining a minimum level related to sample size. Moreover, the paper will point out that for determining the minimum size of the sample, the absence of correlation among data is essential. If the correlation is present, the minimum level of accuracy of the sample size could be altered, representing the important conclusion of this paper. Furthermore, if there is fixed sample, this approach allows minimum difference between estimated and actual empirical default rate. Finally, the cases indicating inaccurate minimum level of the sample size will be shown as well.*
KEYWORDS: *default probability, default rate, default rate prediction, minimum level of sample size*

INTRODUCTION

It is a common thing for credit model users to calculate default probability through credit rating of the clients. Moreover, they are inclined to know the precise probabilities related to defaults. Consequently, the experiments estimating the difference between expected and actual bankruptcy rate are frequently undertaken (default rates).

However, there are various methods for the calculation. These cases imply further analyses related to bankruptcy rates' fitting within expected range of credit rating (estimating the difference between the expected and actual bankruptcy rate). Usually, these cases involve large samples, especially when the probabilities are low, as it is the case with high credit rating. Nevertheless, how big the sample should be is the frequently asked question. Thus, the aim of the paper is to calculate the number of observations necessary for the tests.

The approach includes statistical relations. Consequently, the results point out that the lowest level of the sample size can be implemented only when there is an absence of correlation among data. In other words, the lower limit can be calculated, when there is no correlation between time and cross sectional data.

Furthermore, the values of correlations influence the value related to lower level of sample size as well. For example, when the correlation coefficient is zero and the sample size is large enough, the lowest level can be small enough. However, when correlation coefficient differs from zero, the adding of observation units would not contribute to the narrowing of confidence interval.

Particularly, the analytical link can be suitable for decision making related to the size number of available data and for probabilities estimation. Otherwise, when the fixed size sample is used, this can be helpful in determining the minimum difference between the expected and actual size of default rate, which is statistically significant. Furthermore, within the cases where the initial hypotheses are jeopardized, the using of simulation model is highly recommended.

THEORETICAL BACKGROUND

Theoretical background of the paper is related to Law of Large Number and the Central Limit Theorem. Furthermore, binomial distribution is used and its tendency to have characteristics related to normal distribution when it is a case with large number of observations. The latter includes situations when the data are independent.

Binomial distribution is determined by two parameters p and n, representing default probability and numbers of observations, i.e. number of companies. Nevertheless, it is essential to stress out that out of n number of companies d number present default companies. Consequently, the aim is to determine whether expected default rate is near the level of actual one. Using relative frequency, default rate is defined as:

$$f_d = d/n \qquad (1)$$

Under the following condition:

$$P(|f_d - p| < \varepsilon) \leq \alpha \qquad (2)$$

where α present stands for the level of significance. Assuming that "default rate" is binomial random variable, there are two cases: default or not. Binomial distribution for large enough number of observations (n) converges to normal distribution. Using CLT the result is:

$$P(np_L \le np \le np_U) \approx \frac{1}{\sqrt{2\pi}} \int_{\frac{n(p_L-p)}{\sqrt{npq}}}^{\frac{n(p_U-p)}{\sqrt{npq}}} e^{-x^2/2} dx =$$

$$= \Phi\left(\frac{n(p_U-p)}{\sqrt{npq}}\right) - \Phi\left(\frac{n(p_L-p)}{\sqrt{npq}}\right) \quad (3)$$

Φ representing density function related to normal distribution. Assuming that:

$$p_U\text{-}p = p\text{-}p_L = \varepsilon .$$

It is easily noticeable that $(p\text{-}\varepsilon, p+\varepsilon)$ presents confidence interval default rate at α significance level. Using relation (3), the following results are acquired:

$$2\Phi\left(\frac{n\varepsilon}{\sqrt{npq}}\right) - 1 \ge 1 - \alpha$$

that is

$$\Phi\left(\frac{n\varepsilon}{\sqrt{npq}}\right) \ge 1 - \frac{\alpha}{2}$$

$$\frac{n\varepsilon}{\sqrt{npq}} \ge \Phi^{-1}\left(1 - \frac{\alpha}{2}\right) \quad (4)$$

$$n \ge \frac{pq}{\varepsilon^2}\left[\Phi^{-1}\left(1 - \frac{\alpha}{2}\right)\right]^2$$

The last row provides the formula essential for calculation of n, representing a minimal number of observations or companies, following default probability p, level of accuracy ε, and level of significance α.

Moreover, in cases including n observations, in order to determine the difference between p and f_d, under the previously set level of significance, the following inequality is used:

$$\varepsilon \ge \sqrt{\frac{pq}{n}}\Phi^{-1}\left(1 - \frac{\alpha}{2}\right)$$

In conclusion, under the expected probability, the further analysis estimates its suitability for calculation of default rate. On the other hand, the question related to the choice of number of the companies necessary for the analysis stays open. Furthermore, it is observed that the figure pq reaches its maximum level providing that p=q=0.5. By setting p=0.5, the calculation of default rate is possible with accuracy, providing there is a minimum number of the companies. Moreover, when the number of the companies is fixed, default rate estimation number will be within ε with the probability of $100*(1-\alpha)\%$. Additionally, this is a standard confidence interval for probability estimation.

Nevertheless, the samples used are significantly smaller than the population, comprising 5-10% out of the overall population. In cases when population is finite, correction factor (N-n)/(N-1) is used, where N represents number of population members, and n presents number of sample members.

The following table presents the values for ε, with the number of observations (companies) n, p=0.005 and α=0.05. Consequently, the table shows that the increase of number of observations is followed by the change related to the value of ε.

Table 1. The values of ε when n, p and α are familiar

n	ε
1000	0.0044
2000	0.0028
5000	0.0020
10000	0.0014

METHODOLOGY

Additionally, it is very useful to analyse n/p, when they present small values. Consequently, it is not recommendable to use analytical results. On the other hand, simulation is more complicated but trusting mechanism determining right values.

The following table shows examples related to simulation and analytical results for the value ε, while n, p and α are familiar.

Table 2. Analytic vs. Simulated levels of ε

n	P	Analytic ε	Simulated ε	Percent difference
100	0.001	0.0062	0.0090	-23%
250	0.001	0.0039	0.0030	8%
500	0.001	0.0028	0.0030	2%
100	0.025	0.0306	0.0250	-18%
250	0.025	0.0194	0.0190	-2%
500	0.025	0.0137	0.0130	-5%

The previous table indicates that analytical result enable acceptable estimation in cases when n/p has higher values. Otherwise, relative difference among predicted results (1-ε analytical/ε simulation) may appear significantly high, in cases concerning small values. The result acquired recommends avoiding approximation when npq is less than 2. Furthermore, these cases include possibility of asymmetrical distribution, thus complicating the interpretation of the results (asymmetry of binomial distribution is presented as 1-6pq/npq). Informal experiments recommend simulation in cases when npq is less than 4. Furthermore, the experiments include relative errors less than 10%, predicting ε.

Unfortunately, the latter does not present the best mechanism for estimation of n using simulation. However, analysts more frequently have fixed samples of the companies than they have fixed values for ε, making it not as practical problem as it could be. Furthermore, it is quite feasible to use methodology for calculating specific values for n, by using inequality (4) already presented in the paper. Consequently, the approximation fit well, except for small values. Excluding extreme values, errors were below the level of 10%.

Hence, the previous section deals with setting the low limit. Statistical theory, applying CLT restrict both values and the upper limits. However, it is seldom case that companies' databases fit conditions imposed by CLT. Thus, hypotheses annulling may appear as the result of additional variances and covariance affecting the higher values for n and ε.

Additionally, the companies' rating may be determined by estimated probability. Moreover, the estimated values may cause the increase of sample's variability.
Furthermore, the analysis presented on the following two tables clearly indicates that the result appear to be worse when there is a correlation among data. Hence, it is advisable to avoid analysis related to the same company in certain period of time, influenced by the same economic factor.
Table 3 shows values related to ε when n, p, correlation coefficient are already given and α =0.05.

Table 3. Values for ε when n, p, α are familiar

Correlation	N	p=0.01	p=0.03	p=0.05
0.0	500	0.008	0.011	0.018
0.1	500	0.020	0.048	0.07
0.2	500	0.030	0.063	0.108
0.3	500	0.036	0.083	0.142
0.1	1000	0.006	0.008	0.011
0.2	1000	0.020	0.046	0.067
0.3	1000	0.029	0.061	0.102

Thus, it is clearly noticeable that ε has the smallest value when correlation coefficient equals zero, which presents the main goal, due to the fact that ε presents difference between actual and expected probability at given level of significance.
Furthermore, the following table shows values for ε when probability has only one value, i.e. 0.01, level of significance is 0.05, correlation coefficient has only two values and finally and number of observations lies within the range from 100 to 1000.

Table 4 .Values for ε when n, p, α are familiar

Correlation	n	p=0.01
0.03	100	0.040
0.03	250	0.038
0.03	500	0.036
0.03	1000	0.034
0.00	100	0.020
0.00	250	0.010
0.00	500	0.008
0.00	1000	0.006

Having presented the results, it is evident that the accuracy of probability is more influenced by the independence of the data than by the number of observations. Additionally, the independence appears to be very important due to convergence of binomial distribution towards normal.
Thus, it is essential to mention that the increase of correlation coefficient is followed by the increase of distribution asymmetry. However, the biggest weakness related to parameters' asymmetry is their interpretation. Nevertheless, table 4 clearly indicates that there is asymmetrical distribution for small values of n as well (values smaller than 500).
Moreover, table 4 indicates that distribution becomes asymmetrical when correlation coefficient equals zero and n value is low. Consequently, as long as n is less than 500, both theoretical and simulated predictions for ε are lower than p.
However, it is difficult to estimate correlation coefficient in practice, due to samples' overlapping. Thus, plenty of companies would be included in the sample for more than a year, causing overlapping. Furthermore, default rates could not be constant within time. Finally, various correlation effects influence the change of default rate' variance.
To summarize, there is a great deal of evidence for actual implementation of predicted values of p and n using inequalities (2) and (3), ignoring unexpected external effects.

CONCLUSIONS

In conclusion, while using mathematical model for calculating defaults' probabilities, it is essential to determine the probabilities' accuracy as well. Consequently, the estimation of actual and predicted default rates has to be done. Furthermore, statistical method is implemented in order to determine the lowest limit or number of observations needed accurately.
The model's presence, setting the lowest limit is useful when rigorous conclusions related to probabilities' estimation are not made. Furthermore, determining the lowest number of observation does not include positive correlation among data.
On the other hand, if the sample is fixed, this approach may be used to set the difference between actual and predicted default rate.
Finally, as long as the values for ε and n are lower and do not satisfy pointed inequalities, the result obtained would not be statistically significant.

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VIBRATION GENERATION ON WATER JET TECHNOLOGY HEAD DUE TO WATER PRESSURE CHANGES

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ABSTRACT: *After recent research activities focused on water jet technology and abrasive water jet process parameters optimalization, it is necessary to stress attention to aspects which have been out of main research stream but they are very important for understanding cutting process physical principles, improving production systems operability and cutting quality improving. The paper deals with a research of technology parameters fluctuation effect on AWJ production system technology head vibration generation during technical ceramics cutting production process. The submitted paper points at possible sources of undesirable vibrations: pump pressure, which can be a reason of reliability and AWJ technology production systems lifetime reduction, and of abrasive nozzle wear increasing as well as of cutting edge quality reducing.*
KEYWORDS: *Water jet, vibrations, amplitude of vibration acceleration*

MEASUREMENT METHODS AND USED DEVICES

A miniature piezoelectric accelerometer from Brüel & Kjær was used for vibration measurements (type: 4507-B-004 parameters: IEPE, TEDS, 1-axis, 100mV/g), which was fixed onto water jet technological head using bee wax. Signals processing and evaluation was carried out with modular system which is based on National Instruments CompactDAQ platform with specialized function module NI – 9233 for vibrations measuring. Signal processing was performed using graphic programming software LabVIEW Signal Express extended with Sound and Vibration Toolkit module which contains a set of tools for vibrations and sounds evaluation. The experiments were carried out in the firm Wating Prešov s.r.o. where during technical GRES ceramics cutting the pressure values of the pump were varied: 200 MPa, 250 MPa, 350 MPa. The technological head speed was 500 mm.min^{-1}. The table 1 summarizes the conditions under which the experiments were performed and for which evaluated graphic dependencies are valid.

Tab. 1 Experiment conditions

Distance of the technological head from the material	*2-3 mm*
Water nozzle diameter	*0,25 mm*
Focusing tube diameter	*1,02 mm*
Cut material thickness	*10 mm*
Abrasive type, abrasive mesh	*Indian garnet, mesh 80*
Abrasive mass flow	*200 g/min*

RESULTS

The figures 1, 2 and 3 represent graphic dependencies of average value of amplitude of vibration acceleration on given frequency at a given pump pressure value. The figure 4 presents a graph which compares of three courses maximal values of amplitude of vibration acceleration on given frequency. Maximal value of vibration acceleration amplitude for analyzed pump pressure value was protracted for each interval within 200 Hz frequency interval. The amplitude value of vibration acceleration less than 25.10^{-6} was neglected. This value was a determination of a limit under which vibrations measured in standby mode (a mode when the device is on and waits for programme activating) are considered to be not generated due to technological parameters.

