ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering

We are very pleased to inform that our international scientific journal ***ACTA TECHNICA CORVINIENSIS - Bulletin of Engineering*** completed its six years of publication successfully [2008 - 2013, Tome I - VI].

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 all contributors and all collaborators!

Aims & Scope

General Aims

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

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.

Mission

ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering is an international and interdisciplinary journal which reports on scientific and technical contributions. The ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering advances the understanding of both the fundamentals of engineering science and its application to the solution of challenges and problems in engineering and management, dedicated to the publication of high quality papers on all aspects of the engineering sciences and the management.

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.

The Editor reserves the right to return papers that do not conform to the instructions for paper preparation and template as well as papers that do not fit the scope of the journal, prior to refereeing. The Editor reserves the right not to accept the paper for print in the case of a negative review made by reviewers and also in the case of not paying the required fees if such will be fixed and in the case time of waiting for the publication of the paper would extend the period fixed by the Editor as a result of too big number of papers waiting for print. The decision of the Editor in that matter is irrevocable and their aim is care about the high content-related level of that journal.

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We strongly believe that the open access model will spur research across the world especially as researchers gain unrestricted access to high quality research articles. Being an Open Access Publisher, Academic Journals does not receive payment for subscription as the journals are freely accessible over the internet.

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Mechanical Engineering
Metallurgical Engineering
Agricultural Engineering
Control Engineering
Electrical Engineering
Civil Engineering
Biomedical Engineering
Transport Engineering
Nanoengineering
CHEMISTRY
General Chemistry
Analytical Chemistry
Inorganic Chemistry
Materials Science &
Metallography
Polymer Chemistry
Spectroscopy
Thermo-chemistry

ECONOMICS
Agricultural Economics
Development Economics
Environmental Economics
Industrial Organization
Mathematical Economics
Monetary Economics
Resource Economics
Transport Economics
General Management
Managerial Economics
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Environmental Soil Science
Environmental Health
BIOTECHNOLOGY
Biomechanics
Biotechnology
Biomaterials
MATHEMATICS
Applied mathematics
Modeling & Optimization
Foundations & methods

History

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.

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

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.

ACTA TECHNICA CORVINIENSIS – BULLETIN OF ENGINEERING publishes invited review papers covering the full spectrum of engineering and management. 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.

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.

Advisory Board & Steering Committee & Scientific Reviewers

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. 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.

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.

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. The evaluated paper may be recommended for:

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

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.

Associate Editors & Regional 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 six 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.

The members of the Editorial Board may serve as scientific reviewers.

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.

ndexes & Databases

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Tome VII [2014]
Fascicule 4 [October – December]

Abstract: A series of experiments was carried out on a HHO gas producing dry cell, whether we can optimize it by finding an electrolyte concentration, current value, etc. or changing the setup by alternating the distance between the plates. KOH solution was used, and the unit was monitored in several regards, for example cell voltage, gas production, ml/min/W value. Peaks in efficiency were between 5 and 8 g/l concentration and the more current went through the electrolyte, the gas was produced.

Abstract: The objective of present article is an atempt to simulate numerically temperature separation phenomena (Ranque-Hilsch affect) inside the vortex tube. For this simulation computational fluide dynamic (CFD) analysis, applying standard k-ε turbulence model, is used. Geometry is drawn in 3D space using Autodesk Inventor Professional and transferred in Autodesk Simulation CFD to solve the problem. Initial conditions for inlet air stream: temperature 22ºC, flow rate 40l/min and gauge pressure 6 bar are set. As a result air flow velosity field and temperature field is found. Predicted temperatures at cold and hot end are 4 and 42ºC. It can be concluded that vortex tube can be analysed and further optimisated by CFD modeling.

Abstract: This work was carried out to study comparatively the reinforcement efficiency of cow bone and cow bone ash particles in polyester matrix composites in order to consider the suitability of the materials as biomaterial. Cow bone was procured from an abattoir, washed with water and sun dried for 4 weeks and a portion was burnt. The bone ashes and un-burnt bone portions were pulverized separately using the ball mill. Sieve analysis was carried out on the pulverized bone ash and bone particles into particle sizes of 75µm, 106µm and 300µm. Composite materials were developed by casting into tensile and flexural tests moulds using pre-determined proportions of 2, 4, 6, and 8 wt % for both the cow bone and cow bone ash. The samples after curing were striped from the moulds and were allowed to further cure at room temperature for 3 weeks before tensile and flexural tests were performed on them. The tensile test results showed that bone particles reinforced composites have the best tensile properties except in Modulus of elasticity where bone ash particles reinforced composite samples have higher values while the flexural test showed that bone ash particle reinforced samples has the best flexural properties.

Abstract: Many e-learning materials and learning management systems are implemented and used in higher education institutes. The learning materials assisting acquisition of knowledge can either be stand-alone or can be available through the network. In recent years, papers were published about the benefits of the involvement of computers and internet in education. One should also note that some say that although the use of modern technology has some potential effects, it is difficult to turn them into actual ones or to measure them. This paper attempts to give an overview of the most important concepts of e-learning (the virtual learning environment, the learning management system etc.), the main benefits, the disadvantages, the guidelines, rules (the heuristic evaluation instrument and protocol for e-learning programmes, the learning management evaluation tool user guide etc.) and standards that ought be followed when creating such systems. University of Szeged is using CooSpace as an e-learning system. Although CooSpace has its limitations (for example it cannot record the student's progress in acquisition of the curriculum), it has become a popular and a widely used system at the university.

Abstract: Objective of ergonomic design is, among others, adaptation of manual workstations, workplace, working space, environmental conditions and lighting intensity to human properties and skills. Ergonomically designed workstation in

production system with modular structure brings many benefits, e.g. increased motivation and satisfaction of employee, higher performance, productivity, efficiency, and processing quality. This article is a reference to help methodically plan, design and implement ergonomic workstations by considering variables such as employee size, type of task, lighting, and other key factors. The goal is to present the rules of ergonomic for work systems: body height and working height; work area; reach zone; parts presentation; range of vision; lighting; adjustment of work equipment. Using of the modular building- block system for designing individual workplaces enables flexibility and optimal adaptation to task and individual employee concerned.

| 6. | *Ivana LONČAREVIĆ, Biljana PAJIN, Ljubica DOKIĆ, Zita ŠEREŠ, Aleksandar FIŠTEŠ, Dragana ŠORONJA SIMOVIĆ, Veljko KRSTONOŠIĆ – SERBIA* RHEOLOGICAL AND TEXTURAL PROPERTIES OF COCOA SPREAD CREAM WITH SUNFLOWER LECITHIN | 47 |

Abstract: *Sunflower lecithin, together with commonly used soy lecithin, is a by-product of degumming of crude oil during refining process and can be defined as a mixture of phospholipids, residual oil and minor components. This paper investigated the influence of sunflower lecithin on rheological and textural characteristics of cocoa spread cream. Cocoa spread cream samples were made with the addition of 0.3, 0.5 and 0.7% of sunflower lecithin, with a milling time of 40 and 50 minutes in a laboratory ball mill. The results are compared with the results obtained for rheological and textural analyses of standard cocoa spread cream with soy lecithin added. Cocoa cream spread samples with the addition of all applied concentration of soy lecithin in milling time range of 40 to 50 minutes show lower values of thixotropic curve area, mean viscosity and Casson viscosity, but higher values of Casson yield stress, compared with cocoa cream samples with sunflower lecithin. Optimal concentration of soy lecithin is 0.5% with retention time of 40 minutes in laboratory ball mill, while addition of 0.7% of soy lecithin increases complexity of cocoa spread cream, but reduces Casson viscosity. On the other hand, the addition of 0.7% of sunflower lecithin and milling time of 50 minutes show the lowest values of rheological parameters. Cocoa cream samples with sunflower lecithin have lower values of textural parameters comparing with samples with standard soy lecithin.*

| 7. | *Zoltán FABULYA – HUNGARY* ANALYSIS OF THE LOAD-EFFICIENCY GRAPH OF THE BOILER | 51 |

Abstract: *The rentability and quality of preserved food (besides the quality of the basic materials, the good recipe and the features of the production belts) are determined by their heat-treatment and its organization. The production process which was not planned carefully can imply quality problems and considerable increase of expenses. To support work organization with computer has not been in practice in Hungary so far. My main objective in case of technologies with an autoclave group is to elaborate a program system based on simulation which could help reduce the direct costs of heat-treatment and improve the quality of products. For this objective it is necessary to carry out further sub-tasks and examinations whose results should be utilized in the system. One of these is to analyse with simulation the load-dependent efficiency graph of gas boiler which provides the necessary amount of steam and then to use the results to find the conditions of optimal operation and to calculate costs reduction arising from it.*

| 8. | *G. ADEDOKUN, T.K. AJIBOYE, O.R. OYENIRAN – NIGERIA* QUALITY ASSURANCE AS A STRAGETIC APPROACH TO MINIMISE MAINTENANCE COST | 55 |

Abstract: *Entrepreneur's primary objective is to firmly established itself, maximize profit and minimize maintenance cost of its low-cost best quality products that will generate high demand while maintaining a continuous focus on cost-containment and operating efficiencies. This objective can only be achieved if the products' quality meets standard demand of end users. Many approaches to quality control are not effective. Nonconformities in the factory testing are caused basically by excessive process variation and mistakes. Some approaches to quality control can effectively control process variation, but it cannot prevent most mistakes because mistakes are frequently the dominant source of nonconformities. Since maintenance cost of any product is inversely proportional to its quality;hence, the quality and maintenance of any products cannot be over emphasized to attract their high demand. Experience shows many industrial activities collapsed when they were expected to be at the peak of their production performances and theoutcome effect is that, they start to run at a huge loss when they were expected to make profit. Investments on structures will have impact on industrialization when the trend leading to this collapse could be reversed in order to enjoy the full benefits derived from it. Meanwhile, the only strategic approach to minimize maintenance cost is to maximize the quality. An attempt has been made in this paper to discuss maintenance cost minimization from the basics that detect mistakes and enable corrections before nonconformities are generated, achieving the highest degree of quality at minimum maintenance cost.*

| 9. | *Imre Zsolt MIKLOS, Cristina Carmen MIKLOS, Carmen Inge ALIC – ROMANIA* DRIVE MECHANISM ANALYSIS OF DOOR WINDOWS TO ROAD VEHICLES | 61 |