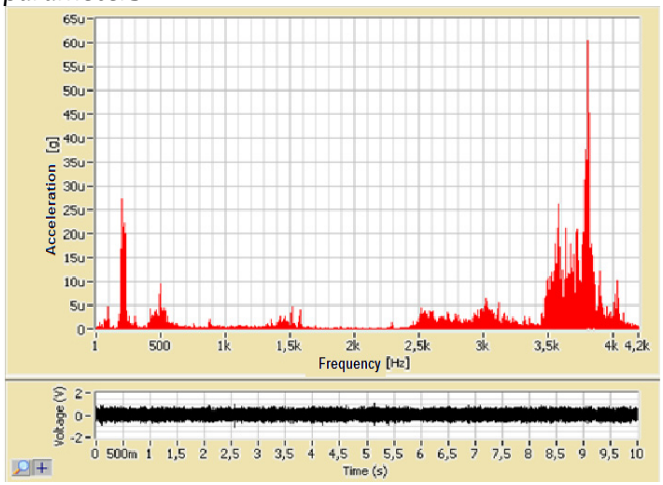

Fig. 1. Dependency of vibration acceleration on given frequency (pressure 250 MPa)

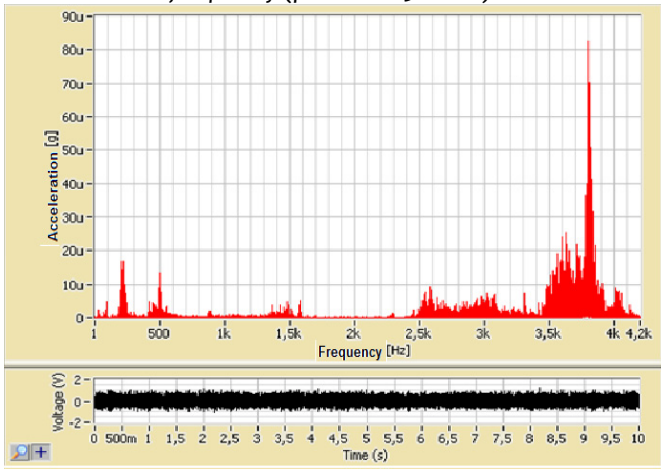

Fig. 2. Dependency of vibration acceleration on given frequency (pressure 300 MPa)

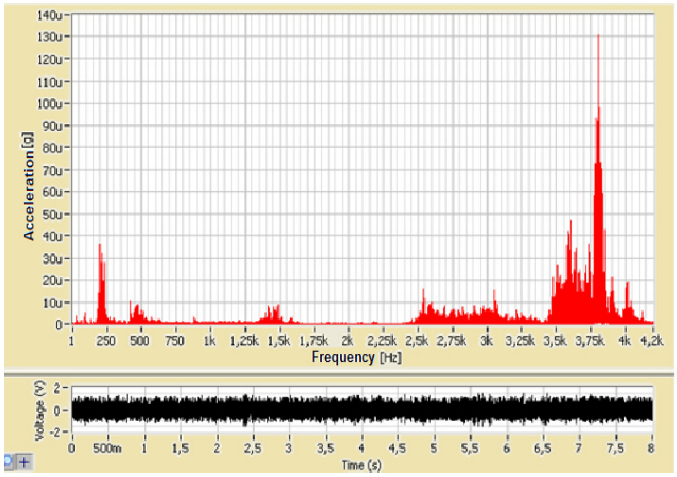

Fig. 3 Dependency of vibration acceleration on given frequency (pressure 350 MPa)

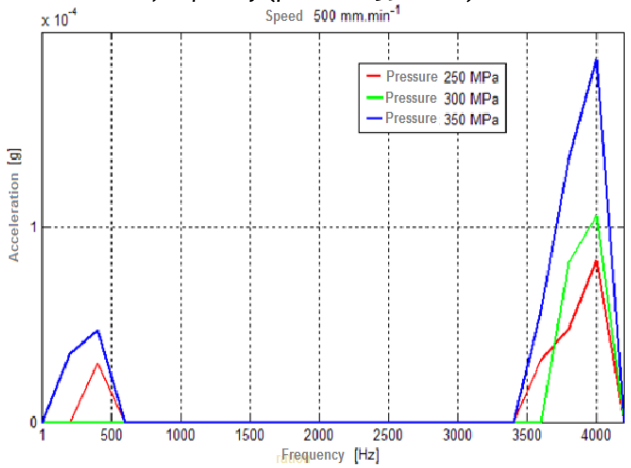

Fig. 4 Comparison of dependency of vibration acceleration on given frequency at three analyzed pressure values

DISCUSSION

On the base of the presented graphic dependencies it can be concluded that the highest vibration values were measured at the pressure values of 250 MPa and 350 MPa within frequency interval from 200 Hz to 400 Hz where the value of vibration acceleration does not exceed 4.10^{-5} g and within frequency interval from 3 400 Hz to 4 200 Hz where maximal value of vibration acceleration amplitude oscillates around the value of $1,3.10^{-4}$ g. The smallest vibration values were measured at pump pressure of 300 MPa where the value of vibration acceleration amplitude within frequency interval from 3 400 Hz to 4 200 Hz is almost half of the pressure 350 MPa and within frequency interval from 200 Hz to 400 Hz no significant values of vibration acceleration amplitudes were measured.

CONCLUSIONS

To sum up, it can be concluded that the pump pressure affects generation of water jet technological head vibrations and that these technological head vibrations can be reduced by change of pump pressure, which could improve cutting edge quality at AWJM cutting.

By reducing undesirable vibration, rising of reliability and lifetime of AWJ technology producing systems, abrasive jet wear reducing, noise level lowering and improving AWJ technology producing system operation safety and hygiene can be achieved.

New knowledge submitted in this paper was formulated on the base of performed experiments and graphic relations. On the base of gained relations, conclusions, recommendations and contributions for scientific activity and business practice were formulated as well.

The experiments were performed as a part of an extensive research carried out in Wating Prešov s.r.o.

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SYNERGISTIC EFFECTS OF STARCH AND RUBBER-LATEX AS CORE BINDERS FOR FOUNDRY SAND CORES PRODUCTION

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ABSTRACT: *Foundry technology is developing in Nigeria and other developing countries in the world; therefore, there are high demands for raw materials. New materials continue to be developed to meet special requirements which require special processing in order for their properties to be effectively utilized. High cost of imported binders has generated great interest in characterizing the locally available materials, therefore necessitating the need to look into domestically available binders that will meet the criteria for manufacturing, that is, reliability, cost, toxicity and availability; these are rationale behind this work. In this study, efforts were made to produce inexpensive and efficient binders from locally sourced materials (starch, and rubber latex) in Nigeria for the use of foundry cores. This was carried out by blending the locally sourced materials: starch-rubber latex (1:2) with silica sand, and water in different proportions while bentonite was used as control. Binders from various blend compositions were used to make core samples, and each core sample produced was subjected to the following mechanical tests: green compressive strength, dry compressive strength, collapsibility, and surface hardness. The blending caused great improvement in the mechanical properties of the core samples produced. The dry compressive strength values for all the core samples produced were greater than the corresponding green compressive strength values. The collapsibility decreased with increasing proportions of blended binders while the surface hardness values for starch-rubber latex binder cores were higher than for the core samples from bentonite binder.*
KEYWORDS: *Foundry, Cores, Binders, mechanical tests, Starch and Rubber-latex*

INTRODUCTION

Foundry is the mother of all industries for the reason that it provides components and raw materials for all other industries. This presupposes that there will be no true industrialization without a solid based foundry industry which is what Nigeria and other developing countries were experiencing.

Foundry as a manufacturing process through liquid route relies on the imported raw materials which are basically expensive. The current standard in Nigeria and other developing countries of the world have a very little advancement due to lack of affordable local sand binders, hence, the room for improvement.

Core binders in the next 5-10 years will be different from those in use now. The driving force of those changes will be environmental regulations, as binders will have to become more environment-friendly to meet the demands of lower air pollutant emission levels while maintaining or exceeding the productivity demands of a competitive global marketplace. Two major types of binders are used in core making practice: resin-based organic binder sand inorganic binders such as sodium silicate [Awopegba, 2002].

Sand cores are commonly employed, in foundry practice, to form complicated cavities in castings. Apart from being handled as separate entity in dry state during mould assembling, delicate and often complex sand cores are subjected to high stress during pouring due to hydrostatic pressure exerted by the molten metal.

Therefore, cores must be able to sustain the hydrostatic pressure of the liquid metal without breakage or change in geometric configuration. This implies that possession of sufficient strength in dry state after baking or curing is very important. In addition, cores are also expected to break easily (collapsibility) during shake out in order to release sand mass out of the inner and hidden cavities of solidified casting. Fumes and gases evolved during pouring must again be easily conveyed out via the core through the mould to avoid the formation of gas cavities in the casting. However, it is difficult to obtain natural sand that possess these properties, thus, sand cores are synthetically prepared by the combination of many ingredients such as sand grains, core binders and special additives (Olakanmi and Arome, 2009).

*Meanwhile, binders were developed to strengthen the cores, which are the most fragile part **of** a mold assembly. Clay binders are cheap, facile and convenient for core-making, but, they are rarely used because of their low bonding strength and poor permeability. Synthetic resins have high strength and good moisture resistance but their high cost, high gas forming capacity and non-recycling feature restrict their widespread applications in foundry practice. Rubber latex cores belong to the organic category (Olakanmi and Arome, 2009). Therefore, an efficient core binder, sourced locally in a developing economy such as Nigeria, represents a major advancement in obtaining sand cores of desirable performance and high strength in reducing the cost of production of castings. Core oils, synthetic resin, clays and cereal binders had been identified by Gilson (1993), Beeley (2001) and Jain (2003), as widely used core binders.*

Various researchers have worked on some of those materials. Among them are Ademoh (2009) that studied the establishment of the beneficial effects of addition of linseed oil to foundry sand cores bonded with Nigerian gum Arabic grades 2 and 4. Characterization of the core-binding properties of fatty - based oils was studied by Olakanmi and Arome (2009;) and Shehu and Bhatti (2012) investigated the use of yam flour (starch) as binder for sand mould production in Nigeria.

This research work centered primarily on the production of core binders starch and rubber latex characterized with a view to finding alternatives to the imported foundry core binders that deplete Nigeria's foreign exchanges for the production of foundry cores, from locally sourced materials, which could be used as substitutes for the imported binders such as bentonite and resin. The work mainly concentrates on two materials: starch and rubber latex, all of which are sourced locally. Starch was obtained from cassava tubers in a cassava plantation at Ikire (7.35N and 4.183E) in Irewole local Government Area of Osun State Nigeria and rubber latex from the Horticulture Department of the Federal College of Agriculture (7.25N and 5.195E), Akure, Ondo State Nigeria.

MATERIALS AND METHODS

Materials: The materials used are silica sand (which was obtained along the River band of Owena in Owode-Owena (Igbaraoke) (7^{o} 24" 0"N and 5^{o} 3" 0"E), Ondo State, Nigeria), Cassava tuber that produced hydrolyzed starch from Ikire in Irewole local Government, Osun State, Nigeria, standard specimen moulding box, rubber-latex, bentonite, wooden core box, water, ammonium hydroxide, rammers and distil water.

Equipment:

A standard foundry equipment –Laboratory shatter index testing machine (CCRB), weighing machine, batch type oven, pH meter, universal sand-strength testing machine, (tensiometer), cylinder core box, measuring cylinder and beakers, set of sieves, shaking tables, automatic vibrating sieve machine, and hardness tester, mechanical rammer, moisture tester, permeability machine, BSS set of sieves and shatter index tester in the foundry shop of Nigeria was employed to measure the most relevant properties (green/dry compressive strengths, shatter index, moisture content, collapsibility and permeability) of foundry sand.

Methods - Sample Preparation:

The binders were weighed and blended together in this order (starch-rubber latex) and they were mixed with quantities of silica sand, water and binders in different proportions.

Five compositions were prepared from the binders using bentonite (as control) and starch-rubber latex. The total number of prepared compositions from the binders was twenty (20). Thirty-five core samples each were made from the two different binders with varied sand, water and binder compositions as shown in Table 1.

The prepared core samples were dried by spreading in the sun for three days. Thereafter, each sample was subjected to mechanical tests. Dry compressive strength, green compressive strength, and surface hardness tests were all carried out on the samples before they were oven-dried while the other tests were carried out after oven-drying in a batch-type oven set at temperature of 120 to 150°C for 3 hours in conformity with destructive tests approach. The core samples were prepared in accordance with Onyemaobi (1998). Altogether, 210 samples were oven dried while green compressive strength test was simultaneously carried out on the remaining 35 samples being allowed to stay for 18 hours.

A total of seventy (70) samples were made altogether for this research as seven samples were obtained from every composition using two different binders.

Table 1: Types of cores using blended binders and their compositions

Types of Core	Compositions		
Bentonite-Bonded Core	%Sand	%Water	%Binder
	93.86	4.10	2.04
	92.96	4.08	2.96
	92.07	1.39	6.54
	94.45	1.22	7.33
	90.79	0.51	8.70
Types of Core	Compositions		
Starch-Rubber Latex(S+R) Core	%Sand	%Water	%Binder (Starch + Rubber) 1:2 ratio
	93.86	4.10	2.04
	92.96	4.08	2.96
	92.07	1.39	6.54
	94.45	1.22	7.33
	90.79	0.51	8.70

The weights of the samples from each composition were taken using a weighing machine. Six samples from each composition were carefully arranged into the oven cabinet and placed in the batch-type oven which was set at a temperature of 120 to 150°C, and heating was continued for 3 hours.

Particles Size Analysis:

The dried known quantity 50 gm of Owena river silica sand grains free of clay was used to determine the fineness number, using a set of standard testing sieves. The BSS No. of 6, 12, 20, 30, 40, 50, 70, 100, 140, 200 and 270 were used. The sand was placed on the coarsest sieve at the top and after 20 minutes of vibration, which is the recommended shaking time to achieve complete classification of the sand, the weight of the sand retained on each sieve was obtained and converted to a percentage equivalent. Each percentage was multiplied by a factor and the fineness number was obtained by adding all the resulting products, dividing the total by the percentage of sand retained and grain fineness number (BSS) were computed according to equations [1, 2].

$$Average\ \_grain\ \_fineness = \frac{Total\ \_products}{\%\,retained} \quad (1)$$

$$Average\ \_grain\ \_fineness = \frac{4433\ .8}{98\ .52} = 45 \quad (2)$$

(Sheu & Bhaiti, 2012)

The purpose of the analysis is to determine the distribution of grain sizes within the sand. Sands used in foundry have a wide range (40-220) of fineness number. Higher numbers represent fine sands generally used for light castings, coarse-grained sands with lower fineness numbers are used in steel castings (Eze, et al, 1993) (Ayoola, 2012) .

Moisture Content Determination:

The moisture contents were determined using a speedy moisture tester. A sample of each mixture was weighed on the weighing balance of the tester and

poured into the flask of the moisture tester. The flask was shaken for the recommended 3 minutes and percentage moisture content of the sample was read directly from the calibrated dial instrument at the top of the flask attached to the machine.

Green/Dry Compressive Strengths Determination:

The green compressive strength test was carried out to assess the bond strength of the green sand core. Green compressive strength test was performed immediately after the specimen was stripped from the tube to prevent any increase in green strength due to air drying with increase in exposure time (Heine, et al, 1977). The silica sand of fineness number of 45, according to the British standard, was used to produce core test specimens with different percentages of mixtures of cassava (starch) and rubber latex as the binders.

160 g sand was poured into the standard cylindrical test tube with diameter of 50 mm and length 50 mm, rammed by impact with three blows of 6.50 kg weight. By manually turning ramming device, the weight was dropped from a height of 50 mm and the test-piece was stripped from the tube. Stead increase in load was applied on the specimen under the universal sand-strength testing machine until failure occurred and the load at which the sample collapsed was recorded. Each of the five samples was subjected to gradual load on the machine in the foundry workshop of Federal Polytechnic Idah Kogi State, Nigeria. Same procedure was used (that is, as in green compressive strength test) in preparing test samples for dry compressive strength, but in this case samples were sun-dried for two days before the tests (Sheu and Bhaitti, 2012).

Shatter Index Determination:

The shatter index test was performed with the shatter index tester. The test sample was prepared without stripping. The sand test-piece was positioned at the top of a tower 1.83 m high and ejected from a specimen tube by gently pulling down the handle onto a steel anvil head 75 mm in diameter. On impact, the test-piece shatters, some of the sand from the sand core remaining on the anvil and the rest was been projected on to 12.5 µm mesh B.S.sieve. The sand which passes through the sieve into the sieve pan was weighed and the shatter index was computed. Shatter index values ware used to determine the collapsibility of the moulding sand core (Loto, 1990).

Permeability Determination:

Permeability was determined by measuring the rate of flow of air through a standard rammed test-piece. Standard air pressure of 9.8×10^2 N/m^2 was passed through the specimen tube that contained green sand placed in parameter of the permeability meter and time for 2000cm^3 of air was recorded to determine permeability in numbers (Schey, 1997). Direct-reading instrument was used in determining the permeability by increasing percentages of cassava (starch) and rubber-latex content.

Results and Discussion

The results for the five tests carried out on the entire core samples from the locally sourced blended binders and the imported binder (bentonite) used as control are shown in Figures 1, 2, 3 and 4.

Green Compressive Strength:

The green compressive strength result obtained for each of the samples is shown in Figure 1. The green compressive strength value increased as the quantity of binder in the core mixture increased. Starch-rubber latex cores were observed to have the highest green compressive strength. For instance, cores with starch-rubber latex 8.70 g composition have green compressive strength value of 72.0 N. This was due to the relatively large quantity of rubber latex (twice that of starch) which when exposed to the atmosphere coagulates to form a tough and sticky mass (Morrison, 1987). Cores using bentonite as binder, with the same binder composition of 8.70 g, gave a compressive strength of 38.0 N

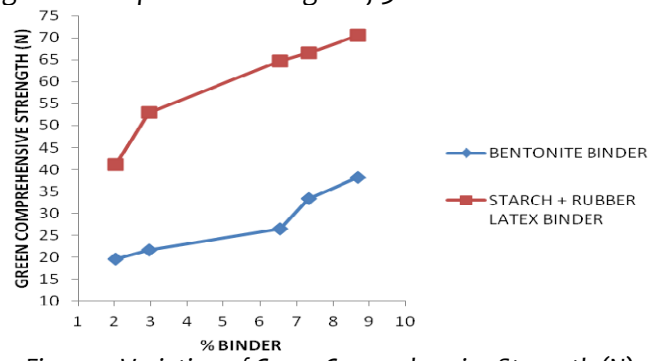

Figure 1: Variation of Green Comprehensive Strength (N) with % Binder in Produced Cores

Dry Compressive Strength Test:

The dry compressive strength for each core samples was observed to increase as the quantity of the binders in the core mixture increased (Figure 2).

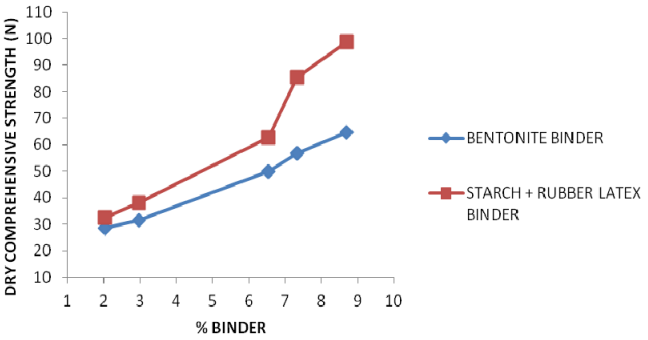

Figure 2: Variation of Dry Comprehensive Strength (N) with % Binder in Produced Cores

The starch-rubber latex cores were observed to have higher dry compressive strength at all binder compositions than all the other cores made from other binder (bentonite). Also the deviation from bentonite-bonded cores was observed to be critically high at all binder compositions. Cores from binder mixtures of composition 8.7 g (that is, 2.90 g starch and 5.80 g rubber latex) had dry compressive strength of 102N while bentonite bonded cores had dry compressive strength of 65 N. The reason for this was the fact that starch and rubber latex were extremely hardened when oven-dried (baked) coupled with the fact that rubber latex is characteristically gummy (Premamony Ghosh, 1990), which made the cores produced from it not to disintegrate easily when subjected to compressive forces.

Collapsibility Test:

The result shows that starch-rubber latex core samples have a collapsibility of $4.0x10^3$ g for binders of composition 2.87 g. While higher collapsibility was obtained from cores with a composition above 2.87 g. At a relatively high binder composition for the core mixture, starch-rubber latex core samples collapsed relatively well on application of weights. This was due to the high proportion of starch present in the core samples which by its nature was syrupy and when used solely as binder for the production of cores gave crack-bonded cores that are easily collapsed on application of loads. This confirms that starch aids collapsibility (Mikhailor, 1989).

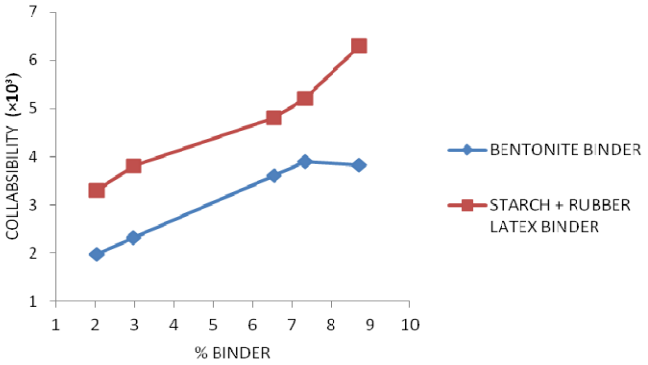

Figure 3: Variation of Dry Collapsibility with % Binder in Produced Cores

Bentonite-bonded core samples have superior collapsibility properties (Figure 3). This shows that relatively low weights were required to disintegrate a given bentonite-bonded core samples. For instance, at binder composition of 3.5 g, the bentonite-bonded core samples required 2.71 x 10^3 g load to collapse while the starch-rubber latex core samples required 4.4 x 10^3 g load to collapse. Although the deviations from the ideal were critical in all the cases considered.

Surface Hardness Test:

Starch-rubber latex-molasses core samples have the same surface hardness value (Figure 4).

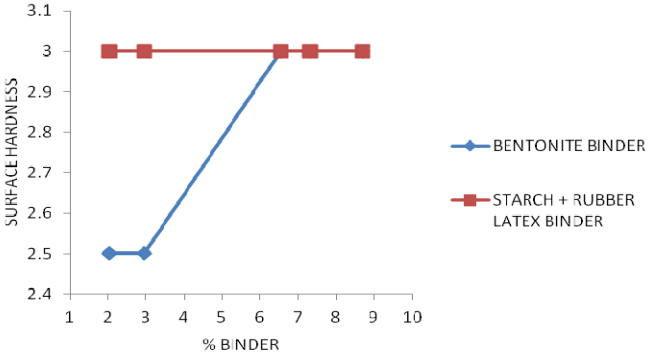

Figure 4: Variation of Surface Hardness with % Binder in Produced Cores

This result trend was due to the presence of rubber latex, in the binder composition, which is a gummy mass that gets toughened when baked (Stanley, 1987). Above this composition, the surface hardness of bentonite-bonded core samples increased up to a binder composition of 6.25g at which point it was observed that the surface was as hard as that of starch-rubber latex

Conclusions

The following conclusions were drawn from the research results:

a) Compressive Strength

Green compressive strength values for all the cores produced from all the blended blenders increased as the quality of binder in the core mixture is increased. The cores produced from starch-rubber latex binder mixture have the highest green compressive strength values. The dry compressive strength values for starch-rubber latex cores deviate far from bentonite cores.

b) Surface Hardness

Starch-rubber latex cores had greater surface hardness values than bentonite-bonded cores with composition below 6.5 g, while the surface hardness value was the same for the cores with 6.5g composition and above.

c) Collapsibility

For binders of 2.8 g composition, starch-rubber latex had collapsibility of $4.0x10^3$ g. The choice of either of these binders at this composition should therefore be based on their relative availabilities and market costs.

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ABOUT THE ENVIRONMENTAL MANAGEMENT SYSTEM APPLIED IN THE METALLURGICAL COMPANIES AND THE MONITORING PROCESS OF POLLUTANTS IN WASTE WATERS

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ABSTRACT: *The pollution monitoring is a necessary part of any environmental management system, being the basis for a fully informed decision-making process and developing environmental management strategies. To ensure a thorough decision, it is essential to be fully convinced that the measurements reflect the reality. The discharges into the environment from the major sources are pursued in a general monitoring process of the significant sources of pollutants within catchments. The objectives also include monitoring systems, optimization issues, verification and compliance with legislative requirements, such as allowable emission limits. We have analyzed the quantities of metallic elements (Mn, Ni, Zn, Cr, Cu and Pb) found in the wastewater from the areas of steel works and rolling mills, and we performed a calculation of pollutants in water, based on the measurements made (according to Romanian standards) between 2008-2010. The monitoring plans are designed and implemented to collect data about the water quality and the significant discharges of pollutants from the major sources. In this paper, we present the assessment of emission impact on waters, based on a case study conducted on the company TMK Reşiţa (Romania).*
KEYWORDS: *environmental management system, pollutants, waste waters, monitoring*

INTRODUCTORY NOTES

Currently, the big companies should be concerned with achieving environmental performance by controlling the environmental impact of the work they carry out. These concerns fall within the context of developing economic and legislative policies, measures to encourage the environmental protection, increasing concerns of interested parties in the environmental issues and sustainable development.

The National Company "Romanian Waters" seeks, through the national water quality monitoring system, the quality status of groundwater and surface water resources, and the observance of the concentrations of pollutants, included in the regulatory documents issued to users for water quality protection.

This study aims to highlight the situation of the site where performs its activities the company TMK REŞIŢA, located on the administrative territory of Resiţa municipality, Caraş Severin county.

The integrated steel plant is located on the right bank of Bârzava River. The main watercourse that drains the studied area is Bârzava River (it collects water from an area of 917 km^2 and has a length of 127 km). The major tributaries (with constant flow) of Bârzava River are the brooks: Ţerova, Valea Domanului and Valea Mare. Upstream from Reşiţa municipality, some reservoirs are built.

Specific for the company is that, on the above-mentioned territory, the main productive departments are so organized as to constitute virtually separate enclosures, adjacent to the residential and industrial areas. Near the location of the slag dump, there are no protected natural areas, and no areas to protect the natural and cultural patrimony elements.

Also, there are no protected areas for the drinking water and the mineral or thermal water springs. Downstream by ca. 30 km from TMK REŞIŢA and UCM Reşiţa, which are the main pollution sources of Bârzava River, it is located a drinking water station, in Birda. The production site has an area of 356,873 m^2, being located in the northern part of Resita municipality.

The activities of the company TMK REŞIŢA are: steel-making by electric arc process, continuous casting and vacuum treatment, for the generation of utilities for the basic activities. Some sectors of the company have ceased the activity or were scraped. Currently, the only activities taking place on site are those related to the electric steel plant and continuous casting, along with support activities of maintenance and supply of utilities which serve the above.