Abstract: *This paper is meant to present a description as well as a classification of the mechanisms for manipulating the windows of road vehicles. A life-size 2D modeling was performed for the handling mechanism with two arms crossed and motorized drive. A structural, kinematic and kinetostatic computer assisted analysis was made using SAM in actual operating conditions.*

| 10. | Mohamed A. A. El-SHAER – EGYPT SEISMIC LOAD ANALYSIS OF DIFFERENT R.C. SLAB SYSTEMS FOR TALL BUILDING | 65 |

Abstract: *This paper introduced the lateral analysis for tall buildings due to the seismic performance for different reinforced concrete slab systems. It study three systems, flat slab, ribbed slab, and panelled beam slab. The three systems are from the most attractive and commonly used floor systems, especially in high-rise constructions. In high seismicity regions, the declared non-ductile flat slab system poses a significant risk, brittle punching failure arises from the transfer of shearing forces and unbalanced moments between slab and columns that may trigger a progressive building collapse. This system is inherently flexible due to the non-rigid slab-column connections, and the building high aspect (height/width) ratio. Hence, in regions of high seismic risk, design codes recommended the use of slab-column frames to resist slabs, and require another stiffer system to resist lateral wind and seismic forces. From this standpoint, the choose of a system that provide rigid concrete slab than flat slab to resist lateral wind and seismic forces. This system is chosen to be the ribbed slab, and the panelled beam slab. These two systems of concrete slabs are ductile, and balanced moments between slab and columns. As the different types of seismic load resisting systems generally presented. Then, three systems of slabs performance for systems high-rise buildings during seismic loads are introduced. Some seismic design, analysis and performance assessment aspects of flat slab, and ribbed slab, and panelled beams systems for high-rise buildings are subsequently discussed. Finally, suggestions to improve the seismic performance of high - rise buildings horizontal members in slabs (ribs or beams-column) buildings are presented. ETABS version 9.5 is for analysis under lateral loads. ETABS is a programmer for linear, nonlinear, static and dynamic analysis, and the design of building systems. Multistory buildings constitute a very special class of structures and therefore deserve special treatment. The program is used to calculate the drifts for the systems and we noticed that the minimum drift was occurred in the ribbed slab system.So that, in high seismic risk regions, ribbed-slab-column frames is recommended to be gravity load resisting systems for building of high values of height/width ratios.*

| 11. | Carmen BRĂCĂCESCU, Cristian SORICĂ, Dragos MANEA, Bogdan IVANCU, Sorin POPESCU – ROMANIA THEORETICAL RESEARCHES ON KINEMATICS AND DYNAMICS OF VIBRATING SIEVES ELECTROMAGNETICALLY DRIVEN | 75 |

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| 12. | D. RAJENTHIRAKUMAR, T. KARTHIK, V. JANARTHANAN, S. NANTHAKUMAR – INDIA DEFECT REDUCTION IN GAS TUNGSTEN ARC WELDING PROCESS USING FAILURE MODE EFFECTS ANALYSIS | 79 |

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| 15. | *Slobodan STEFANOVIC, Damjan STANOJEVIC, Nenad JANJIC – SERBIA* *Imre KISS – ROMANIA* *ANALYSIS OF TECHNOLOGICAL PROCESS OF CUTTING LOGS USING ISHIKAWA DIAGRAM* | 93 |

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| 16. | *Peter SIMONYI – HUNGARY* *SOME RESULTS OF A RESEARCH ON LOCAL ECONOMIC DEVELOPMENT (LED) IN COUNTRYSIDE IN HUNGARY* | 99 |

Abstract: *Local Economic Development (LED) is in focus in some ex-socialist countries of Europe. Eight different settlements were examined by different methods in 2012-2013 to study the present situation of its state of economy and employment and the local resources in a research. The aim of this paper is to show the key factor of LED, to attempt for standardization taking into account the scientific literature, to define indicator of well-being in countryside and an evaluation by a new LED model.*

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| 18. | *Alexandra GOGA BODNÁROVÁ, Zuzana FARKAŠOVSKÁ,* *Ervin LUMNITZER – SLOVAKIA* *EFFECT OF NOISE ON DETERMINATION OF INDEX SOUND INSULATION OF THE SEPARATING ELEMENTS IN ENGINEERING MANUFACTURE* | 109 |

Abstract: *The aim of this paper is to give a general description and analysis of the method for measuring airborne sound insulation separating structures according to STN EN ISO 140-4, STN EN ISO 140-14 and STN EN ISO 717-1 and develop guidance on the evaluation of airborne sound insulation of these structures in the software program NorBuild 1028 and examine if the choice of excitation signal has an effect on the measurement results. This paper describes an accurate measurement procedure, including a description of the used measurement technique that was used in measuring the sound insulation of the selected partition walls at different excitation sound field.*

| 19. | *Jimit R. PATEL, Gunamani DEHERI – INDIA* *PERFORMANCE OF A MAGNETIC FLUID BASED DOUBLE LAYERED ROUGH POROUS SLIDER BEARING CONSIDERING THE COMBINED POROUS STRUCTURES* | 115 |

Abstract: *Efforts have been made to obtain the analytical solution for pressue, load and friction for a magnetic fluid based*

Abstract: *The paper presents the issue of the thermal stratification of the metal bath in the ladle during its stationary period. Due to the suggested research and experiments we aim primarily at knowing this phenomenon in detail and at investigating its influence upon the control of the temperature during the continual pouring of the steel. As a consequence of the natural convection, a vertical temperature gradient appears in the metal bath, because the metal bath, is formed of layers of steel, colder towards the bottom and the top of the ladle, and hotter in its middle section. The phenomenon of thermal stratification of the metal bath from the ladle and its influence upon the temperature control during the steel continuous casting has a major importance in steel plants.*

Abstract: *Cloud Computing holds the potential to eliminate the requirements for setting up of high-cost computing infrastructure for the IT-based solutions and services that the industry uses. It promises to provide a flexible IT architecture, accessible through internet for lightweight portable devices. This would allow multi-fold increase in the capacity or capabilities of the existing and new software. In a cloud computing environment, the entire data reside over a set of networked resources, enabling the data to be accessed through virtual machines. Since these data-centres may lie in any corner of the world beyond the reach and control of users, there are multifarious security and privacy challenges that need to be understood and taken care of. Also, one can never deny the possibility of a server breakdown that has been witnessed, rather quite often in the recent times. There are various issues that need to be dealt with respect to security and privacy in a cloud computing scenario. This extensive survey paper aims to elaborate and analyze the numerous unresolved issues threatening the Cloud computing adoption and diffusion affecting the various stake-holders linked to it.*

The ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering, Fascicule 4/2014 [October-December/2014], includes original papers submitted to the Editorial Board, directly by authors or by the regional collaborators of the Journal.

Also, the ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering, Fascicule 4/2014 [October-December/2014] includes scientific papers presented in the sections of Conference on The International Conference on Science and Technique based on Applied and Fundamental Research – ICoSTAF 2014 (25 April, 2014), hosted by University of Szeged, Faculty of Engineering, in Szeged, Hungary. The new current identification numbers of the papers are # 1, 4, 6, 7, 13 and 16, according to the present contents list.

1. *Attila GÖLLEI*

MEASURING AND OPTIMISATION OF HHO DRY CELL FOR ENERGY EFFICIENCY

1. *University of Pannonia, Faculty of Information Technology, Department of Electrical Engineering and Information Systems, Veszprém, Egyetem u. 10, HUNGARY*

Abstract: *A series of experiments was carried out on a HHO gas producing dry cell, whether we can optimize it by finding an electrolyte concentration, current value, etc. or changing the setup by alternating the distance between the plates. KOH solution was used, and the unit was monitored in several regards, for example cell voltage, gas production, ml/min/W value. Peaks in efficiency were between 5 and 8 g/l concentration and the more current went through the electrolyte, the gas was produced.*
Keywords: *HHO gas, electrolyte concentration, dry cell*

1. INTRODUCTION

Nowadays, with the growing need for energy and revulsion toward fossil and nuclear fuels puts sustainable and green energy in the foreground, e.g. energy from the Sun, the wind, tides, waves, and so on. Several disadvantages stop renewable energy from replacing traditional, oil or natural gas-based and nuclear energy sources, cost of installation, the continuity of the sources, combined with the unbalanced need for energy (both on the residential and industrial level), but the main problem is regulations stopping the energy being fed it into the main grids. So the solution could lie in storing energy. There are numerous methods to store energy, for example electro-chemical (HHO dry cell), chemical, [1] mechanical ways, or simply storing it as heat by crystallizing $CaCl_2$ hydrates. Most of these methods have their disadvantages and limited efficiency. We carried out experiments on a HHO gas producing dry cell, to see if we can optimize it, choosing a certain value of current, concentration of the solution, at which it produces the most gas. We can store hydrogen (or the oxygen-hydrogen mixture), thus we can store energy.

In the cell, electric current splits distilled water to its components, hydrogen and oxygen. Making hydrogen and oxygen from water with electricity is a very simple electrochemical process that can be carried out easily and in a very demonstrative way. The electrolyte in the cell is made up of the distilled water and a strong but diluted base, KOH in our case. Producing hydrogen in large or industrial quantities calls for an optimized or a near-optimized cell model. In a process with a big demand for energy only a few percent of variance in the efficiency could mean a significant energy surplus or shortage. [2]

We used a so-called dry cell to make hydrogen and oxygen gas and henceforward we discuss the electrochemical parameters of this dry cell.

What is this dry cell? Why dry cell?

The name could be misleading as this electrolyzing cell uses water just like any other electrolyzing unit. There are, though, some attributes of this cell that makes it easier to design and handle. With wet HHO cells, the whole unit is underwater, while in the case of dry cells, the plates are separated with rubber seals. These seailings stop the water from leaking from the cell, the electrical connections and the edges of the plates are not touching the electrolyte. These parts of the unit are staying dry, thus the name dry cell.

To make sure the gas made from the electrolyte gets out of the cell and the solution to flow between the plates, there are holes on the top (for the gas) and bottom (for the electrolyte) on the metal slats. (Figure 1)

What are the benefits of these cells? There are two main advantages to the application of the HHO units.

1. With the dry cell generator, considering the surface of the plates in the unit, we can use much less electrolytes compared to wet cells. Therefore, the volume and weight of the cell is smaller.

2. As the electronic connections are underwater in the wet cell model, their surface will slowly be corroded by the electrolyte. In the HHO cells, the connections are situated on the outside, thus not corroding. [3]
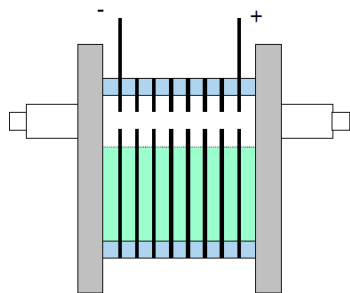
Figure 1. The theoretical setup of HHO block

2. ELECTROCHEMICAL BASIS OF CALCULATIONS

Electrochemical cells could be galvanic battery or an electrolyzing cell. Cells are called electrolytic cells are when they are using external current supply to create chemical reactions. The electrochemical cell is made up of two electrodes and a fluid, current-carrying electrolyte. The electrolyte can be a watery solution or molten salts (solvation). The chemical reaction happening on the surface of the electrodes (reduction or oxidation) is called an electrode reaction.