In the technological process of steel-making by electric arc process, the water is used only to cool the various components of the electric furnace (door, vat, vault, electrode supports) and the installation of flue gas capture and treatment. For the direct and indirect cooling, the casting machine uses water that comes through closed, independent circuits, i.e.:

- *Treated water - for indirect cooling in closed circuit, at moulds and closed items. After cooling, the water is entirely recovered on independent circuits having higher temperature, without any contamination;*
- *Industrial filtered water – for direct cooling of the billets (secondary cooling) and the opened elements of the casting machine. After cooling, the water is gravity recovered through drains. It is contaminated by heating and iron oxide particles and oils.*

The water losses from the circuits are normally due to evaporation (at open circuits) or leaks (in closed circuits). The compensation for losses is made in the water station, by adding water of appropriate quality.
From the technological processes, it results metal waste that is further recycled in the process, or liquid solutions that are neutralized and diluted before discharging to sewer.
The location of the landfill has two impermeable barriers, as follows:

- *a natural geological barrier composed of sandy clay, sandstone and conglomerates, with thicknesses of several tens of meters, located beneath the slag dump.*
- *a built barrier, represented by the actual slag dump, which has an average thickness of 32 m, which was cemented over time, satisfying the conditions of permeability and thickness (permeability of 10^{-9}m/s, layer thickness greater than 0.5 m).*

The existence of a natural geological barrier along with another one built assures the required conditions for the deposit waterproofing and groundwater protection. The water from precipitation is discharged into Țerova Brook, unpolluted, with characteristics similar to natural waters.
The storing of the auxiliary materials used in the process is made inside a separate hall, specially arranged for this purpose. The transport and handling are performed with appropriate means, by trained personnel. Most of the supporting materials are solid (lumps, pellets, or powders) and packed, and they are not stored directly on the ground. They do not fall into the category of dangerous or high toxicity substances, and that's why their management does not require special transportation, storage or handling measures.
The protection of groundwater and surface water resources and the aquatic ecosystems is to improve and maintain their natural quality, in order to avoid negative effects on the environment and human health, in the context of achieving sustainable development.
The maximum permissible concentrations of pollutants contained in wastewater, discharged into water resources, in permeable soils or depressions with natural drainage and in sewage systems, are determined for the discharge area according to the capacity of the receptors, and are mentioned in the permits and authorizations for water management issued to the water users.
Reducing the negative impact on the environment in the regions its operation is an essential condition and one of the main priorities of the strategic development. In accordance with the principle of sustainable development, the efforts were mainly focused on improving the environmental efficiency of production processes, reducing consumption of natural resources, and minimizing waste disposal. [6]
The main tasks in this area – reducing water consumption and gradually reducing the impact on water bodies – must be solved due to the development of recycling schemes and increasing the efficiency of existing treatment facilities.[6] The transition to recycling water supply is a prerequisite for the introduction of new production capacities, modernization and reconstruction of production facilities.

DEVELOPMENT OF A CONCEPTUAL MANAGEMENT MODEL

The Company's system to manage waste from production aims to implement practical actions to reduce waste generation, recycling, disposal and minimization of placement in the environment.
Based on the information provided by this stage of the study, and on those provided in the documentation accompanying the request for integrated environmental permit for the company site, we further propose a conceptual model of site, to illustrate how the work can affect the quality of the environment and human health.
The pollution monitoring is a necessary part of any environmental management system, being the basis for a knowingly conducted decision-making process and for developing environmental management strategies.
The discharges into the environment from major sources are traced in a general monitoring process of the significant sources of pollutants within the boundaries of an atmospheric area or a river basin. The objectives of the monitoring systems include also process optimization issues, verification and compliance with legislative requirements (i.e. allowable emission limits).
The monitoring plans are designed and implemented to collect data on air and water quality, and the discharges of significant pollutants from major sources. The elements of a monitoring plan typically include the following elements:

- *selection of significant parameters;*
- *method of sampling and transport of samples, specifying the sampling point, frequency, type and quantity of samples, and the test equipment;*
- *analyses of samples or, alternatively, continuous monitoring.*

The conceptual model includes the identification of the potential and actual sources of pollution, the ways of pollution transmission and the sensitive receptors. Based on it, we will further decide the need for investigations or monitoring conducted to achieve the general target of the study (i.e. to obtain a reference point for the current site).
The proposed conceptual model is based on:

- *data on site history and the industrial activities that were held here – for soil and groundwater;*
- *the current technological processes, balances of raw materials, auxiliary materials, utilities;*
- *monitoring of the activity by the holder of this activity;*
- *monitoring carried out by other specialized units – accredited laboratories;*
- *findings, information and recommendations of the steel related reference documents.*

To complement the database on the studied site, we considered the monitoring results of:

- noise measurements at various points on the site and neighbourhood, to gain an insight into the areas most exposed to noise;
- determinations on the premises immission limits, due to the fugitive and diffuse emissions from the electric steel shop and the continuous casting;
- determinations regarding the emissions level;
- highlighting the potential impact of water discharges in Bârzava River;
- groundwater analysis, to determine its degree of contamination.

The background levels of pollutants, such as metals, are measured in air, water and soil, along with other parameters, in preset points and with preset frequencies, by using specified equipment and methods. The objective is to collect and analyze representative samples able to indicate the data to be used in the environmental management system. To ensure acceptable levels of background, predictions of the pollutants concentrations are made, using models and data on emissions from some major sources of pollution, which were subsequently verified by direct observations. Time variations of the concentrations of pollutants in surface and groundwater can occur due to:

- seasonal weather changes;
- phenomena of mining landfills erosion;
- human activities, including the remedial measures applied.

To avoid uncontrolled waste water entering the aquifer systems and/or surface emissaries, we will ensure the implementation of measures. The monitoring results are always the basis of the establishment of technical and organizational measures for groundwater and emissaries protection.
The plants are implementing an integrated approach to solving the problem of water resources, gradually achieving optimization of water consumption, water distribution, use, and sewage.

STUDY ON THE MONITORING ACTIVITY AND THE WASTE WATER SOURCES

From the data existing at the administrator of the watercourse (Romanian Waters), it results that, over the years, at normal operation of the company production capacities, the Bârzava River water quality was ensured both in the Birda capture and Romania-Serbia border. On the other hand, it has been frequent accidental pollution due to uncontrolled pollution, especially from the company.
The main pollutants were: petroleum products, cyanide and ammonia. This accidental pollution occurred in the production departments which have meanwhile ceased (coke plant, blast furnaces, open-hearth steel plant). In the moment, as result of technological restructuring, it is unlikely to repeat similar phenomena. But, it is required to plan the site quality surveillance. The monitoring of the work activity is made as follows:

- monitoring of air emissions;
- monitoring of groundwater emissions;
- monitoring of pollutants emissions level in soil;

The holder of this activity is required to monitor the emissions of pollutants from the flue and to monthly report the results, observing the frequency and methods of analysis indicated in the monitoring program.

Table 1. Monitoring of air emissions

Monitoring of air emissions		
No.	Indicators	Frequency
1	Powders	continuous
2	Sulphur oxides	half-yearly
3	Nitrogen oxides	half-yearly
4	Chrome (Cr)	half-yearly
5	Nickel (Ni)	half-yearly
6	Manganese (Mn)	half-yearly
7	Lead (Pb)	half-yearly
8	Cadmium (Cd)	half-yearly
9	Zinc (Zn)	half-yearly
10	Benzene	yearly

Table 2. Monitoring of pollutants emissions level in soil

Monitoring of pollutants emissions level in soil		
No.	Indicators	Frequency
1	Cadmium (Cd)	yearly
2	Chrome (Cr)	yearly
3	Copper (Cu)	yearly
4	Zinc (Zn)	yearly
5	Lead (Pb)	yearly
6	Manganese (Mn)	yearly
7	Hydro carbides	yearly
8	Nickel (Ni)	yearly

Table 3. Monitoring of emissions level in waste waters and

Monitoring of emissions level in waste waters evacuated in Bârzava River		
No.	Indicators	Frequency
1	Settled materials	monthly
2	Chlorides	monthly
3	Sulphates	monthly
4	Nitrogen (totally)	monthly
5	Phosphorus (totally)	monthly
6	Synthetic detergents	monthly
7	Iron (totally)	monthly
8	Residuum filtered at 105°C	monthly
9	Ammonium	monthly
10	Chrome (Cr)	half-yearly
11	Copper (Cu)	half-yearly
12	Nickel (Ni)	half-yearly
13	Zinc (Zn)	half-yearly
14	Manganese (Mn)	half-yearly
15	Lead (Pb)	half-yearly

Table 4. The groundwater emissions

Monitoring of groundwater emissions		
No.	Parameters	Frequency
1	pH	yearly
2	Conductivity	yearly
3	Color	yearly
4	Oxidability	yearly
5	Nitrites	yearly
6	Nitrates	yearly
7	Sulphates	yearly
8	Lead (Pb)	yearly
9	Cadmium (Cd)	yearly
10	Nickel (Ni)	yearly
11	Mercury (Hg)	yearly
12	Copper (Cu)	yearly
13	Zinc (Zn)	yearly
14	Chrome (Cr)	yearly
15	Manganese (Mn)	yearly

All the alerts regarding the accidental pollutions at TMK Reşiţa are from the period before 2000 and refer to the functioning of the sectors that have meanwhile ceased.

In the areas of the steel shop and continuous casting machine, there were no major incidents to cause serious damage to any environmental factors.

However, it should be noted that in the current operation of the electric steel shop, where the wet gas purification plant has been replaced by a dry cleaning plant (bag filters), the particulate air pollution was greatly reduced, having little impact on the sensitive receptors in the area. The waters are collected in the internal network of sewers for industrial wastewater and discharged into Bârzava River by the discharges named "Eruga" and "Rolling Mills".

The sources of wastewater are:

- the installation of secondary cooling by spraying on the molten steel stream, cooling of the open elements of the continuous casting machine and cutting of the semi-finished products that come from the continuous casting machine; waters containing iron oxide particles (scale) and oils from anointing the parts of the continuous casting machine. These waters are treated in the water station and recycled in full;
- washing the filters with gravel and sand. These waters are filtered and separated from the petroleum products by treatment with surfactants, and then fully recycled;
- other sources (auxiliary activities) – waters with insignificant flow rates and reduced loading;
- overflow from the cooling tower – conventionally cleaned waters,
- domestic wastewater;
- rainwater – from the production area.

The domestic wastewater is collected separately and discharged into the municipal sewage, through three discharge points, named: Platan Discharge, Pasaj Discharge and LDS Discharge.

The rainwater collected from the production site is collected by the internal sewage networks and discharged into Bârzava River, through those two above-mentioned discharge points – Eruga and Rolling Mills.

There is no risk of contamination with toxic substances of the rainwater that washes the production site. In the worst case, these waters will lead dust, but this is deposited in a very short time, as sediment, on the river bottom, being assimilated into the natural environment.

RESULTS & DISCUSSION

In order to reduce negative impacts on the air the company is introducing advanced technology with a high degree of industrial emissions purification. Every year activities in this area are carried out, including overhaul of pollution control equipment to improve the efficiency of gas cleaning, etc.

Measurements of emission and immission levels were performed continuously by the company. The results of monitoring the particulate matter emissions, sediment particulate emissions and immission level are presented in the Tables 5–7.

Table 5. Monitoring the particulate matter emissions

Prelevation type (standard; sequential; intermittent)	Prelevation duration [h]	Minimal and maximal concentration [mg/m^3]	Maximal admissible concentration [mg/m^3]
Standard - Eruga	24	0.024 – 0.037	0.05
Standard - RMAS	24	0.024 – 0.031	0.05
Standard – LDS	24	0.022 – 0.049	0.05

Table 6. Monitoring sediment particulate emissions

	Prelevation point	Sediment particulate [g/m^2/month]	Maximal admissible limits [g/m^2/month]
1.	Medium Laboratory	6.57 – 12.67	17
2.	RMAS	3.23 – 16.34	17
3.	ERUGA	6.726 – 12.59	17
4.	LDS	10.55 – 15.90	17

Table 7. Immission level

Pollutant	Values [µg/mc]			Admitted [µg/mc]
	Zone Eruga	Zone LDS	Zone RMAS	
Particulate matter	9.5/10.8	10.6/ 12.4	3.2/8.6	50/150
Sulphur oxides	112/100	100/57	100/100	125/250
Nitrogen oxides	110/100	100/100	100/100	200/100
Monoxide carbon	500/ 500	500/ 500	500/ 500	10.000/ 6.000
Cadmium [Cd]	0.0014/ 0.0001	0.024/ 0.0001	0.0001/ 0.0001	0.02/0.5
Lead [Pb]	0.069/ 00002	0.013/ 0.0074	0.022/ 0.0045	05/5

Based on the results of monitoring the production activities, in order to reduce the pollutant emission and immission, the following partial conclusions may be listed:

- The concentration of the particulate emissions from suspension falls below the regulated threshold;
- The concentration of the emission sedimentary particulates falls below the regulated threshold;
- The concentration of metals in immission falls below the regulated threshold.

No work is required to reduce the emissions and immission of air pollutants. The action plan provided the necessary work to reduce the emissions of air pollutants; this work was completed by the company in due time.

Table 8. Measurements of emission in water. Evacuation – Rolling Mills

	Evacuation – Rolling Mills	
Indicators	Results [mg/l]	Admitted [mg/l]
Manganese	0.032	1.0
Nickel	0.0127	0.5
Zinc	0.037	0.5
Chrome	0.0012	1.0
Copper	0.0248	0.1
Lead	0.0213	0.2

Table 9. Measurements of emission in water. Evacuation – Eruga

	Evacuation – Eruga	
Indicators	Results [mg/l]	Admitted [mg/l]
Manganese	0.033	1.0
Nickel	0.0102	0.5
Zinc	0.066	0.5
Chrome	0.0014	1.0
Copper	0.0321	0.1
Lead	0.0272	0.2

The monitoring results of the emissions to water are presented in Tables 8-9. The quantities of metallic elements (Mn, Ni, Zn, Cr, Cu and Pb) found in the wastewater are presented in Tables 10-11.