If the electrode's material is not participating directly in the electrode reaction, it is called an indifferent electrode (e.g. graphite electrode). The oxidation happens on the anode, the other electrode is the cathode, on which the reduction happens. In the process of electrolysis, if there is more than one possible type of electrical reaction, then a simple anion will detach form the positive anode (e.g. chloride), lacking this anion, OH- will be created by water splitting. [4]

Water's dissolution voltage at 25°C (room temperature) is 1,23 V (E_{MF}), the temperature coefficient is -0,85 mV/K, meaning that at 100°C this voltage goes down to 1,17V. [5,6] Therefore, in the light of these data, the specific energy demand to make hydrogen through electrolysis at 25°C can be calculated in the following way [7]:

The amount of charge needed to detach 1 kg hydrogen gas:

$$q = z \cdot F \cdot M = 2 \cdot 96487 \cdot 0,5 = 96487 As/mol = 26801 Ah/kg$$

$$w_{H2} = q \cdot E_{MF} = 26801 \cdot 1,23 = 32966 Wh/kg$$

Since the volume of 1 kg standard state H2 is 12474 l, the amount of energy required to produce 1 liter hydrogen is:

$$w_{H2} = \frac{32966}{12474} = 2,64 Wh/l$$

To have 1 liter of hydrogen, we need 1.5 liter HHO gas. To produce 1 liter HHO gas(0.667 l hydrogen) this much energy is necessary: [3]

$$w_{H2(HHO)} = 0,667 \cdot 2,64 = 1,76 Wh/l$$

We measured the unit at 10 different concentration of electrolyte, at different currents. We examined the voltage on the plates and the amount of gas produced through electrolysis.

3. THE MEASUREMENT UNIT

You can see the setup of one block of the unit on Figure 2.
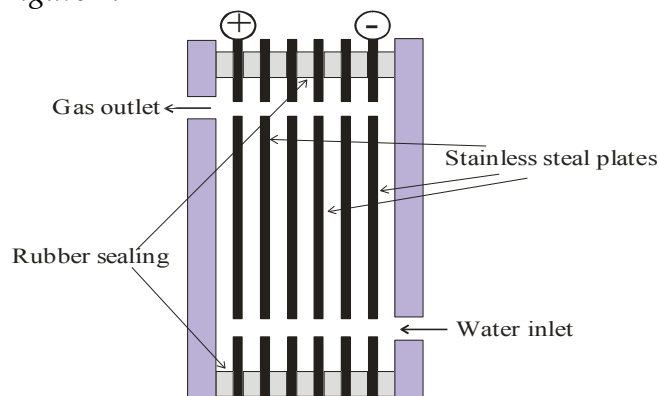
Figure 2: Gas generator block setup

In our setup, 5 cells make up one block, so 5 cells connected in series gives one gas-producing block. The block's electrical connections are on the two plates on the ends (see Fig. 1). Out of the six electrode plates, four are neutral electrodes, as they don't have electrical connection on them. The potential is divided between the neutral plates according to voltage division in series connections. That means that voltage between two electrodes is the fifth of the voltage on one whole block. In our experiment, we had a unit that had 3 blocks connected in parallel connection that made up the unit. (Fig. 2)

Other than the HHO cell, we needed a water tank to infuse the electrolyte into the cell. We also installed a tube between the gas outlet and the tank, because the produced gas is not pure gas, it comes out as bubbles, so there is electrolyte coming out in the tube that needs to be recycled into the

system. Then, as the electrolyte drips back in the tank, the gas can escape through another hose, into the bottle, which we use to measure the volume and speed of the production of hydrogen.

We connected a power supply (Manson SPS9600) to the electrical connections of the HHO unit, and we could adjust the voltage input during the experiment. We also needed a PWM modulator to adjust the current and frequency.

4. EXPERIMENTS AND RESULTS

According to the principle of electrolytic dissociation, due to added energy or dilution, a chemical compound's molecules can break up into ions. This causes the ions to have a weak electrical conductivity. But you can dilute an electrolyte and increase this electricity to a certain limit, and beyond that it stagnates. This explains why there's only a small window for the optimum, when it comes to finding the right concentration of the solution. We monitored current, voltage, cell voltage, MMW (milliliter/minute/watt) and liter/minutes (we didn't experiment with the temperature, but we noticed some changes in the performance of the unit). The voltage, frequency and current was controlled by us, we also experimented with the distance between the plates. We can judge the effectiveness of the unit at certain concentrates by MMW value, liter/minute, current/gas production and power. (Table 1)

Table 1. Obtained results of experiment

Electrolyte concentration (g/l)	MMW (ml/min/W)	Gas production (l/min)	Power of unit (W)
1	2.13	0.2	10.8
2	2.66	0.75	34.44
3	2.66	1.37	55.83
4	2.59	1.51	82.15
5	2.72	1.9	90.6
6	2.63	2.52	119.5
7	2.67	2.96	140
8	2.65	2.76	125
9	2.46	2.28	105.6
10	1.82	2.15	103.2

We expected that 3-5 grams of KOH/liter is where the electrolytic dissociation is allowing the most electrical conductivity, thus at higher current (15-40 A) the unit would produce the most hydrogen. The first series of experiments were done according to voltage. We measured the productivity of the cell at six different values of voltage (2,5 – 15 V) and 10 different solution concentration (1-10 grams

KOH per liter). We used software called Statsoft Statistica to make graphs of our findings (Figure 3).
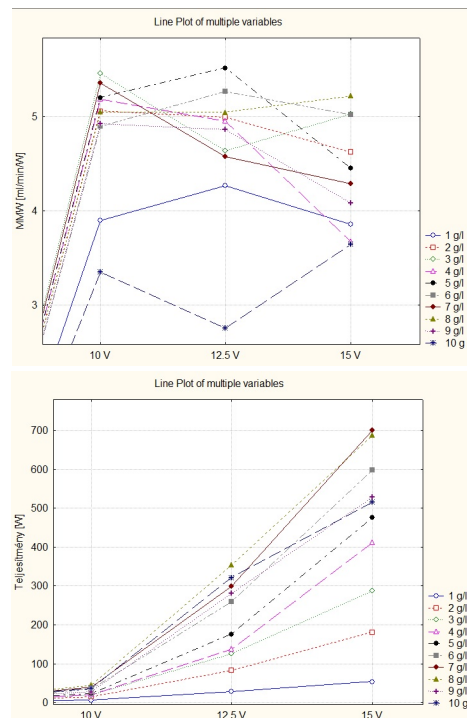
Figure 3. MMW and power of dry cell – voltage-based experiments
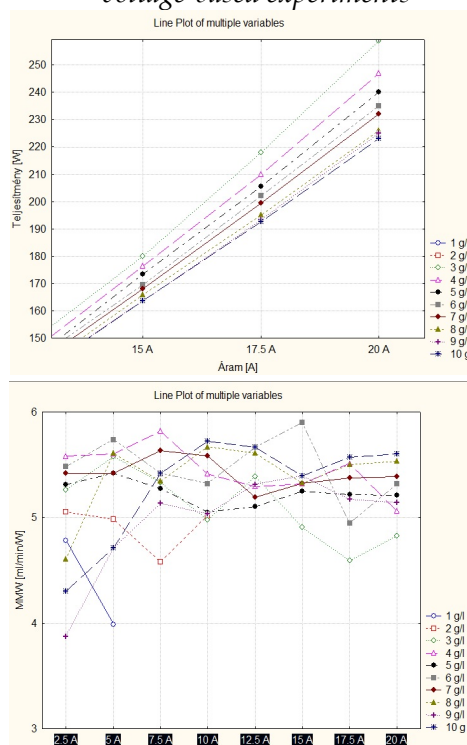
Figure 4. MMW and power – current-based experiments

While, we had the highest MMW value at 5 g/l, we can say that the concentration that has very high values at all of the monitored values is the 7g/l concentration. The cell produced 3 liters of HHO

gas per minute, has a 5,35 MMW value, worked with 50 A and 700 W at 7 g/l.

The second batch of experiments was done in a similar fashion, but by current values. (Figure 4)

We went on to see whether or no frequency has any significance in the operation of the cell. At 6 g/l concentration and 14 A, we found that frequency doesn't play a significant role in electrolysis (Figure 5).
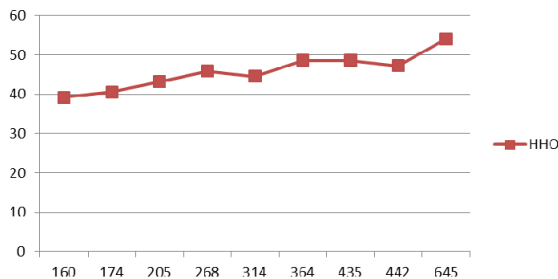
Figure 5. The relation between frequency and gas output

Lastly, we changed the distance between the plates, 1mm to 5 mm. We found that the closer the plates are the better efficiency the cell worked with. (Figure 6)
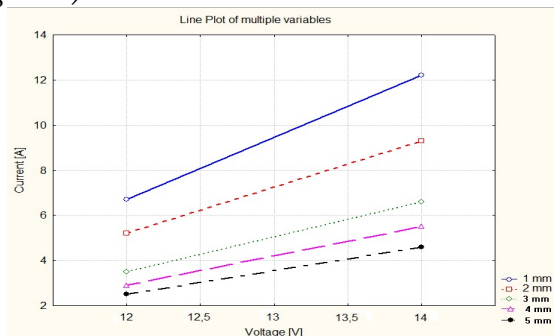
Figure 6. Realtion between distance of the plates and current

While we couldn't pinpoint an optimal concentration or current value, we should change the range of 3-5 g/l to 5-8 g/l, because we found that our dry cell worked with the best efficiency in that domain. The theoretical efficiency of an HHO cell is 60-70 %, ours was working at approximately 55 %. We also proved the Faraday laws, by observing that the more current we let through the electrolyte, the more gas we could produce. Temperature also alter gas production, as the hotter the solution (the more mobile are the ions), the more HHO gas is put out.

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¹·*Penka ZLATEVA*, ²·*Krystin YORDANOV*, ³·*Diyan M. DIMITROV*

NUMERICAL SIMULATION OF TEMPERATURE SEPARATION PHENOMENA INSIDE VORTEX TUBE

¹,²· *Technical University of Varna, Dep. Heat Engineering, BULGARIA*
³· *Technical University of Varna, Dep. Technical Mechanics, BULGARIA*

Abstract: *The objective of present article is an atempt to simulate numerically temperature separation phenomena (Ranque-Hilsch affect) inside the vortex tube. For this simulation computational fluide dynamic (CFD) analysis, applying standard k-ε turbulence model, is used. Geometry is drawn in 3D space using Autodesk Inventor Professional and transferred in Autodesk Simulation CFD to solve the problem. Initial conditions for inlet air stream: temperature 22ºC, flow rate 40l/min and gauge pressure 6 bar are set. As a result air flow velosity field and temperature field is found. Predicted temperatures at cold and hot end are 4 and 42ºC. It can be concluded that vortex tube can be analysed and further optimisated by CFD modeling.*
Keywords: *Ranque-hilsch vortex tube, temperature separation, CFD model, k-ε model, numerical simulation*

1. INTRODUCTION

The Vortex Tube (VT) is a device that generates cold and hot air from compressed air.It was invented by Georges J. Ranque in 1933[1]. The German engineer Rudolf Hilsch suggested the working vortex tube design in 1947 [2]. It is a simple low cost device, with no moving parts, no electricity and there is a possibility to adjust the temperature [3,4]. The main drawbacks are connected with its low thermal efficiency, the noise and the availability of compressed air. VT is commonly used for inexpensive spot cooling, when compressed air is available, like cutting tools of CNC machines, laboratory equipment, etc.