Table 10. Quantities of metallic elements (Mn, Ni, Zn, Cr, Cu and Pb) found in the wastewater - Evacuation Eruga

Evacuation Eruga	Mn	Ni	Zn	Cr	Cu	Pb
2008	53.67	16.59	107.33	2.28	52.2	44.24
2009	27.47	2.09	41.21	7.59	26.69	26.81
2010	28.2	6.5	53.3	13	9.6	13

Table 11. Quantities of metallic elements (Mn, Ni, Zn, Cr, Cu and Pb) found in the wastewater - Evacuation Rolling Mills

Evacuation Rolling Mills	Mn	Ni	Zn	Cr	Cu	Pb
2008	130.6	51.83	151	4.9	101.22	86.93
2009	86.37	21.12	168.15	9.56	34.92	116.88
2010	79.45	18.92	154.35	8.7	41.92	72.22

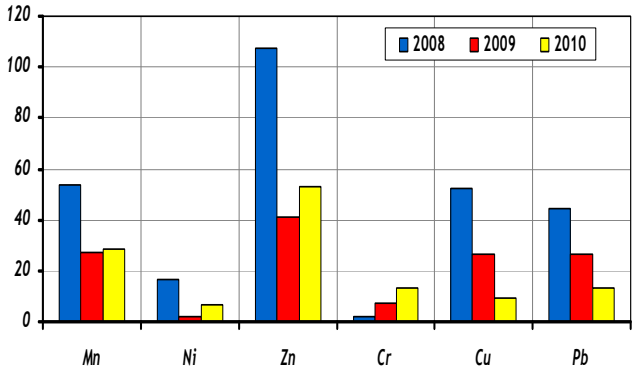

Figure 1. Quantities of metallic elements (Mn, Ni, Zn, Cr, Cu, Pb) found in the wastewater – Evacuation Eruga

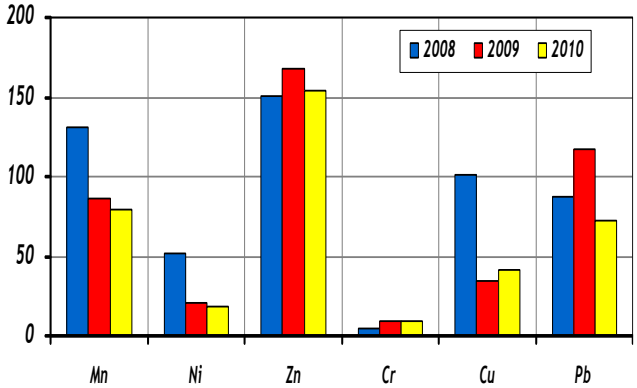

Figure 2. Quantities of metallic elements (Mn, Ni, Zn, Cr, Cu, Pb) found in the wastewater – Evacuation Rolling Mills

The quality indicators, the water discharge values (measured at the two stations) and the values provided by the norms in force are presented in Table 12. The quality indicators in Tables 13-16 are presented (in the case of Eruga evacuation station, respectively in the case of Rolling Mills evacuation station).

Table 12. Quality indicators

Quality indicators	Evacuation – Eruga [mg/l]	Evacuation – Rolling Mills [mg/l]	Admitted [mg/l]
Particulate matter	26 – 36	25.4 – 52	60
Chlorides	7.296 – 14.245	7.644 – 10.076	500
Sulphates	16.3 – 29.2	15.4 – 25.7	600
Nitrogen (totally)	1.48 – 3.74	1.1 – 1.88	10
Phosphorus (totally)	0.182 – 0.365	0.144 – 0.398	1
Detergents	0.042 – 0.204	0.039 – 0.061	0.5
Matter extractable	7– 8.8	6.3 – 9	20
Iron (totally)	0.32	0.32	5

Table 13. Quality indicators – Evacuation "Eruga" [mg/l]

	Particulate matter	Chlorides	Sulphates	Nitrogen (totally)
2008	10.132	11.621	12.11	2.918
2009	13.427	10.115	10.295	2.371
2010	12.635	6.838	10.182	1.238

Table 14. Quality indicators – Evacuation "Eruga" [mg/l]

	Phosphorus (totally)	Detergents	Matter extractable	Iron (totally)
2008	0.35	0.175	7.458	0
2009	0.227	0.294	3.568	0
2010	0.173	0.13	0.582	0

Table 15. Quality indicators – Evacuation "Rolling Mills" [mg/l]

	Particulate matter	Chlorides	Sulphates	Nitrogen (totally)
2008	35.509	18.474	23.982	3.854
2009	17.271	10.466	13.297	0.7848
2010	7.745	10.036	13.122	1.238

Table 16. Quality indicators – Evacuation "Rolling Mills" [mg/l]

	Phosphorus (totally)	Detergents	Matter extractable	Iron (totally)
2008	0.894	0.219	14.8	0
2009	0.1141	0.098	5.812	0.0434
2010	0.0986	0.009	0.518	0

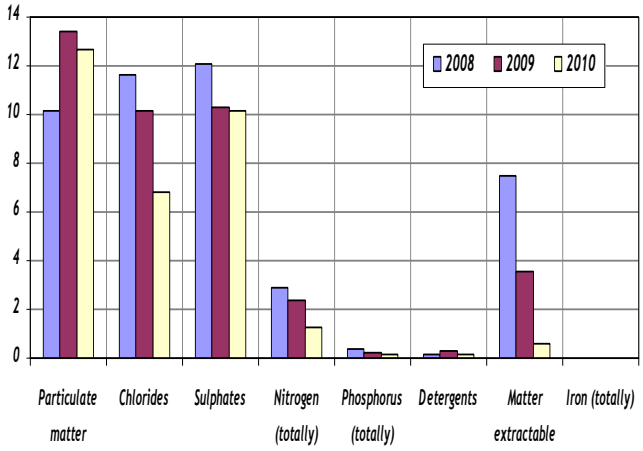

Figure 3. Quality indicators – Evacuation "Eruga" [mg/l] (according to the data included in Tables 13-14)

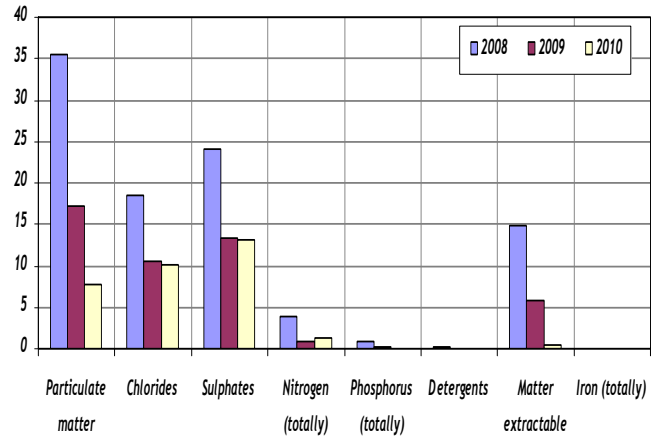

Figure 4. Quality indicators – Evacuation "Rolling Mills" [mg/l] (according to the data included in Tables 15-16)

Based on the water emissions measurements, the following partial conclusions may be listed:

- *The chemical analysis of the wastewater discharged into Bârzava River indicates that it is within the acceptable limits. The discharge of these waters does not change the quality category of Bârzava River.*
- *The action plan have been provided the necessary works to reduce the emissions of pollutants in surface water, these works being executed by the company. No further works are required, because the effluents meet the regulated limits.*

CONCLUSIONS

The environmental plan provides the necessary works for reducing the emissions of pollutants in soil and groundwater, these works being executed by the company. Likewise, the drillings required for groundwater monitoring on the company site and the slag dump have been made.

In terms of environmental impact assessment, a rigorous quality management is essential for designing studies on the initial conditions and for the subsequent environmental management programs, especially for the sample collection, preparation and analysis, evaluation of the analytical results, choosing locations, especially those for waste disposal.

Based on the results of production activities monitoring, carried out on the site of TMK RESITA Company, we can conclude the followings:

- *The concentration of the pollutants in soil falls below the alert threshold value. The concentrations of pollutants in groundwater fall below the regulated limits. We found small exceeding values at the indicators Mn and Pb, in the slag dump area. So, the further groundwater monitoring is recommended to track the progress over time of these pollutants;*
- *The rainwater is collected from the internal sewage networks and it is discharged into Bârzava River through two discharge points – Eruga and Rolling Mills. There is no risk of contamination with toxic and dangerous substances of the rainwater that washes the production site. In the worst case, these waters will lead dust, but that is deposited in a very short time, as sediment, on the river bottom, being assimilated into the natural environment;*
- *The indirect cooling water from the EAF, LF and dedusting plant, which is conventional clean water, is recirculated in the plant. The overflow discharged into Bârzava River is conventional clean water which falls within the permissible limits on discharge;*
- *The company does not generate industrial waste water, but only conventional clean cooling water or reduced pollutant loading cooling water;*
- *The quality of the effluents discharged falls in the imposed discharge conditions (Eruga and Rolling Mills discharges into Bârzava River). The detailed modeling is not required, given the low concentration of discharged pollutants;*
- *The chemical analysis of the wastewater discharged into Bârzava River indicates that the water composition is within the acceptable limits. The discharge of these waters does not change the quality category of Bârzava River;*
- *After monitoring the emissions and immissions, it was found that they fall within the regulatory limits. We recommend to continue the monitoring and to take the appropriate actions in case of exceeding the current regulatory limits;*
- *After monitoring the emissions to surface waters, it was found that they fall within the regulatory limits;*

The quality assurance plan formulated the arguments that led to the establishment of the number of sampling points, the location of these points, the sampling frequency, the equipment and methods of sample collection.

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A NEW APPROACH FOR SOLVING GAS DYNAMIC EQUATION

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ABSTRACT: *In this paper, a new analytical technique called the Reconstruction of Variational Iteration Method (RVIM) is suggested for finding the exact solution of gas dynamic equation. The solution procedure explicitly reveals the complete reliability and simplicity of the proposed algorithm. The RVIM technique has been successfully applied to many nonlinear problems in science and engineering. All of these verify the great potential and validity of the RVIM technique in comparison with Variational Iteration Method (VIM) for strongly nonlinear problems in science and engineering.*
KEYWORDS: *Reconstruction of Variational Iteration Method (RVIM), Gas dynamic equation; Analytical solution, Adomian decomposition method (ADM)*

INTRODUCTION

Gas dynamics is a science in the branch of fluid dynamics concerned with studying the motion of gases and its effects on physical systems, based on the principles of fluid mechanics and thermodynamics. The science arises from the studies of gas flows, often around or within physical bodies, especially at speeds comparable to the speed of sound or beyond, and sometimes with a significant change in gas and objects temperatures [1].

Some examples of these studies include but not limited to choked flows in nozzles and valves, shock waves around jets, aerodynamic heating on atmospheric reentry vehicles and flows of gas fuel within a jet engine. At the molecular level, gas dynamics is a study of the kinetic theory of gases, often leading to the study of gas diffusion, statistical mechanics, chemical thermodynamics and non-equilibrium thermodynamics [2].

Gas dynamics is synonymous with aerodynamics when the gas field is air and the subject of study is flight. It is highly relevant in the design of aircraft and spacecraft and their respective propulsion systems. Progress in gas dynamics coincides with the developments of transonic and supersonic flight. As aircraft began to travel faster, the density of air began to change, considerably increasing the air resistance as the air speed approached the speed of sound.

The phenomenon was later identified in wind tunnel experiments as an effect caused by the formation of shock waves around the aircraft. Major advances were made to describe the behavior during and after World War II, and the new understandings on compressible and high speed flows became theories of gas dynamics.

Most phenomena in real world are described through nonlinear equations and these kinds of equations have attracted lots of attention among scientists. A wide range of nonlinear equations do not have a precise solution, so analytical methods have been used to handle these equations.

Many different new methods have recently presented some techniques to eliminate the small parameter; for example, Hirota's bilinear method [3], the homogeneous balance method [4], inverse scattering method [5], Adomian's decomposition method ADM [6], the Variational Iteration Method [7-10], Homotopy Perturbation Method [11-14] Energy Balance Method [15], as well as Homotopy Analysis Method (HAM)[16].

One of the newest analytical methods to solve nonlinear equations is Reconstruction of variational Iteration Method (RVIM) which is an accurate and a rapid convergence method in finding the approximate solution for nonlinear equations.

By applying Laplace Transform, RVIM overcomes the difficulty of the perturbation techniques and other variational methods in case of using small parameters and Lagrange multipliers, respectively. Reducing the size of calculations and omitting the difficulty arising in calculation of nonlinear intricately terms are other advantages of this method.

In this paper RVIM has been applied for finding the exact solution of following equation:

$$\frac{\partial u}{\partial t}+1/2\frac{\partial(u^2)}{\partial x}=u(1-u)+g(x,t);\quad 0\le x\le 1, t>0 \qquad (1)$$

BASIC IDEA OF RVIM

To clarify the basic ideas of our proposed method in [17, 18], we consider the following differential equation same as VIM based on Lagrange multiplier [19]:

$$Lu(x_1,\cdots,x_k)+Nu(x_1,\cdots,x_k)=f(x_1,\cdots,x_k) \qquad (2)$$

By suppose that

$$Lu(x_1,\cdots,x_k)=\sum_{i=o}^{k}L_{xi}u(x_i) \qquad (3)$$

where L is a linear operator, N a nonlinear operator and $f(x_1,\cdots,x_k)$ an inhomogeneous term.

We can rewrite equation (2) down a correction functional as follows:

$$L_{xj}u(x_j)=\underbrace{f(x_1,\cdots,x_k)-Nu(x_1,\cdots,x_k)-\sum_{j\neq j}^{k}L_{xi}u(x_i)}_{h((x_1,\cdots,x_k),u(x_1,\cdots,x_k))} \qquad (4)$$

therefore

$$L_{xj}u(x_j)=h((x_1,\cdots,x_k),u(x_1,\cdots,x_k)) \qquad (5)$$

with artificial initial conditions being zero regarding the independent variable x_j.

By taking Laplace transform of both sides of the equation (5) in the usual way and using the artificial initial conditions, we obtain the result as follows

$$P(s).U(x_1,\cdots,x_{i-1},s,x_{i+1},x_k)=H((x_1,\cdots,x_{i-1},s,x_{i+1},x_k),u) \quad (6)$$

where $P(s)$ is a polynomial with the degree of the highest derivative in equation (6), (the same as the highest order of the linear operator L_{x_i}). The following relations are possible;

$$\ell[h]=H \quad (7\text{-}a)$$

$$B(s)=\frac{1}{P(s)} \quad (7\text{-}b)$$

$$\ell[b(x_i)]=B(s) \quad (7\text{-}c)$$

which that in equation (7-a) the function $H((x_1,\cdots,x_{i-1},s,x_{i+1},x_k),u)$ and $h((x_1,\cdots,x_{i-1},x_i,x_{i+1},x_k),u)$ have been abbreviated as H, h respectively.

Hence, rewrite the equation (6) as;

$$U(x_1,\cdots,x_{i-1},s,x_{i+1},x_k)=$$

$$=H((x_1,\cdots,x_{i-1},s,x_{i+1},x_k),u).B(s) \quad (8)$$

Now, by applying the inverse Laplace Transform on both sides of equation (8) and by using the (7-a) - (7-c), we have;

$$u(x_1,\cdots,x_{i-1},x_i,x_{i+1},x_k)=$$

$$=\int_0^{x_i} h((x_1,\cdots,x_{i-1},\tau,x_{i+1},x_k),u).b(x_i-\tau)d\tau \quad (9)$$

Now, we must impose the actual initial conditions to obtain the solution of the equation (2). Thus, we have the following iteration formulation:

$$u_{n+1}(x_1,\cdots,x_{i-1},x_i,x_{i+1},x_k)$$
$$=u_o(x_1,\cdots,x_{i-1},x_i,x_{i+1},$$
$$\int_0^{x_i} h((x_1,\cdots,x_{i-1},\tau,x_{i+1},x_k),u).b(x_i-\tau)d\tau \quad (10)$$

where u_o is initial solution with or without unknown parameters. Assuming u_o is the solution of Lu, with initial/boundary conditions of the main problem, In case of no unknown parameters, u_o should satisfy initial/ boundary conditions. When some unknown parameters are involved in u_o, the unknown parameters can be identified by initial/boundary conditions after few iterations, this technology is very effective in dealing with boundary problems. It is worth mentioning that, in fact, the Lagrange multiplier in the He's variational iteration method is $\lambda(\tau)=b(x_i-\tau)$ as shown in [18].

The initial values are usually used for selecting the zeroth approximation u_o. With u_o determined, then several approximations $u_n\ n>o$, follow immediately. Consequently, the exact solution may be obtained by using:

$$u(x_1,\cdots,x_{i-1},x_i,x_{i+1},x_k)=$$
$$=lim_{n\to\infty}u_n(x_1,\cdots,x_{i-1},x_i,x_{i+1},x_k). \quad (11)$$

APPLYING RVIM FOR GAS DYNAMIC EQUATION

In order to assess the advantages and the accuracy of RVIM for solving gas dynamic equation, we will consider the following two examples. For the sake of comparison, we take the same examples as used in [20].

Example 2.1. Homogeneous gas Dynamic equation:

To apply the RVIM, first we rewrite Eq. (1) with g(x, t) = o in the following form:

$$\frac{\partial u}{\partial t}=-1/2\frac{\partial(u^2)}{\partial x}+u-u^2, \quad (12)$$

With initial condition:

$$u_o(x,t)=e^{-x}, \quad (13)$$

At first rewrite eq. (1) based on selective linear operator as

$$\ell\{u(x)\}=u_t=\overbrace{-1/2\frac{\partial(u^2)}{\partial x}+u-u^2}^{h(x,t,u)} \quad (14)$$

Now Laplace transform is implemented with respect to independent variable x on both sides of eq. (14) and by using the new artificial initial condition (which all of them are zero) we have

$$sU(x,t)=\ell\{h(x,t,u)\} \quad (15)$$

$$U(x,t)=\frac{\ell\{h(x,t,u)\}}{s} \quad (16)$$

And whereas Laplace inverse transform of 1/s is as follows

$$\ell^{-1}[\frac{1}{s}]=1 \quad (17)$$

Therefore by using the Laplace inverse transform and convolution theorem it is concluded that

$$u(x,t)=\int_0^t h(x,\varepsilon,u)d\varepsilon \quad (18)$$

Hence, we arrive the following iterative formula for the approximate solution of subject to the initial condition (13).

So, in exchange with applying recursive algorithm, following relations are achieved

$$u_{n+1}=u_o+\int_0^t(-1/2\frac{\partial(u^2)}{\partial x}+u-u^2)d\varepsilon \quad (19)$$

Now we start with an arbitrary initial approximation $u_o(x,t)=e^{-x}$, that satisfies the initial condition and by using the RVIM iteration formula (19), we have the following successive approximation

$$u_o(x,t)=e^{-x},$$
$$u_1(x,t)=te^{-x},$$
$$u_2(x,t)=\frac{t^2}{2}e^{-x},$$
$$u_3(x,t)=\frac{t^3}{3!}e^{-x},$$
$$u(x,t)=u_o+u_1+u_2+\ \ldots=e^{-x}(1+t+\frac{t^2}{2}+\frac{t^3}{3!}+\ldots)=e^{t-x}$$

Obtained upon using the Taylor expansion for e^t. Which is exactly the same as obtained by Adomain decomposition method [20], homotopy perturbation method [21] and the variational iteration method coupled with He's polynomials [22].

Example 3.2. Inhomogeneous gas Dynamic equation:

Now we rewrite Eq. (1) in the following form:

$$\frac{\partial u}{\partial t} = -1/2\frac{\partial(u^2)}{\partial x} + u - u^2 - e^{t-x}, \qquad (20)$$

With initial condition:

$$u_0(x,t) = 1 - e^{-x}, \qquad (21)$$

At first rewrite eq. (20) based on selective linear operator as

$$\ell\{u(x)\} = u_t = \overbrace{-1/2\frac{\partial(u^2)}{\partial x} + u - u^2 - e^{t-x}}^{h(x,t,u)} \qquad (22)$$

RVIM's iteration formulae in t-direction can be readily obtained.

$$u_{n+1} = u_0 + \int_0^t (-1/2\frac{\partial(u^2)}{\partial x} + u - u^2 - e^{t-x})d\varepsilon \qquad (23)$$

Now we start with an arbitrary initial approximation $u_0(x,t) = 1 - e^{-x}$, that satisfies the initial condition and by using the RVIM iteration formula (23), we have the following successive approximation

$$u_0(x,t) = 1 - e^{-x},$$

$$u_1(x,t) = -e^{t-x} + e^{-x},$$

$$u_n(x,t) = 0, n \geq 2$$

$$u(x,t) = u_0 + u_1 + u_2 + \ldots =$$

$$= 1 - e^{-x} \quad e^{t-x} + e^{-x} + 0 + 0 + \quad \ldots = 1 - e^{t-x}$$

which is exactly the same as obtained by Adomain decomposition method [20], homotopy perturbation method [21] and the variational iteration method coupled with He's polynomials [22].

CONCLUSIONS

In this paper, we successfully apply Reconstruction of Variational Iteration Method (RVIM) for finding the exact solution of gas dynamic equation.

The obtained solutions are compared with those of ADM, HPM and VIMHP. Simplicity and requiring less computation, rapid convergence, and high accuracy are advantages of this technique.

Moreover, the RVIM reduces the size of calculations by not requiring the tedious Adomian polynomials, and hence the iteration is direct and straightforward.

The results reported here provide further evidence of the usefulness of RVIM for finding the analytic and numeric solutions for the linear and nonlinear diffusion equations and, it is also a promising method to solve different types of nonlinear equations in mathematical physics.

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SIZING THE IVF-o INSTALLATION FOR DRYING OF GRASSY PLANTS BY AIR VENTILATION

[1-4.] NATIONAL RESEARCH - DEVELOPMENT INSTITUTE FOR MACHINES AND INSTALLATIONS DESIGNED TO AGRICULTURE AND FOOD INDUSTRY, INMA BUCHAREST, 6 ION IONESCU DE LA BRAD BLV., 013813 BUCHAREST, ROMANIA

ABSTRACT: *This paper presents the technical solutions of an installation for completion of drying hay up to the humidity of 17 ... 18%, by ventilation with cold air or hot air. The installation is constructed from assemblies developed within a modular structure so that users can configure their drying installation according to the needs of the farm. Specific to the installation is the solar panel constructed from a number of solar collectors Nc made of light materials, painted inside with paint or solar lacquers of black color for having an as higher as possible absorption degree of the solar radiation. For the sizing of the drying installations depending on the needs of the feedingstuffs farm were developed tables based on the interdependence of drying platform dimensions, the necessary flow to the fan and the amount of conserved forage material.*

KEYWORDS: *completion hay drying, necessary of feedingstuffs, solar panel*

INTRODUCTION

Ensuring feedingstuffs necessary of good quality for feeding the animals from livestock farms during winter is a matter that concerns particularly the farmers, especially those from hilly and mountainous areas.

The most famous and used feedingstuffs harvesting and conservation technologies which satisfy nearly totally the requirements of the livestock sector are:

- *technology of and obtaining the hay harvesting;*
- *harvesting and conservation technology of feedingstuffs in the form of semi-silage;*
- *technology of harvesting and preservation in form of silage.*

Although in recent years has developed the technology of grass and maize conservation by ensilage, drying as hay remains one of the most used methods, being an excellent complement of the corn silage.

By the drying process is carried out the moisture reduction of feedingstuffs from 70 ... 80% as field green mass, up to 17 ... 18%, allowing the long term storage without mold [1, 2, 3, 5].

The hay has a significant weight in the forage balance during winter, especially in hilly and mountainous regions where there are large areas of grasslands. In the plain regions, hay is produced on agricultural lands planted with annual or perennial forage plants, the natural grasslands occupying smaller areas. The importance of hay is determined by the large share that it has in the animal feeding and of the increased content in nutrients and vitamins.

The nutrient-rich of hay depends primarily on the chemical composition and the nutritional value of green fodder from which it come, appropriate to harvest time and secondly on the conditions of harvesting, handling and storage.

To reduce drying time and implicitly of the loss of nutrients were developed several methods of harvesting, preparation and conservation of hay. The known methods for feeding stuffs drying are: traditional drying (natural) on stubble; drying on supports; drying feeding stuffs by ventilation with cold air; drying of feedingstuffs by venting with hot air; drying of green fodder by thermal dehydration in special drying and briquetting stations etc.

The biggest losses of nutrients are obtained at the traditional drying of hay on stubble. These losses reach in case of bad weather, even to 50 ... 60%, the drying time rising to over 6 ... 8 days [1].

Collection of pre-dried hay with a dry matter content of 60 ... 70% and drying it with special equipment by cold or hot air ventilation, can reduces the losses by up to 15 ... 20% [5].

In the paper will be presented the technical solutions of an installation for ventilation of hay, in which the air is heated in solar collectors.

MATERIALS AND METHODS

To meet the requirements of farmers in the conservation of fodder plants as hay were conducted researches to achieve a hay drying installation by ventilation of cold or hot air, friendly with the environment, affordable and easily adapted to the specific of farms.

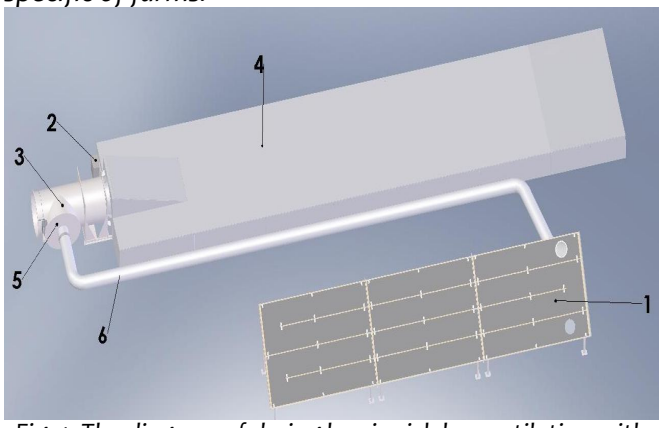

Fig. 1. The diagram of drying hay in rick by ventilation with cold or hot air, solar collectors variant, IVF - o
1. solar panel assembled, 2. electrical installation, 3.ventilation equipment, 4. drying and storage platform; 5.flange connection with the piping, 6. pipe for hot air circulation

Following this objective, it have acted to achieve of an installation (fig. 1) adaptable to the needs, with the main assemblies developed in a modular structure so that the users to configure their drying installation according to the needs of the farm and to the purchasing power.

Since the method of feedingstuffs drying by ventilation with hot air proved to be expensive in terms of energy consumption (electrical, mechanical) it have resorted to the use of non-conventional energy (solar, geothermal) for heating of air, in our case was made the installation with solar collectors assembled as a panel (Fig. 2).

The simplest construction of a solar panel consists of two end type solar modules (1), (3) and an intermediary solar collector (2) (Fig.2).

The intermediary cells were designed so that the solar panel can be constructed with „N" intermediary module, without any constructive changes, in order to increase the area exposed to the sun and of the air volume heated.

Drying of fodder plants stored on the hay drying and storage installation platform, begins at the time when the ventilation plant will be put into operation by pressing the starting button of the power panel and the air aspirated by the fan will be spread in the mass of forage layer stored on the drying platform.

The paper presents the technical methods approached for the sizing of forage drying installation by ventilation with cold or hot air, in accordance with the requirements of forages and the climate characteristics in the area of placement.

Also, the solar panel was designed in modular construction, of collectors with the dimensions that allow the transport and the safe handling and with simple means.

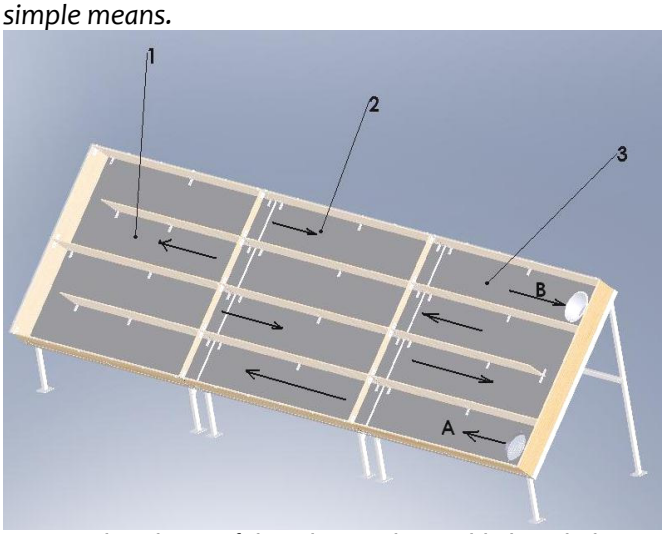

Fig.2 - The scheme of the solar panel assembled , with three solar collectors. 1. solar collector I, 2. intermediary solar collector 3. solar collector II

Each captor is built from a welded metal frame equipped with attachment points of the components. Onto the frame shall be mounted the thermal insulated panel for the cell isolation and capturing the heat, the side walls and end beams. The modules are isolated on top by a glass or plexiglass cover.