The vortex tube phenomena can be observed physically, but is dificult to explain. Compressed air is sent through the tangential inlet nozzle to create the vortex motion inside the tube, fig. 1.
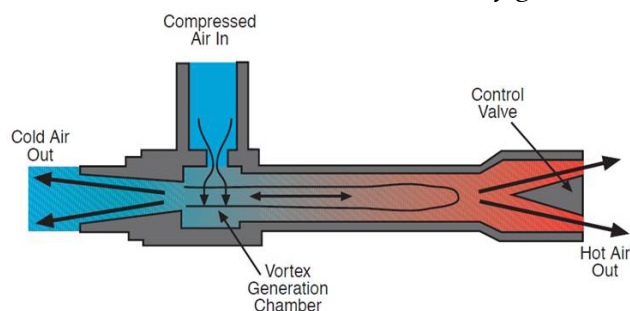
Figure 1. Vortex tubeschematic [3]

As the vortex moves along the tube, a temperature separation is formed. Hot air moves along the tube periphery, and cold air is in motion in the inner core. This resulting radial temperature separation inside the vortex tube is also called the Ranque-Hilsch effect. So far, there is no single theory that explains the radial temperature separation.

Nowadays, researches use computational fluide dynamic (CFD) to explain this phenomena [5-9]. In [5] the fluid dynamics model of the vortex tube is set in order to understand the temperature separation phenomena. In [6] the results from similar to [5] CFD model with commercially available vortex tube geometry is set. Researsches [5] also measure the temperatures at the hot and cold end of the VT and compare them with model predictions. The temperatures are in reasonable agreement with the experimental ones, if a standard k-ε turbolence model is used. In [7] a similar conclusion is given.

The aim of the present study is to createnumerical model of vortex tube effect in order to use it in a further optimisation of the design.

2. THE MODELING APPROACH

A computational fluid dynamic (CFD) analysis, using k-ε turbolence model, is set to solve fluid velocity and temperature field inside a vortex tube.

For this purpose, a commercially available software Autodesk Inventor Professional and Autodesk Simulation CFD, are used. The following approach is used to create the present CFD model.

2.1. Geometry conditions

The geometry of the vortex tube is designed in a way, which allows its parts to be made with universal metal cutting machines.It is modeled in 3D space as a solid body with the shape and dimensions shown on fig. 2. The swirl chamber is designed with two inlet nozzles. The inner diameterof 8 mm and L/D =30 were chosen. Such L/D ratio is suggsted in [8] for VT with similar design. Dimensions of the tube body are 385 x 30 x 54 mm.

To create CFD model this 3D geometry is transferred to Autodesk Simulations CFD environment.
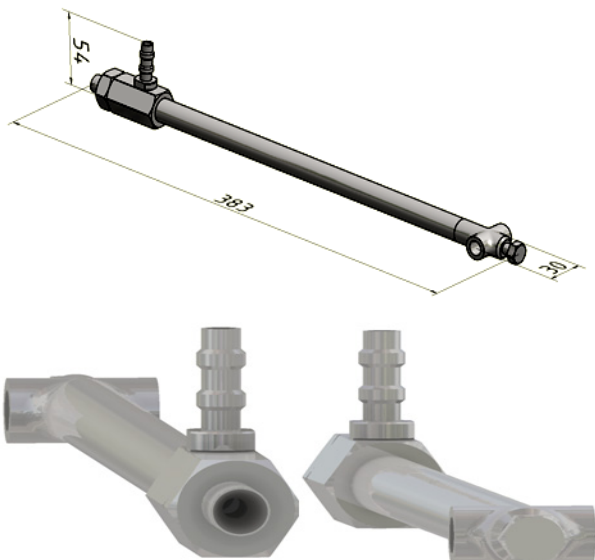
Figure 2. 3D CAD model of vortex tube

2.2. Physical conditions

The body of VT will be made of steel. To keep the price low, steel C45 is chosen as a VT material. The working fluid is air. All the cavities in VT are set as an air domain. The thermal properties of the used materials as a function of the temperature c=c(t), k=k(t) are taken from the sofware material library. In table 1 only values for temperature 22°C are given.

Table 1.Properties of materials at 22°C

Materials	C, kJ/(kg.K)	k, W/(m.K)	ρ, kg/m³
Air	1,0057	258	1,205
Steel C45	46,5	544	7,833

2.3. Initial and boundary conditions

The initial and boundary conditions, given at different areas to simulate the vortex tube, are as follows.

Pressure inlet boundary condition to the inlet area of the vortex tube (at the inlet of the nozzle) with volume flow rate of 40 l/min, total gauge pressure of 6 bar and total temperature of 22°C.

Pressure outlet boundary condition to the cold end region of vortex tube with gauge pressure of 0 bar.

Pressure outlet boundary condition to the hot end area of vortex tube with gauge pressure of 1 bar. Pressure at hot outlet is kept higher than that at the cold exit to reduce the flow through hot exit.

2.4. Meshing

The created mesh consists tetragonal finite elements. The size of the elements is 0.5 mm, figure 3. Their number is 103651, and the nodes are 27620.
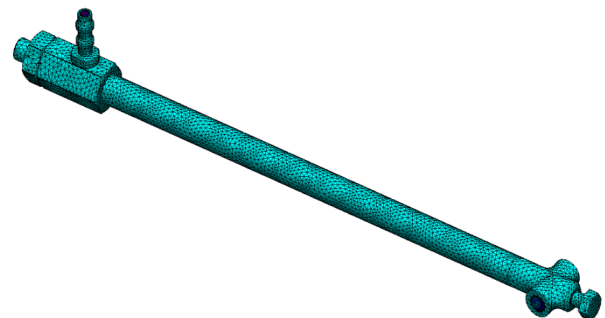
Figure 3. Mesh of finite elements

2.5. Problem solving

The created numerical model is solved in Autodesk Simulation CFD enviroment. The duration of the simulation is 220s, time steps 10s.

3. RESULTS AND ANALYSIS

As a result of the numerical simulation, the velocity and temperature field inside the vortex tube, are visualised. The following figures illustrate the fluid flow and temperature field at 55, 110, 165 u 220s, afterwards the fluid flow and temperature difference betweeen hot and cold end remain practically constant.

Figures 4-7 illustrate the distribution of the velocity magnitude in YZ plane. Figures 8 and 9 a,b illustrate the air velocity magnitude in XZ plane.

As it can be seen (fig. 4-7) the air in the core of the tube cross section has higher velocity and the air velociy increases at the cold end of the VT. Figures 8,9 show the vortex creation.
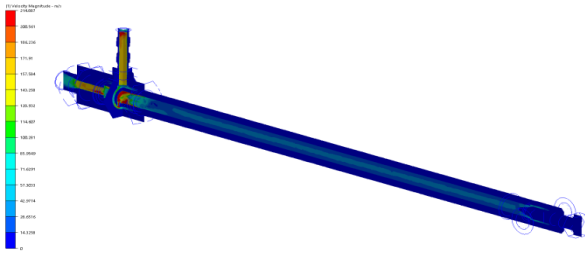
Figure 4. Distribution of velocity magnitude at 55 s in the YZ plane [m/s]
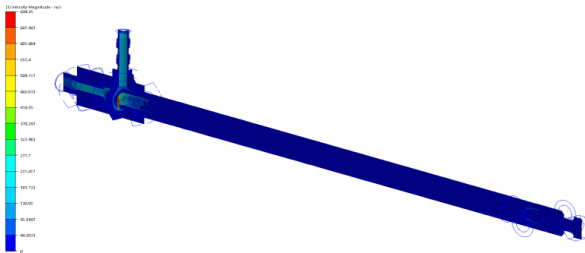
Figure 5. Distribution of velocity magnitude at 110 s in the YZ plane [m/s]
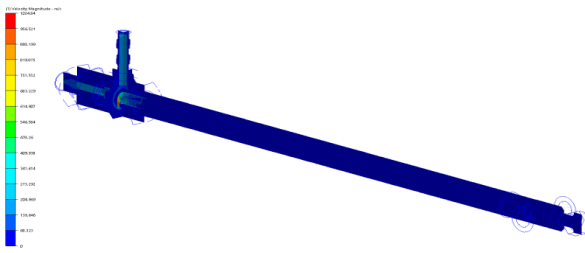
Figure 6. Distribution of velocity magnitude at 165 s in the YZ plane [m/s]
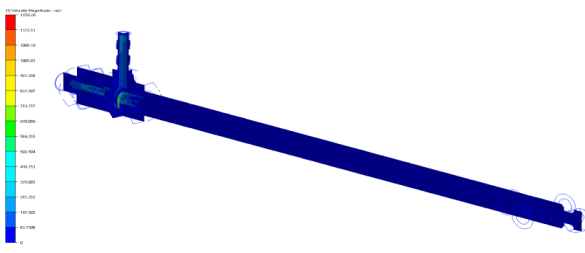
Figure 7. Distribution of velocity magnitude at 220 s in the YZ plane [m/s]
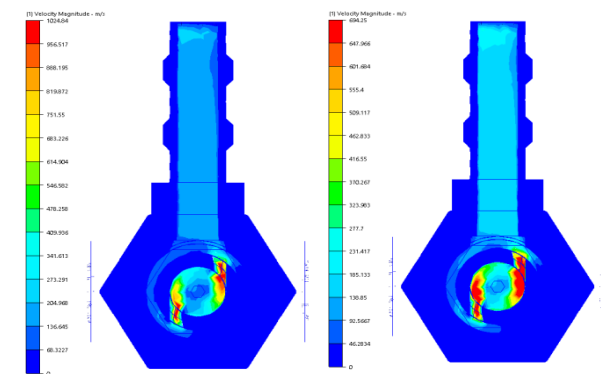
a) at 55s *b) at 110s*
Figure 8. Distribution of velocity magnitude in the XZ plane [m/s]
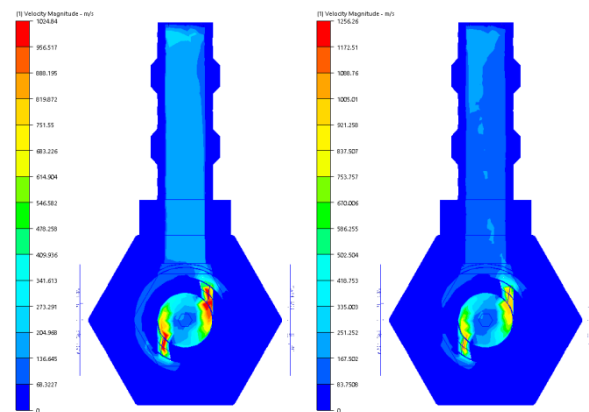
a) at 165s *b) at 220s*
Figure 9. Distribution of velocity magnitude in the XZ plane [m/s]

The temperature field, at the above mentioned time intervals, is illustrated on figures 10-13.
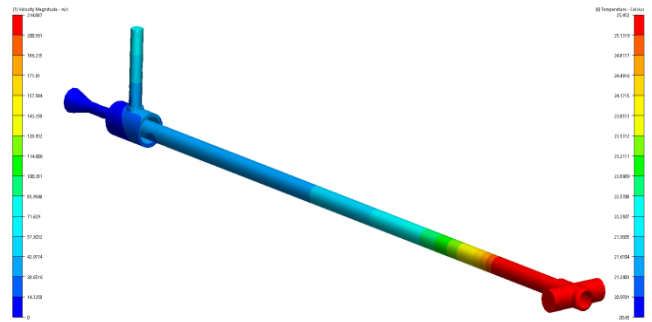
Figure 10. Distribution of temperature at 55s (only air domain)
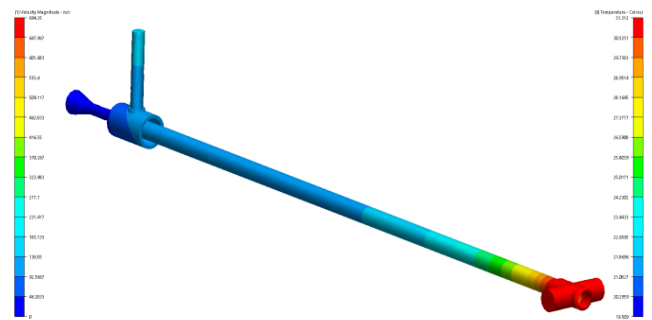
Figure 11. Distribution of temperature at 110s (only air domain)
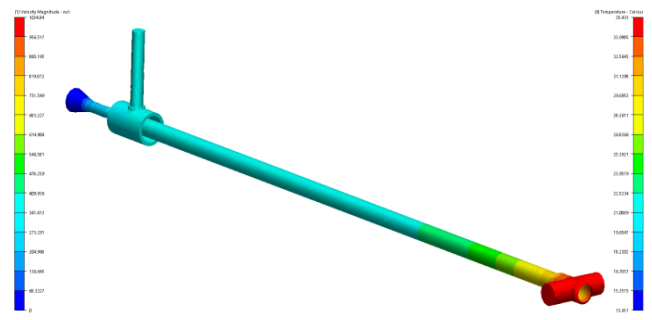
Figure 12. Distribution of temperature at 165s (only air domain)
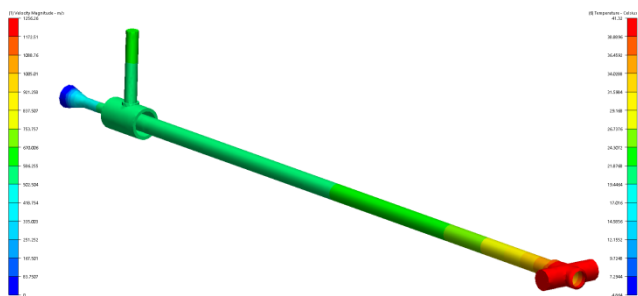
Figure 13. Distribution of temperature at 220s (only air domain)

The analysis of the above presented figures shows that if at the inlet of the designed vortex tube there is air with temperature of 22°C, a flow rate of 40l/min and total gauge pressure of 6 bar, a temperature change at the two ends of the vortex tube will be observed. The longer end is with a higher temperature than the one set at the inlet (hot end), and the shorter one is with a lower temperature than the one set at the inlet (cold end). Predicted temperatures at the ends after 220s are 4°C at the cold end and 42°C at cold one.

4. CONCLUSIONS

In conclusion, it is shown that the CFD approach is applicable for simulating Ranque-Hilsch effect. The details of the flow velocity and temperature distribution are presented. It is found that various levels of complexity in the turbulence modeling are suitable for vortex tube analysis.

On the base of the simulation studies of the vortex tube, made with the help of the program products Autodesk Inventor Professional and Autodesk Simulation CFD, an unstationary distribution of the temperature field and the velocity are obtained. Further optimisation of the VT design is needed in order to improve its efficiency.

Nomenclature

C – heat capacity, J/(kg.K);

ρ – density, kg/m³;

k – coefficient of heat transfer, W/(m.K);

t – temperature, °C;

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1. I.O. OLADELE, 2. O.O. DARAMOLA, 3. A. T. ADEWOLE

COMPARATIVE STUDY OF THE REINFORCEMENT EFFICIENCY OF COW BONE AND COW BONE ASH IN POLYESTER MATRIX COMPOSITES FOR BIOMEDICAL APPLICATIONS

1-3. Department of Metallurgical & Materials Engineering, Federal University of Technology, Akure, NIGERIA

Abstract: This work was carried out to study comparatively the reinforcement efficiency of cow bone and cow bone ash particles in polyester matrix composites in order to consider the suitability of the materials as biomaterial. Cow bone was procured from an abattoir, washed with water and sun dried for 4 weeks and a portion was burnt. The bone ashes and un-burnt bone portions were pulverized separately using the ball mill. Sieve analysis was carried out on the pulverized bone ash and bone particles into particle sizes of 75µm, 106µm and 300µm. Composite materials were developed by casting into tensile and flexural tests moulds using pre-determined proportions of 2, 4, 6, and 8 wt % for both the cow bone and cow bone ash. The samples after curing were striped from the moulds and were allowed to further cure at room temperature for 3 weeks before tensile and flexural tests were performed on them. The tensile test results showed that bone particles reinforced composites have the best tensile properties except in Modulus of elasticity where bone ash particles reinforced composite samples have higher values while the flexural test showed that bone ash particle reinforced samples has the best flexural properties.
Keywords: cow bone and ash, polyester, composites, mechanical properties, biomedical

1. INTRODUCTION

The development of materials for any replacement application should be based on the understanding of the structure to be substituted. This is true in many fields, but particularly exigent in substitution medicine. The demands upon the material properties largely depend on the site of application and the function it has to restore. Ideally, a replacement material should mimic the living tissue from a mechanical, chemical, biological and functional point of view.

Mineralised tissues such as bones, tooth and shells have attracted considerable interest as natural anisotropic composite structures with adequate mechanical properties. In fact, nature is and will continue to be the best materials scientist ever. Who better than nature can design complex structures and control the intricate phenomena (processing routes) that lead to the final shape and structure (from the macro to the ultra-structural level) of living creatures? Who can combine biological and physico-chemical mechanisms in such a way that can arrive to ideal structure–properties relationships? Who, else than nature, can really design smart structural components that respond, in-situ, to exterior stimulus adapting the microstructure and correspondent properties? In the described line of thinking, mineralized tissues and biomineralization processes are good examples to learn from for the materials scientist of the future. This is especially true for engineers that want to develop composites to replace mineralized tissues [1].

Structurally, the bone matrix consists of type I collagen fibres reinforced by hydroxyapatite nano-crystals precipitated along the collagen fibres [2]. The mineral part is responsible for the stiffness whereas the collagen is responsible for its flexibility. A demineralised bone becomes very flexible being easily twisted, whereas a bone without collagen is very brittle [3].

The major component of compact bone is called the osteon. Organised in concentric lamellar matrix, the osteons create cylindrical conduits known as Haversian canals, which provide access for the circulatory and nervous systems. The capillaries within the Haversian canals originate from arteries and veins within the marrow cavity. It is known that the structure of bones is continuously adapted to the stresses applied to it [4]. Thus, any substitution implant material should be compatible and not disturb significantly the stress environment of the surrounding living tissue [5]. Materials that are biocompatible are called biomaterials, and the biocompatibility is a descriptive term which indicates the ability of a material to perform with an appropriate host response in a specific application. This definition has been further extended by Wintermantel and Mayer [6], and they distinguished between surface and structural compatibility of an implant [7]. Surface compatibility means the chemical, biological, and physical suitability of an implant surface to the host tissues while structural compatibility is the optimal adaptation to the mechanical behavior of the host tissues. From all the above discussion it becomes evident how difficult it is to design and produce materials that can be used on replacement and fixation of bones or for filling bone defects, especially those that must work under load bearing conditions. That explains why synthetic materials are only about 10% of the bone grafting market, where autografts and allografts still reign. Biomaterials are finding increase use in problem areas like replacement of deceased or damage parts.

The use of by-products as reinforcement is a modern technology for producing relatively inexpensive materials of high strength from suitable homogeneous matrix bases. Therefore, cow bones and its ash were used in this research. These materials have constitutes a waste of natural resources since the physical and mechanical properties are yet to be effectively brought to the attention of modern designers. Cow bones which are obtainable from slaughtered cows in abattoirs are usually burnt or sold to feed mill for the production of animal feeds. However, this by-product in some cases are left to waste but can be used as reinforcement in polymer to produce composite materials for biomedical use due to its good mechanical properties[8]. This work was carried out to investigate comparatively the mechanical properties of cow bone particles and cow bone ash particles. This was done in order to study the effect of biocompatibilization treatment on the mechanical properties of the developed composites.

2. MATERIALS AND METHODS

The main materials that were used for this work are as follows: unsaturated polyester resin, cow bones, methyl ethyl ketone peroxide (MEKP) used as the catalyst, cobalt 2% in solution used as the accelerator, polyvinyl acetate used as the mould releasing agent, and ethanol used as a cleaning agent.

2.1. Material Preparation. The cow bone was procured from the abattoir, washed with water so as to remove the dirty particles that might have been stuck to the bone, and sun dried for 4 weeks. The bones were separated into two portions; one portion is burnt into ashes while the other portion was crushed with hammer. The two portions were pulverized separately using Denver laboratory ball mill to further reduce the particle sizes. The particles from the process were sieved with sieve shaker 16155 models into 75, 106, and 300 μm sieve sizes.

2.2. Mould Production. Tensile mould of gauge length 90 × 5× 3 mm of a dumb-bell shape and flexural mould of 150 × 50× 3 mm were used for the production of tensile and flexural samples respectively

2.3. Production of Composites. To develop the composites, 1.5 g each of catalyst and accelerator was added to 120 g of the polyester resin while bone particulate was varied in a predetermined proportions of 2, 4, 6, and 8 wt % for all the particle sizes. After proper stirring, the homogenous slurry is poured into the mould and allowed to be cured at room temperature before it is removed. Same procedure was also adopted for the bone ash particles for all the three different particle sizes. Three (3) samples were produced for each mechanical property that was carried out from each proportion. The striped samples are left to be cured

further at room temperature for 3 weeks before the mechanical tests were carried out.

2.4. Mechanical Testing of Cast Samples.

Following the moulding of the composites samples were prepared for tensile and flexural tests.

(a) Determination of the Tensile Properties of the Materials. In the present study, tensile tests were performed on INSTRON 1195 at a fixed crosshead speed of 10mmmin−1. Samples were prepared according to ASTM D412 (ASTM D412 1983) and tensile strength of the standard and conditioned samples was calculated.

(b) Determination of the Flexural Property of the Materials. Flexural test was carried out by using Tensiometric Universal Testing Machine in accordance with ASTM D790. To carry out the test, the grip for the test was fixed on the machine, the sample that has been cut into the test piece dimensions of 150mm × 50mm × 3mm was hooked on the grip, and the test commenced. As the specimen is stretched, the computer generates the required data and graphs. The flexural test was performed at the speed of 100 mm/min.