The intermediate collectors are differentiated between them by the fact that these have the windows at the connecting ends, through which the air communicate from one module to another.

The sizing of drying installations with air is made starting from the cold air flow necessary for the drying of one ton of forages, or knowing the necessary air flowrate for a base area of 1m^2.

The values recommended by [1, page 70], for the specific air flow, Qu, necessary for the ventilation of one m2 of the drying platform surface, of a layer with a height of approx. 2 m, are different, depending on zone:

- *for dry climates zons: Q_u = 200 ... 250 m^3/h on each m^2 (0,005... 0,069 m^3/s)*
- *for wetter climate zones (hilly or mountainous area): Q_u= 300 .... 450 m^3/h on each m^2 of drying surface (0,08 ... 0,125m^3/s).*

Higher air flow rates are necessary when the system has no side walls sealed and air leaks occur.

The airflow necessary for ventilation was calculated with the equation (1):

$$Q_{necesar\_ventilare} = Q_u \bullet S_p \qquad (1)$$

where: S_p – the surface of drying and storage platform;

Q_u - airflow necessary for surface of the platform of 1 m^2,

The value of the airflow necessary for ventilation calculated with formula (1) is necessary for choosing the ventilator from the installation endowment.

It is recommended according to [5, page 24] the following:

- linear velocity of airflow through a layer of withered forage to be of 0.1 m / s;

- the intensity of airflow through a layer of dry forage to be 0,1 m^3 air per m^2/s;

Tyhe analysis and establishment of the dimensional characteristics of the forage store and of the solar air heating panel will be done in conjunction with the necessary flow for ventilation, the necessary mass forage for the number of animals of the farm.

On configuring the solar panel and establishing the number of collectors it is recommended that the volume of resulted solar panel to be at least double that of the ventilator flowrate which will be chosen according to the necessary ventilation flowrate value.

RESULTS AND DISCUSSION

The project developed for the storage platform imposed the following initial data:

S_p - the drying platform surface is determined by two end modules and n intermediate modules with the following dimensions:

$$S_p = L \bullet B\ [m^2] \qquad (2)$$

L – platform length [m]

$$L = \sum_{i=1}^{n} l_i + 2l_c\ [m] \qquad (3)$$

l_i – the length of an intermediate module, [m],

l_i = 2 m

l_c – the length of the end module, [m],

l_i = 2,1 m

B – the platform width, B=3 m

V_d - the deposit volume was calculated for the hay layer height of 4 m.

M_f – the feeding stuffs weight [kg].

$$M_f = \psi \bullet V_d \ [kg] \qquad (4)$$

ψ – volumetric weight from the alfalfa hay at 17% moisture, according to [2].

Ψ = 60 kg/m^3

The interdependence between the drying platform dimensions, the necessary flowrate to the fan and the quantity of forage material conserved is presented summarized in Table 1.

Table 1 (1). Sizing of drying platform and necessary flow at the fan

Surface of drying platform	The volume of forage deposit	The necessary flowrate to the ventilator depending on the climate of the area	
S_p	Vd	$Q^{a)}_{ventilator}$	$Q^{b)}_{ventilator}$
[m^2]	[m^3]	[m^3/s]	[m^3/s]
18.6	74.4	1.16	1.94
24.6	98.4	1.54	2.56
30.6	122.4	1.91	3.19
36.6	146.4	2.29	3.81
42.6	**170.4**	**2.66**	**4.44**
48.6	194.4	3.04	5.06
54.6	218.4	3.41	5.69
60.6	242.4	3.79	6.31
66.6	266.4	4.16	6.94
72.6	290.4	4.54	7.56
78.6	314.4	4.91	8.19
84.6	338.4	5.29	8.81
90.6	362.4	5.66	9.44
96.6	386.4	6.04	10.06
102.6	410.4	6.41	10.69

Table 1 (2). Sizing of drying platform and necessary flow at the fan

Surface of drying platform	The forages weight at the humidity of 17%		The number of cows fed in the winter months
S_p	M_f		E_{vaci}
[m^2]	[kg]	[t]	[cap]
18.6	4464	4.464	3... 4
24.6	5904	5.904	4... 6
30.6	7344	7.344	5...7
36.6	8784	8.784	6... 9
42.6	**10224**	**10.224**	**7... 10**
48.6	11664	11.664	8... 12
54.6	13104	13.104	9... 13
60.6	14544	14.544	10... 15
66.6	15984	15.984	11... 16
72.6	17424	17.424	12... 17
78.6	18864	18.864	13... 19
84.6	20304	20.304	14... 20
90.6	21744	21.744	14... 22
96.6	23184	23.184	15... 23
102.6	24624	24.624	16... 25

a-The air flowrate necessary to the ventilator, calculated for dry climate zones, considering the specific air flowrate Qu=225 [m^3/h]

b-The air flowrate necessary to the ventilator, calculated for wetter climate zones, considering the specific air flowrate Qu=375 [m^3/h]

Based on these data and the categories of animals in the household, the farmer can check if the stock is enough for a period of 6 months, such as might take the winter. It is considered that a 600 kg cow consumes about 5 ... 8 tons of silage, 1 ... 1.5 tons of hay and 0.5 ... 1 tone of concentrate feed in a normal winter of around 4 ... 5 months.

Sizing of solar panel of drying installation by ventilation with hot air will be done in conjunction with the necessary flow to the fan. It is recommended that the solar panel volume to be at least double compared to the airflow required for ventilation of feeding stuffs, expressed in m^3/s.

The solar panel proposed to study will consist of N_c solar collectors made of lightweight materials, painted inside with dye or solar varnishes in black colour to have the as possible highest absorption rate for the solar radiation.

The main assemblies are shown in Figure 2, and the inside dimensions are the same for the three types of collectors.

The technical characteristics of the solar panel depending on the number of collectors are summarized in Table 2.

The construction of solar panel modules and the information from Tables 1 and 2 allow users the hay drying installation configuration after the necessary in feedingstuffs, the farm size and the financial possibilities.

Table 2 (1). The characteristics of solar panels depending on the number of collectors

The inside dimensions of the solar collectors			The number of solar collectors	The inner volume of a solar panel
h_c	L_c	l_c	Nc	Vi
[m]	[m]	[m]	[Buc.]	[m^3]
0.254	3	2.05	3	4.67
			4	6.23
			5	7.78
			6	9.34
			7	10.90
			8	12.46
			9	14.01
			10	15.57
			11	17.13
			12	18.68
			13	20.24
			14	21.80
			15	23.35
			16	24.91
			17	26.47
			18	28.02

Table 2 (2). The characteristics of solar panels depending on the number of collectors

The inside dimensions of the solar collectors			Solar Panel length	The solar panel surface
h_c	L_c	l_c	L_{pc}	S_{ps}
[m]	[m]	[m]	[m]	[m^2]
0.254	3	2.05	9	18.389
			12	24.518
			15	30.648
			18	36.777
			21	42.907
			24	49.036
			27	55.166
			30	61.295
			33	67.425
			36	73.554
			39	79.684
			42	85.813
			45	91.943
			48	98.072
			51	104.202
			54	110.331

For example, in a farm with an effective of 10 cows, to ensure of food in the winter months, according to Table 1, it is necessary a quantity of approx.10 tons of hay stored on a platform with an area of approx. 43 m2 and a height of 4 m. The constant flow ventilator from the installation endowment, will ensure a flowrate of 4,5 m^3/s in the wet climate zones.
The necessary solar panel will be made of N_c solar collectors with a volume of at least 9 m^3.

CONCLUSIONS

Following the research can formulate the following conclusions and assessments:

- *To reduce the loss of nutrients at the traditional drying on stubble of hay, it is recommended application of technology of harvesting and storing of herbaceous forage plants at the humidity of 30...35% and finalizing the drying by the air ventilation;*
- *In the case of completion of hay drying in deposits there are necessary special drying installations by ventilation with cold air or hot air, properly sized depending on the necessary in feedingstuffs of the farm;*
- *For the small farms are recommended the driers of hay by ventilation with air warmed with panels made of solar collectors, for cost reduction under the aspect of electrical or mechanical energy.*
- *The parameters analyzed in Tables 1 and 2, provide to beneficiaries the information necessary to configure a drying installation of hay, constructed of lightweight solar collectors.*

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Scientific Events in 2012

1. THE 4th INTERNATIONAL CONFERENCE ON MATERIALS SCIENCE AND TECHNOLOGIES – ROMAT 2012
17–19 October, 2012, Bucuresti, ROMANIA

On behalf of the Organizing Committee, we are honored to invite you to participate and submit a paper at the 4th INTERNATIONAL CONFERENCE ON MATERIALS SCIENCE AND TECHNOLOGIES – ROMAT 2012 organized by POLITEHNICA University of Bucharest - Materials Science and Engineering Faculty in association with Bucharest Chamber of Commerce and Industry.

We are convinced that your presence will particularly contribute to a high level of the conference and it is an occasion to achieve an efficient idea and information exchanges for further development of this field.

The 4th INTERNATIONAL CONFERENCE ON MATERIALS SCIENCE AND TECHNOLOGIES aims to providing a forum for presentation and discussion of scientific research, technological development and practice on the subjects of advanced materials and technologies, materials characterization, environmental protection in materials industry, economics and management in materials industry.

The Conference is jointly organized by the POLITEHNICA University of Bucharest, Materials Science and Engineering Faculty and Bucharest Chamber of Commerce and Industry.

The Conference topics will cover the following fields:

- *ADVANCED MATERIALS AND TECHNOLOGIES: Ferrous and Non-ferrous Metallurgy; Materials Engineering; Materials Processing; Nanomaterials; Casting-solidification; Biomaterials and Medical Devices;*
- *MATERIALS CHARACTERIZATION: Characterization of Microstructure and Material Properties; Functional Materials Modeling; Nucleation, Microstructure Evolution and Phase Transition; Interface Dominated Mechanical Properties; Nanostructured Coatings, Surfaces & Films*
- *ENVIRONMENTAL PROTECTION IN MATERIALS INDUSTRY: Advanced Techniques for Industrial Effluent Treatment; Environment Management ; Instruments under Sustainable Development Requirements; Solutions for Re-use of By-products and Wastes; Health and Environment*
- *ECONOMICS AND MANAGEMENT IN MATERIALS INDUSTRY: Globalization and Prospects on Regional Metallurgy; The Complementarity – Definition Criterion for Industrial Strategies; The Competitiveness – Fundamental Component of Industrial Policies*

The Conference work will be organized in sessions, including plenary lectures and oral presentations.

Detailed informations here: http://www.romat2012.eu/

2. THE 4th INTERNATIONAL SCIENTIFIC AND EXPERT CONFERENCE – TEAM 2012 (TECHNIQUE, EDUCATION, AGRICULTURE & MANAGEMENT)
17 – 19 October, 2012, Slavonski Brod, CROATIA

The International TEAM Society in cooperation with Mechanical Engineering Faculty in Slavonski Brod, Josip Juraj Strossmayer University of Osijek is honoured to invite you to the 4th International Scientific and Expert Conference TEAM 2012 in the city of Slavonski Brod.

Aim and Scope of the conference: Transfer of Knowledge and Dissemination of Achievements Mobility of Teachers and International Cooperation Interdisciplinary Approach on Development.

Topics: Section 1: PRODUCTION ENGINEERING

- *Advanced manufacturing technologies*
- *Industrial logistics*
- *Material science*
- *Product design and product development*

Section 2: KNOWLEDGE TRANSFER

- *Computer technologies and applications*
- *Education, engineering, pedagogy and didactics*
- *Kinesiologic education in the function of health prevention*
- *Mobility in education*

Section 3: BIOTECHNOLOGY IN AGRICULTURAL ENVIRONMENT

- *Advanced technology and technics in agriculture*
- *Agroecology and organic farming*
- *Landscape architecture and decoration*
- *Plant protection*
- *Wine and fruit production*

Section 4: MARKET-ORIENTED MANAGEMENT

- *Cost management*
- *Knowledge management*
- *Innovation management*
- *EU funding*
- *New opportunities in financial entrepreneurship*

We believe that the conference will provide an open forum for scholar students, academicians, researchers or scientists and insure the exchange of experiences and research results on various aspects and application areas. Conference also gives an excellent opportunity to establish useful professional and research contacts with foreign colleagues and begin a common cooperation between universities and research centers.

Detailed informations here: http://team2012.sfsb.hr/index.html

3. THE 1st INTERNATIONAL SCIENTIFIC CONFERENCE – COMETa 2012 – CONFERENCE on MECHANICAL ENGINEERING TECHNOLOGIES AND APPLICATIONS 28 – 30 November, 2012, Jahorina, BOSNIA&HERZEGOVINA

Faculty of Mechanical Engineering University of East Sarajevo initiates first international conference COMETa 2012, with aims to contribute to the implementation of new technologies into production processes as well as achieving better cooperation between scientific research institutions and enterprises.

Conference topics:

- *Production technologies*
- *Development and design of mechanic systems and components*
- *Modeling and simulation of objects and processes*
- *Mechatronics*
- *Advanced materials, heat treatment, fracture mechanics*
- *Advanced methods of measurement and control of technical systems*
- *Energy efficiency in industry and buildings*
- *Renewable energies and advanced energy technologies*
- *Thermo technique and thermal energy*
- *Maintenance of technical systems*
- *Monitoring and diagnostic of technical systems*
- *Quality and integrated management systems (IMS)*
- *Manufacturing systems, organization and management*
- *Information technologies and intelligent systems*
- *Environmental protection*
- *Education of developers*
- *Student section*

Faculty of Mechanical Engineering East Sarajevo initiates first international conference COMETa 2012, with aims to contribute to the implementation of new technologies into production processes as well as achieving better cooperation between scientific research institutions and enterprises. Production in developed countries is based on the modernization and optimization of manufacturing processes with the use of advanced technologies that are result from scientific researches. The application of new technologies enables more efficient production and competitiveness of enterprises in the global market, where couple with scientific research institutions is very important.