3. RESULTS AND DISCUSSIONS

3.1. Variation of Tensile Properties with Particle Sizes and Particle Contents

3.1.1. Variation of E-Modulus with Particle Sizes for both Cow Bone and Cow Bone Ash Reinforced Composites

Figure 1 shows the variation of E-Modulus of the samples with different particle sizes for both cow bone and cow bone ash reinforced composites. The modulus of elasticity is a measure of the stiffness of the material and is the rate of change of strain as a function of stress within an elastic limit. The results show that the modulus was enhanced by cow bone ash than cow bone particles in all the particle sizes. The best results were obtained from cow bone ash reinforced samples of 300 μm particle size having 8 and 6 wt % with the highest values of 4597.56 Mpa and 4454.38MPa respectively. This was closely followed by 8 wt % of 75 μm cow bone ash reinforced samples with a value of 4450.49 MPa while the unreinforced polyester material has a value of 3966.15 MPa.
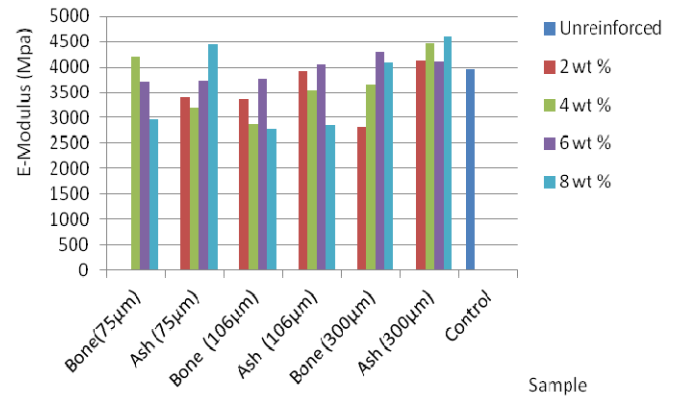
Figure 1. Variation of E-Modulus with Particle Sizes for both Cow Bone and Cow Bone Ash Reinforced Composites

3.1.2. Variation of Tensile Stress at Maximum Load with Particle Sizes for both Cow Bone and Cow Bone Ash Reinforced Composites.

Figure 2 shows the variation of the tensile stress at maximum load of the samples with different particle sizes for both cow bone and cow bone ash reinforced composites.
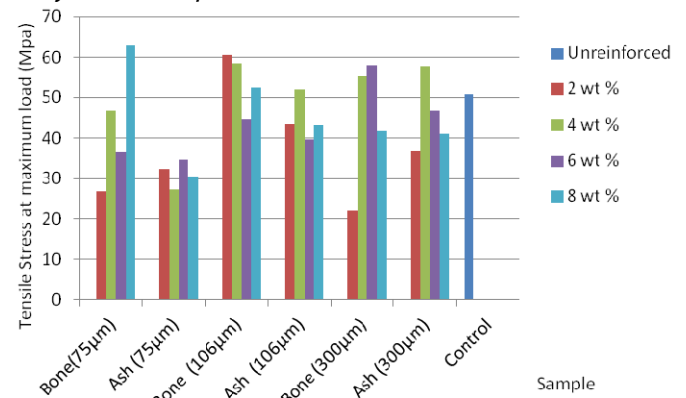
Figure 2. Variation of Tensile Stress at Maximum Load with Particle Sizes for both Cow Bone and Cow Bone Ash Reinforced Composites

Tensile stress at maximum load is the maximum stress that a material can withstand while being stretched or pulled before necking. The trend show that the tensile stress at maximum load increases as the particle size increases for cow bone ash reinforced samples while it decreases as the particle size increases for cow bone particles. This shows that the tensile stress at maximum load is enhanced as the particle size increases for cow bone ash while it decreases as the particle size increases for cow bone particle size. However, the results show that the tensile stress at maximum load for the cow bone reinforced samples were better enhanced compared to cow bone ash samples. From the result, it was observed that sample reinforced

with 8 wt % of particle size 75 µm cow bone has the highest value of tensile stress at maximum load of 63.04 MPa followed by 2 and 4 wt % particle size of 106 µm with a value of 60.72 MPa and 58.54 MPa respectively compared to the unreinforced polyester material with a value of 50.76MPa.

3.1.3. Variation of Tensile Strain at Maximum Load with Particle Sizes for both Cow Bone and Cow Bone Ash Reinforced Composites

Figure 3 shows the variation of the tensile strain at maximum load of the samples with different particle sizes for both cow bone and cow bone ash reinforced composites. Tensile strain at maximum load is the maximum strain that a material can withstand while being stretched or pulled before necking. The trend showed that the tensile strain at maximum applied load decreases as the particle size increases for both cow bone and cow bone ash reinforced samples except for the increase that was observed for the particle size of 106 µm cow bone reinforced sample. From the results, it was observed that cow bone reinforced sample was better enhanced than cow bone ash reinforced samples. The best result was obtained from 4 wt % of particle size 106 µm with a value of 0.025 mm/mm followed by 0.024 mm/mm from 8 wt % of particle size 75 µm cow bone reinforced samples compared to the unreinforced polyester material with a value of 0.01623 mm/mm.
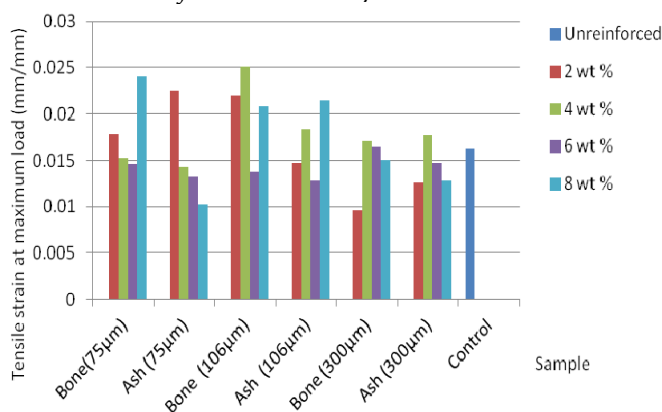
Figure 3. Variation of Tensile Strain at Maximum Load with Particle Sizes for both Cow Bone and Cow Bone Ash Reinforced Composites

3.1.4 Variation of Tensile Stress at Fracture with Particle Sizes for both Cow Bone and Cow Bone Ash Reinforced Composites.

Figure 4 shows the variation of the tensile stress at fracture of the samples with different particle sizes for both cow bone and cow bone ash reinforced composites. Tensile stress at fracture is the tensile stress corresponding to the point of rupture. The same trend as that of tensile stress at maximum load was observed except that tensile stress at fracture was better enhanced for cow bone ash samples at 300 µm. From the result it was observed that 8 wt % of particle size 75 µm of cow bone has the highest value of 63.04 MPa followed by 2 wt % cow bone particle size of 106 µm with a value of 60.72 MPa compared to the unreinforced polyester material with a value of 50.52 MPa.
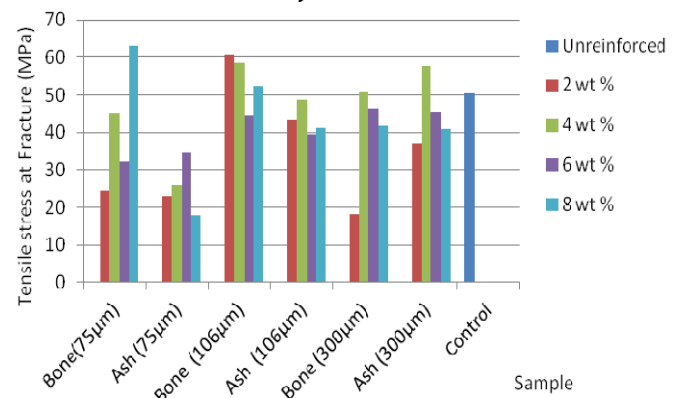
Figure 4. Variation of Tensile Stress at Fracture with Particle Sizes for both Cow Bone and Cow Bone Ash Reinforced Composites

3.1.5. Variation of Tensile Strain at Fracture with Particle Sizes for both Cow Bone and Cow Bone Ash Reinforced Composites

Figure 5 shows the variation of the tensile strain at fracture of the samples with different particle sizes for both cow bone and cow bone ash reinforced composites. Tensile Strain at fracture is the strain strength of the material at the point of rupture. The trend shows that the tensile strain at fracture decreases as the particle size increases for both the cow bone and cow bone ash reinforced samples. This implies that tensile strain at fracture decreases as the particle size increases. Considering the results from this work, it can be deduced that particle size distribution from different reinforcement materials has diverse effect on the properties of the composites. From the results, it was observed that cow bone reinforced sample of 2 wt % from 75 µm has the highest value of 0.03361 mm/mm followed by 2 wt % bone ash reinforced sample from 75 µm with value of 0.02723 mm/mm compared to unreinforced polyester material with a value of 0.01626 mm/mm.
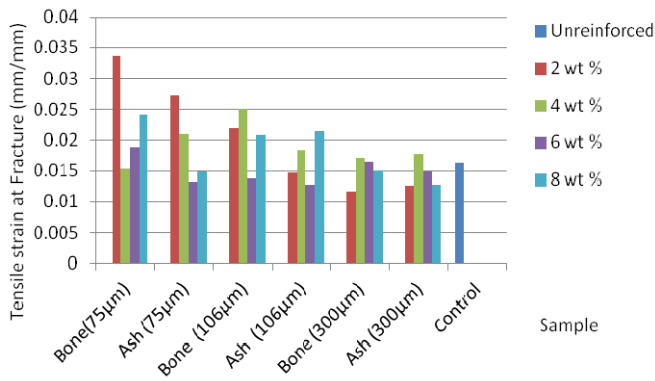
Figure 5. Variation of Tensile Strain at Fracture with Particle Sizes for both Cow Bone and Cow Bone Ash Reinforced Composites

3.1.8.Variation of Impact Energy at Fracture with Particle Sizes for both Cow Bone and Cow Bone Ash Reinforced Composites

Figure 6 shows the variation of impact energy at fracture for the composite samples and the control. The impact energy at fracture is the energy that the specimen has absorbed up to the point of failure. From the Figure, it was observed that the impact energy at fracture decreases as the particle size increases for cow bone particle reinforced samples while cow bone ash reinforced samples gave its optimum result at 106 μm. The best results were obtained from 75μm cow bone with 8 and 4 wt % reinforcements with values 1.49 J and 1.37 J respectively compared to the unreinforced polyester material.
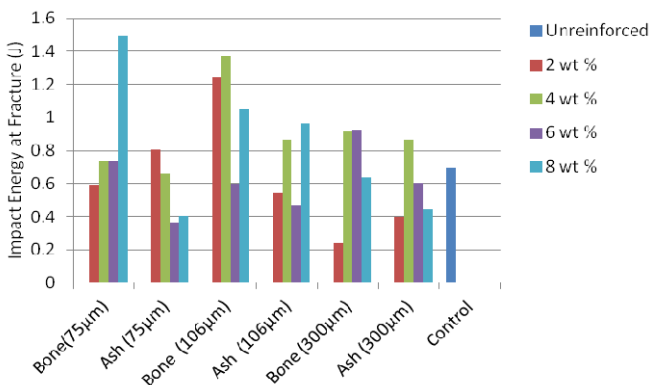
Figure 6. Variation of Impact Energy at Fracture with Particle Sizes for both Cow Bone and Cow Bone Ash Reinforced Composites

3.2. Variation of Flexural Properties with Particle Sizes and Particle Contents

3.2.1. Variation of Bending Strength at Peak with Particle Sizes for both Cow Bone and Cow Bone Ash Reinforced Composites

Figure 7 shows the variation of bending strength at peak of the samples with different particle sizes for both cow bone and cow bone ash reinforced composites. Bending strength at peak represents the highest stress experienced by the material when subjected to bending stress before it ruptured. The trend shows an increase that was followed by reduction for the cow bone reinforced samples as the particle size increases while it decreases for cow bone ash reinforced composite as the particle size increases.

From the result, cow bone ash reinforced sample from 8 wt % of particle size 75 μm has the highest value of 68.24 N/mm^2 followed by 4 wt % of particle size 106 μm cow bone ash reinforced sample with a value of 66.23 N/mm^2 compared to the control with a value of 43.25 N/mm^2.
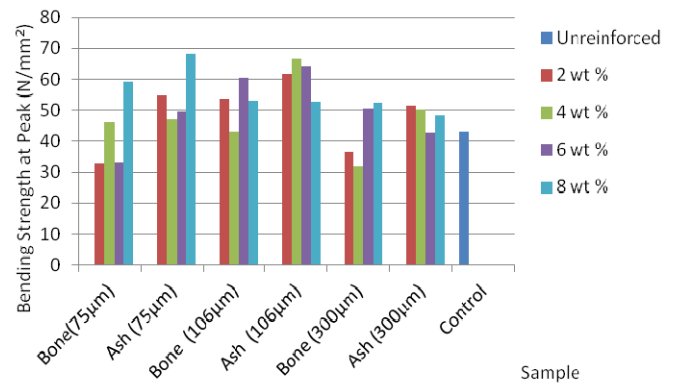
Figure 7. Variation of Bending Strength at Peak with Particle Sizes for both Cow Bone and Cow Bone Ash Reinforced Composites

3.2.2. Variation of Bending Modulus with Particle Sizes for both Cow Bone and Cow Bone Ash Reinforced Composites

Figure 8 shows the variation of Bending Modulus of the samples with different particle sizes for both cow bone and cow bone ash reinforced composites. Bending modulus also known as flexural modulus of elasticity is the ratio of maximum fibre stress to maximum strain within elastic limit of stress-strain diagram obtained in flexure test. The result revealed that cow bone ash reinforced sample had better enhancement compared to that of cow bone particle reinforced samples.

The best result was obtained when 8 wt % of 300 μm particle size was used with an optimum value of 9137 N.mm^2 followed by sample with 8 wt % from 75 μm particle size cow bone reinforced sample with a value of 9103 N.mm^2 compared to the control sample which had a value of 7451.8 N.mm^2.
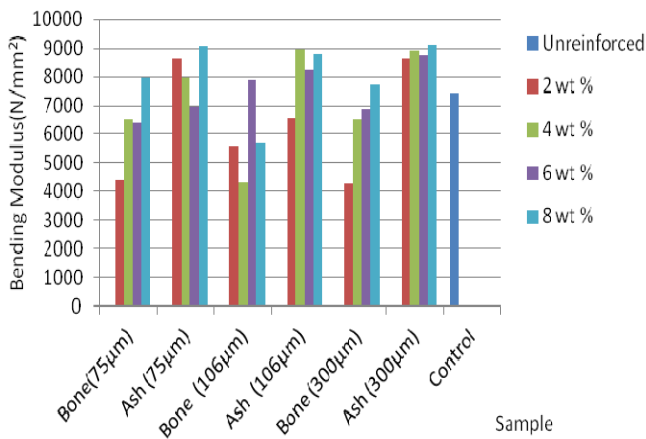
Figure 8. Variation of Bending Modulus with Particle Sizes for both Cow Bone and Cow Bone Ash Reinforced Composites

3.2.3. Variation of Impact Energy at Fracture with Particle Sizes for both Cow Bone and Cow Bone Ash Reinforced Composites

Figure 9 shows the variation of impact energy at fracture of the samples with different particle sizes for both cow bone and cow bone ash reinforced composites. The impact energy to fracture is the energy that the specimen was able to absorb before it failed. Similar trend was observed for both cow bone particles used where 106 μm particle sizes gave the optimum result.

The result shows that 2 wt % of 106 μm particle size from both cow bone ash and cow bone particle reinforced samples gave the highest values of 1.1904 N.m and 1.0804 N.m respectively compared to the control sample which has a value of 0.5684 N.m.
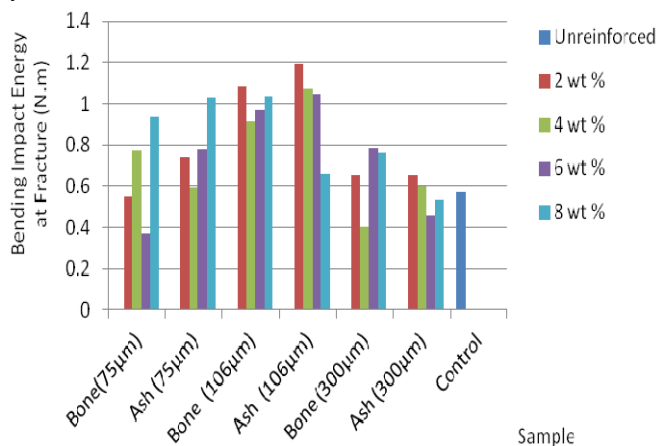
Figure 9. Variation of Bending Impact Energy at Fracture with Particle Sizes for both Cow Bone and Cow Bone Ash Reinforced Composites
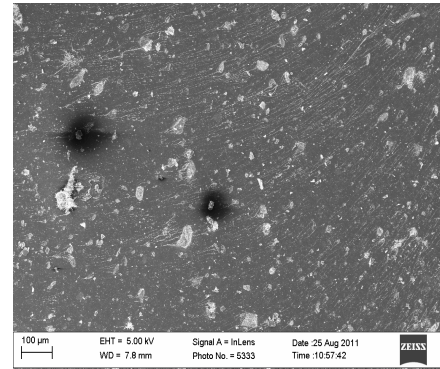
(a) Cow Bone
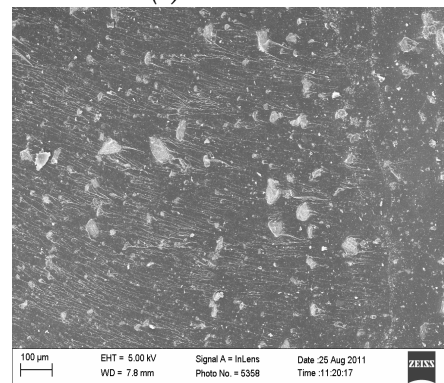
(b) Cow Bone Ash

Plates (a-b). SEM of Fractured surfaces of 8 wt % from 75 μm particle size Cow Bone and Cow Bone Ash-Reinforced Polyester Composites
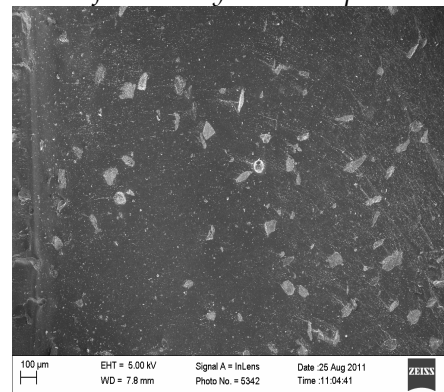
(c) Cow Bone
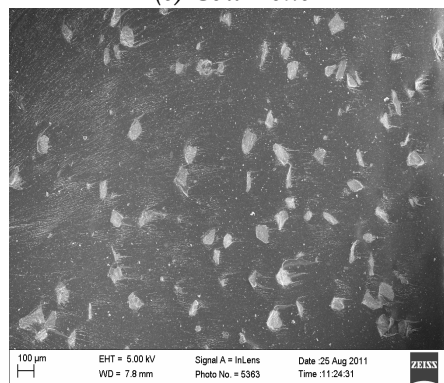
(d) Cow Bone Ash

Plates (c-d). SEM of Fractured surfaces of 8 wt % from 106 μm particle size Cow Bone and Cow Bone Ash-Reinforced Polyester Composites
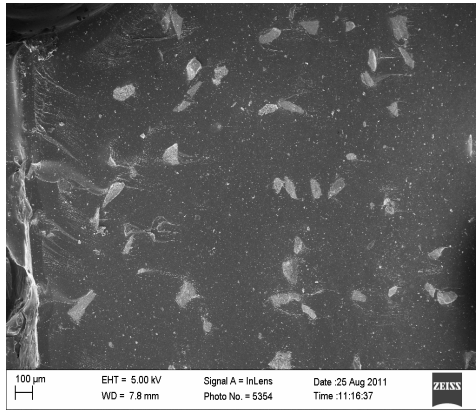
(e) Cow Bone
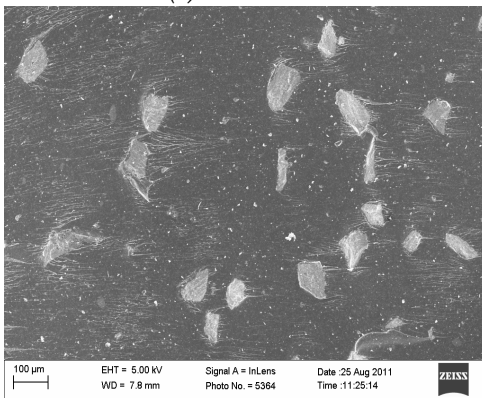
(f) Cow Bone Ash

Plates (e-f). SEM of Fractured surfaces of 8 wt % from 300 µm particle size Cow Bone and Cow Bone Ash-Reinforced Polyester Composites

Plates (a- f) depict the SEM micrographs of cow bone and cow bone ash particulates reinforced polyester composites (a-f). From the micrographs, it was observed that both cow bone and cow bone ash particles were well dispersed (white particle) in the polyester matrix (black surface). However, the influence of the cow bone ash particles on the matrix was more pronounced as this affects the dark coloration of the matrix by causing it to be more whitish (plates b, d, f) than that of the cow bone particle reinforced samples (plates a, c, d). By turning the cow bone into ash is one of the biocompatibility treatment expected to be carried out on cow bone for it to be suitable as biomedical implants [8], this observation shows that, the treatment has influenced the matrix structure and, hence, the expected properties. From the mechanical tests results stated above, it was revealed that better enhancement of the properties were achieved from the composites developed compared to the unreinforced polyester material due to proper dispersal of the particles in the polyester matrix.

4. CONCLUSION

The investigation carried out from this research work has revealed that both cow bone ash and cow bone particles can be used as reinforcement in polyester matrix in order to develop composites materials that is suitable as biomaterials. The work showed that variation in particle sizes as well as biocompatibilization treatment has pronounced influence on the microstructure and mechanical properties of the materials. The following conclusions were also drawn out;

✓ Cow bone ash (biocompatibilization treated) particle reinforcement gave better improvement in flexural/bending strength properties while cow bone particle reinforcement gave better enhancement in tensile strength properties except for modulus of elasticity where cow bone ash particle reinforcement offered better enhancement. This confirmed the fact that biocompatibilization treatment offer improved enhancement for the mechanical properties. Hence, it remains a promising material for biomedical applications.