The main goal of this conference is to bring together renowned national and international experts in the field of research and application of new technologies and development of mechanical systems, for sharing experiences and knowledge. Moreover, public presentations of actual researches and new construction solutions improve the competitiveness of the economy in region.

We have great pleasure to invite all interested scientific research institutions and businesses to actively participate and with their papers contribute to successfully organizing of this scientific conference. Detailed informations here: http://www.ues.rs.ba/en/university/international-cooperation/scientific-conferences-and-meetings/cometa-2012

4. THE 2nd INTERNATIONAL CONFERENCE ON CIVIL ENGINEERING AND BUILDING MATERIAL – CEBM 2012 17 – 18 November, 2012, Hong Kong

The 2nd International Conference on Civil Engineering and Building Material (CEBM 2012) will be held in Hong Kong from November 17-18, 2012. It is a premium international conference covers all areas related to the Theory, Development, Applications, Experiences and Evaluation of Civil Engineering and Building Materials and gathers fellow students, researchers and practitioners in these fields from all around the world.

The conference will continue the excellent tradition of gathering world-class researchers, engineers and educators engaged in the fields of Civil Engineering and Building Materials to meet and present their latest activities. You are cordially invited to attend this interesting event. This conference is co-sponsored by Asia Civil Engineering Association, the International Association for Scientific and High Technology and International Science and Engineering Research Center.

The idea of the conference is for the scientists, scholars, engineers and students from the Universities all around the world and the industry to present ongoing research activities, and hence to foster research relations between the Universities and the industry. This conference provides opportunities for the delegates to exchange new ideas and application experiences face to face, to establish business or research relations and to find global partners for future collaboration.

Topics of Conference :

** Structural engineering*
** Road & Bridge engineering*
** Geotechnical engineering*
** Architecture & Urban planning*
** Transportation engineering*
** Hydraulic engineering*
** Coastal Engineering*
** Engineering Management*
** Computational Mechanics*
** Construction technology*
** Building materials*
** Environmental engineering*
** Computer simulation and CAD/CAE*

Detailed informations here: http://www.iasht.org/cebm/

5. INTERNATIONAL CONFERENCE ON MANUFACTURING – MANUFACTURING 2012 14 – 15 November, Macau, CHINA

Manufacturing 2012 will be the most comprehensive conference focused on the various aspects of advances in Manufacturing and Materials Science. This Conference provides a chance for academic and industry professionals to discuss recent progress in the area of Manufacturing and Materials Science. Furthermore, we expect that the conference and its publications will be a trigger for further related research and technology improvements in this important subject.

The goal of this conference is to bring together the researchers from academia and industry as well as practitioners to share ideas, problems and solutions relating to the multifaceted aspects of Manufacturing and Materials Science.

Detailed informations here: http://manufacturing2012.org/index.htm

6. INTERNATIONAL CONFERENCE ON MANUFACTURING ENGINEERING AND TECHNOLOGY FOR MANUFACTURING GROWTH – METMG 2012
1 – 2 November,2012, San Diego, USA

METMG 2012 will be the most comprehensive Conference focused on the various aspects of advances in Manufacturing Engineering and Technology for Manufacturing Growth. Our Conference provides a chance for academic and industry professionals to discuss recent progress in the area of Manufacturing Engineering and Technology for Manufacturing Growth. Topic:

- *Computer Aided Design and Manufacturing and related topics*
- *Material Forming Processes and related topics*
- *Machining Technology and related topics*
- *Welding Technology and related topics*
- *Metallurgical Manufacturing Processes and related topics*
- *Automation in Manufacturing and related topics*
- *Micro and Nano Fabrications and related topics*

Detailed informations here: http://metmg-conf.org/

7. INTERNATIONAL CONFERENCE ON APPLIED PHYSICS AND MATERIALS SCIENCE – APMS 2012
5 – 6 October, 2012, Dalian, CHINA

APMS 2012 will be the most comprehensive conference focused on the various aspects of advances in Applied Physics and Materials Science. Our Conference provides a chance for academic and industry professionals to discuss recent progress in the area of Information Technology, Applied Physics and Materials Science.
The goal of this conference is to bring together the researchers from academia and industry as well as practitioners to share ideas, problems and solutions relating to the multifaceted aspects of Information Technology, Applied Physics and Materials Science.
Detailed informations here: http://www.apms-conf.org/index.htm

8. INTERNATIONAL CONFERENCE ON BIOMATERIAL AND BIOENGINEERING – ICBB 2012
19 – 20 December, 2012, Hong Kong

We are delighted to invite you to participate in 2012 International Conference on Biomaterial and Bioengineering (ICBB 2012) in Hong Kong, and December 19-20, 2012. The objective of ICBB 2012 is to provide a forum for researchers, educators, engineers, and government officials involved in the general areas of Biomaterial and Bioengineering to disseminate their latest research results and exchange views on the future research directions of these fields.
Topics:

- *Material Science and Engineering*
- *Biomaterial and Bioengineering*
- *Mechanical and Manufacturing Engineering*

The ICBB conference provides a forum for engineers and scientists in academia, industry, and government to address profound issues including technical challenges, safety, social, legal, political, and economic issues, and to present and discuss their ideas, results, work in progress and experience on all aspects of Biomaterial and Bioengineering.
Detailed informations here: http://www.icbb-conf.org/

9. INTERNATIONAL CONFERENCE ON FRONTIERS OF MECHANICAL ENGINEERING, MATERIALS AND ENERGY – ICFMEME 2012
20 – 21 December, 2012, Beijing, CHINA

ICFMEME 2012 is one of the leading international conferences for presenting novel and fundamental advances in the fields of Mechanical Engineering, Materials and Energy. The purpose of the conference is for the scientists, scholars, engineers and students from the universities and the research institutes all around the world to present ongoing research activities, and hence to foster research relations.
Topics:

- *(T1) Materials Science and Engineering*
- *(T2) Materials Properties, Measuring Methods and Applications*
- *(T3) Methodology of Research and Analysis and Modelling*
- *(T4) Materials Manufacturing and Processing*
- *(T5) MEMS, NANO, and Smart Systems-on-Chip*
- *(T6) Energy Systems*
- *(T7) Mechatronics, Automation and Signal Processing*

This conference provides opportunities for the delegates to exchange new ideas and application experiences face to face, to establish research or business relations and to find global partners for future collaboration. It also serves to foster communication among researchers and practitioners working in a wide variety of scientific areas with a common interest in improving Mechanical Engineering, Materials and Energy related techniques.
Detailed informations here: http://www.icfmeme.org/

10. INTERNATIONAL CONFERENCE ON ENVIRONMENTAL AND MATERIALS ENGINEERING – EME 2012
9 – 10 December, 2012, Seoul, KOREA

We are delighted to invite you to participate in 2012 International Conference on Environmental and Materials Engineering (EME 2012) in Seoul, Korea, and December 9-10, 2012. The objective of EME 2012 is to provide a forum for researchers, educators, engineers, and government officials involved in the general areas of Environmental and Materials Engineering to disseminate their latest research results and exchange views on the future research directions of these fields.
Topics:

- *Environmental Science and Engineering*
- *Material Science and Engineering*
- *Mechanical and Manufacturing Engineering*

The EME conference provides a forum for engineers and scientists in academia, industry, and government to address profound issues including technical challenges, safety, social, legal, political, and economic issues, and to present and discuss their ideas, results, work in progress and experience on all aspects of Environmental and Materials Engineering.
Detailed informations here: http://www.eme-conf.org/index.htm

11. CENTRAL EUROPEAN CONFERENCE ON LOGISTICS – CECOL 2012
28 – 30 November, 2012, Trnava, SLOVAKIA

As a result of the scientific collaboration among higher education centers of the central European zone and two previous successful editions held in Miskolc, Hungary (2010) and Częstochowa, Poland (2011), the Institute of Production Systems and Applied Mechanics, belonging to the Faculty of Materials Sciences and Technology (MTF) is proud to announce that the 2012 Central European Conference on Logistics (CECOL 2012) will be held in the city of Trnava, Slovak Republic, during November 28th-30th, 2012.
The CECOL 2012 will provide a high-level international platform for academicians and practitioners from all over the world, to present their research results and development activities in the broad field of Logistics.
Topics of interest for the conference should be related but not limited to:
1. Manufacturing process design, optimization and control
2. Manufacturing automation
3. Manufacturing process simulations
4. Analysis of the material flow
5. Maintenance
6. Production planning
7. Production scheduling
8. New teaching and research approaches
9. Intelligent Manufacturing systems and cells
10. Robot implementation into the logistic processes
11. Among others
Detailed informations here: http://www.mtf.stuba.sk/docs//doc/aktuality/2012/Call_for_papers__cecol_2012_.pdf

12. THE 9th NATIONAL CONFERENCE ON TRIBOLOGY WITH INTERNATIONAL PARTICIPATION – BULTRIB'12
18 – 20 October 2012, Sofia, BULGARIA

The Society of Bulgarian Tribologists and the Faculty of Machine Technologies at the Technical University - Sofia organize the annual Tribological Conference with international participation BULTRIB'12 in the Technical University - Sofia.
Topics:
- *Contact interaction*
- *Tribomechanics and tribotechnics*
- *Tribomaterials & coatings*
- *Tribochemistry & tribotechnology*
- *Lubrication & lubricants*
- *Tribometry & triboinformatics*
- *Nano and micro Tribology*
- *Tribology, industry, ecology*
- *Tribotechnology & education*

The Conference BULTRIB'12 is organized together with the biannual Conference with international participation AMTECH'12. The conferences AMTECH are the scientific forum of the Faculties of Machine Technology and Machine Building at the Technical Universities in Sofia, Plovdiv, Russe, Varna and Gabrovo. The topics of AMTECH embrace: machine technology, material science and material technology, theory of mechanisms, machines and automatic lines, virtual engineering, actual problems of quality management, tribology. The Faculty of Machine Technology at the Technical University – Sofia will host the tenth Conference AMTECH'12 and the ninth Conference BULTRIB'12 in the period 19-20 October 2012.
Detailed informations here: http://www.bultrib.com

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MANUSCRIPT PREPARATION – General Guidelines

These instructions are written in a form that satisfies all of the formatting requirements for the author manuscript. Please use them as a template in preparing your manuscript. Authors must take special care to follow these instructions concerning margins. The basic instructions are simple:

- *Manuscript shall be formatted for an A4 size page.*
- *The top and left margins shall be 25 mm.*
- *The bottom and right margins shall be 25 mm.*
- *The text shall have both the left and right margins justified.*

The original of the technical paper will be sent through e-mail as attached document (.doc, Windows 95 or higher). Manuscripts should be submitted to e-mail: redactie@fih.upt.ro, with mention "for* ***ACTA TECHNICA CORVINIENSIS – Bull. of Eng.".***

STRUCTURE

The manuscript should be organized in the following order: Title of the paper, Authors' names and affiliation, Abstract, Key Words, Introduction, Body of the paper (in sequential headings), Conclusion, Acknowledgements (where applicable), References, and Appendices (where applicable).

THE TITLE

The title is centered on the page and is CAPITALIZED AND SET IN BOLDFACE (font size 14 pt). It should adequately describe the content of the paper. An abbreviated title of less than 60 characters (including spaces) should also be suggested.

AUTHOR'S NAME AND AFFILIATION

The author's name(s) follows the title and is also centered on the page (font size 11 pt). A blank line is required between the title and the author's name(s). Last names should be spelled out in full and succeeded by author's initials. The author's affiliation (in font size 11 pt) is provided below. Phone and fax numbers do not appear.

ABSTRACT

A nonmathematical abstract, not exceeding 200 words, is required for all papers. It should be an abbreviated, accurate presentation of the contents of the paper. It should contain sufficient information to enable readers to decide whether they should obtain and read the entire paper. Do not cite references in the abstract.

KEY WORDS

The author should provide a list of three to five key words that clearly describe the subject matter of the paper.

TEXT LAYOUT

The manuscript must be typed single spacing. Use extra line spacing between equations, illustrations, figures and tables. The body of the text should be prepared using Georgia or Times New Roman. The font size used for preparation of the manuscript must be 11 points. The first paragraph following a heading should not be indented. The following paragraphs must be indented 10 mm. Note that there is no line spacing between paragraphs unless a subheading is used. Symbols for physical quantities in the text should be written in italics.

FIGURES AND TABLES

Figures (diagrams and photographs) should be numbered consecutively using Arabic numbers. They should be placed in the text soon after the point where they are referenced. Figures should be centered in a column and should have a figure caption placed underneath. Captions should be centered in the column, in the format "Figure 1" and are in upper and lower case letters. When referring to a figure in the body of the text, the abbreviation "Figure" is used Illustrations must be submitted in digital format, with a good resolution. Table captions appear centered above the table in upper and lower case letters. When referring to a table in the text, "Table" with the proper number is used. Captions should be centered in the column, in the format "Table 1" and are in upper and lower case letters. Tables are numbered consecutively and independently of any figures. All figures and tables must be incorporated into the text.

EQUATIONS AND MATHEMATICAL EXPRESSIONS

Equation numbers should appear in parentheses and be numbered consecutively. All equation numbers must appear on the right-hand side of the equation and should be referred to within the text.

CONCLUSION

A conclusion section must be included and should indicate clearly the advantages, limitations and possible applications of the paper. Discuss about future work.

ACKNOWLEDGEMENTS

An acknowledgement section may be presented after the conclusion, if desired. Individuals or units other than authors who were of direct help in the work could be acknowledged by a brief statement following the text.

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References should be listed together at the end of the paper in alphabetical order by author's surname. List of references indent 10 mm from the second line of each references. Personal communications and unpublished data are not acceptable references.

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