✓ The enhancement of the mechanical properties of composites was observed to be reducing as the particle sizes increases. Optimum results were obtained from 75 µm particle sizes followed by 106 µm particle sizes. However, 300 µm particle sizes from cow bone ash gave the best enhancement for both tensile and bending modulus. This implies that coarse particle from biocompatibilization treatment offer improved enhancement in modulus property.

✓ By considering the fibre content, optimum results were obtained from 8 wt % addition followed by 2 wt %.

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1. György HAMPEL

LEARNING IN A VIRTUAL ENVIRONMENT

1. Institute of Economics and Rural Development, Faculty of Engineering, University of Szeged, H-6724, Mars tér 7., Szeged, HUNGARY

Abstract: *Many e-learning materials and learning management systems are implemented and used in higher education institutes. The learning materials assisting acquisition of knowledge can either be stand-alone or can be available through the network. In recent years, papers were published about the benefits of the involvement of computers and internet in education. One should also note that some say that although the use of modern technology has some potential effects, it is difficult to turn them into actual ones or to measure them. This paper attempts to give an overview of the most important concepts of e-learning (the virtual learning environment, the learning management system etc.), the main benefits, the disadvantages, the guidelines, rules (the heuristic evaluation instrument and protocol for e-learning programmes, the learning management evaluation tool user guide etc.) and standards that ought be followed when creating such systems. University of Szeged is using CooSpace as an e-learning system. Although CooSpace has its limitations (for example it cannot record the student's progress in acquisition of the curriculum), it has become a popular and a widely used system at the university.*
Keywords: *virtual learning environment, e-learning, learning management system, CooSpace*

1. INTRODUCTION

The purpose of this publication is to give an overview of the most important concepts of e-learning, the main benefits, the disadvantages, the guidelines, rules and standards that ought to be followed when creating such systems.

We are living in a digital economy where information and communications technology (ICT) knowledge is essential for everybody to succeed in almost all areas. The European Commission places a great emphasis on the development of information society. To support the idea, several programmes were launched in the past few years: the Lisbon Strategy (2000), eEurope (2000), the i2010 initiative (2010) and the Digital Agenda for Europe (2010) etc. (Petákné 2013).

To get along in an information society, one has to possess all six forms of literacy (Budai 2009):

✓ *Basic literacy is the ability to read and write which is absolutely necessary (for example to browse on the World Wide Web).*

✓ *Functional literacy is reading and writing skills that are necessary to manage daily living and employment tasks that require reading skills beyond a basic level.*

✓ *Workplace literacy is the required ability – including professional and communication knowledge – to perform workplace tasks.*

✓ *Technological or digital literacy is the ability to use ICT devices and software which enables the user to handle the infrastructure of the information society.*

✓ *Information literacy covers the skills to identify, evaluate and effectively use information.*

✓ *Adaptive literacy is the capability to keep track of technological innovations and take advantage of novelties.*

New educational methods, techniques have emerged which use computers and networks extensively. Technologies seemed futuristic a decade ago like virtual and augmented reality (Cirulis, Brigmanis 2010) also start to infiltrate education. Just as many new methods and technological advancements, e-learning was overhyped at the beginning of its life-cycle. Many electronic learning materials were created along with their management systems in the different areas of education. In the past two decades, the methodology of implementing and evaluating such systems has also improved; guidelines were set up to ensure the success of this new type of learning. Several researches have been conducted to assess its effectiveness and somehow determine the advantages or disadvantages compared to traditional face-to-face education.

Today the question is not whether ICT should be used, but how it should be used. Higher educational institutions are investing in e-learning systems to support their traditional teaching and to improve the students' learning experiences and performance (Tarhini et al. 2013). There is a growing belief that the use of e-learning systems may lead to improvements in efficiency of education considering the number of enrolled students, students' achievements and costs (Castillo-Merino, Serradell-López 2014).

There are basically two types of teachers concerning e-learning: who focus on information transfer and those who focus on student learning (González 2012; Owens 2012). Other researchers identified four types of tutors (Bliuc et al. 2012):

✓ those who use the new technological possibilities for information transfer only,
✓ those who use it for clarifying concepts as well,
✓ those who exchange and develop ideas, too and
✓ those who use ICT the most extensively to explore, share and use it for collaborative knowledge-creation, for developing awareness and skills.

2. THE MAIN CONCEPTS OF E-LEARNING

E-learning is a new method to understand the learning process in which the basic elements remain the same as in traditional learning, but this is supplemented with the means and possibilities of ICT which modifies the knowledge exchange, the assimilation of knowledge and it also brings freedom to learn anywhere (Alecu et al. 2011). It includes several types of activities like courses, informal and indirect networking education, community integration, knowledge management and learning by doing (Alecu et al. 2011).

According to Dillenbourg (Dillenbourg 2000) a virtual learning environment is a designed information space which is not restricted to distance education; it is a social space which integrates multiple tools where the space is explicitly represented, it also overlaps physical environment where the students are not only active, but also actors.

One can speak of blended learning (or combined, mixed learning) when the traditional educational form is used and combined with the facilities provided by ICT (Alina-Mihaela et al. 2012).

Experience shows that blended learning is more effective than face-to-face teaching or using the e-learning method by itself (Hobackova, Semradova 2013). Suitable learning tools have to be created that complement each other (Castillo-Merino, Serradell-López 2014). These learning tools are called the Learning Management System (LMS). The LMS is essential to manage a virtual learning environment. The main task of this system is to identify, to record and to follow the students participating in the educational process and to connect the users (tutors, students and other administrative staff) to their respective courses according to their roles and competencies (Gaceu et al. 2009). Shoonenboom gives a detailed list of the tasks an LMS can be used for (Schoonenboom 2014):

✓ Hold fixed office hours for students;
✓ Answer questions of students in irregular time;
✓ Hold group meetings, discussion on a subject matter;
✓ Video conferencing;
✓ Probe students' knowledge during group meetings;
✓ Examine and comment on the students' acquired knowledge and skills based on evidence put together by the students;
✓ Provide self-test for students to practice;
✓ Administer examinations;
✓ Provide tutor feedback for students after exams;
✓ Make references for further reading;
✓ Peer feedback; comment on and judge each other works;
✓ Write blogs or tell about experiences during the course;
✓ Make (PowerPoint) presentations available;
✓ Make references available to video presentations with further information;
✓ Record own lectures, instructional videos and make them available;

To choose and then operate a proper system, adequate infrastructure (computers with multimedia capabilities and high bandwidth internet) are required on the technical side. Aspects as technical flexibility (hardware and software requirements and support, licence costs, authentication), learning tools (materials, social network capabilities, student tracking and

evaluating) and usability (user interface, ready templates, followed standards, supported languages) are the main factors of the evaluation during the selection of the system (Herdon, Lengyel 2008).

The first step of the implementation of LMS is technology acceptance. It is difficult to implement any e-learning without the acceptance of the new ICT. The second step is innovation which is required as new technology is combined with learning techniques to create good quality e-learning materials. The third step is called inductive learning. While traditional courses are most often taught deductively where under-motivated students apply the learnt material to real-world scenarios, inductive learning techniques require the active participation of the students: for example they offer motivation through the challenge of completing a project, interpreting data or solving a case. The fourth step is the enhanced online classroom where the students are encouraged to solve complex problems with inventing their own solution instead of the tutors' detailed step-by-step procedures (Forrer et al. 2014). So, LMS offers various tools to assist work in a virtual learning environment. According to research these systems are mainly used for distributing materials, less frequently for communication between course participants and even less frequently for online assessment or collaborative learning (Schoonenboom 2014).

On the personal side, key competencies are also required to participate in e-learning course. Students (and tutors as well must possess competencies like: digital skills, self-motivation, self-driven learning capacity, good communication skills, knowledge of foreign languages, cultural awareness etc. (Muresan, Gogu 2013).

3. THE DISADVANTAGES, BENEFITS AND SUCCESS FACTORS

According to experts it is highly probable and desirable that the use of ICT in e-learning will change educational theories and methodologies and people developing e-learning material will have to acquire new skills to achieve success in creating e-learning material (Aharony, Bronsein 2010). It is also highly probable and also desirable that social technologies will improve e-learning experiences

since these create the atmosphere of cooperation and provide easy interaction among the students and tutors. Mobile technologies may also contribute to this experience (Aharony, Bronsein 2010).

It should be clear that modern technology is not a panacea, as – for example – the summarizing paper of Workshop on Virtual Learning Environment (Dillenbourg 2000) states: It has some potential effects, although it is difficult to turn it to actual ones, or at least to measure the positive effects. So, there is hardly any scientific proof of the superiority of the modern technologies.

There may be major challenges for implementing an e-learning material, including the lack of advanced computer skills among the academic staff, little awareness on instructional design techniques, time constraints and security concerns as well. Other disadvantages are that access to computers, smartphones, tablets and computer network is necessary on the students' part (Dissanayeke, Wickramasuriya 2010) (Alecu et al. 2011)

One should also note that there are studies concluding that online students perform worse than students attending face-to-face classes. There are studies that say that the difference between the two groups of students is not significant. There are also studies that show that the use of digital tools with the appropriate teaching method has a significant positive effect on students' achievements (Castillo-Merino, Serradell-López 2014). Studies show evidence of positive effects on students' performance from the adaptation of ICT innovations in teaching and learning (Castillo-Merino, Serradell-López 2014).

Despite the controversial results, in recent years papers were published about the benefits of the involvement of computers and the internet in education (Sideridis et al., 2010). According to publications multimedia materials can enhance enjoyment and engagement of learning which enables users to pay attention for a long time without feeling bored (Dissanayeke, Wickramasuriya 2010). E-learning systems are considered to be successful if they can replicate the classroom experience and consider students' needs. Students will use the system when they think that using the e-learning system will improve their

quality of life by saving time, money and effort (Tarhini et al. 2013). Based on the study of Alecu et al. (2011), the benefits of e-learning systems are:

✓ It is less stressful than the traditional type of learning;
✓ Increased collaboration and interactivity among students;
✓ Allows self-phased learning;
✓ Modular information architecture which allows progressive learning;
✓ Students can be easily monitored during their learning process and the tutor can intervene if necessary;
✓ Tutors and students do not need to be at the same place, this is more convenient and also reduces costs;
✓ Spreading and updating the curriculum on the network makes it easy for students to access the latest materials

To measure the acceptance of these systems, the technological acceptance model can be used (Tarhini et al. 2013), which models how users accept and use a technology. According to the model perceived usefulness ("the degree to which a person believes that using a particular system would enhance his or her job performance") and perceived ease-of-use ("the degree to which a person believes that using a particular system would be free from effort") (Davis 1989).

4. GUIDELINES TO DEVELOP A VIRTUAL LEARNING ENVIRONMENT

To find and use good quality resources to build an e-curriculum is fundamental. Finding out how to employ these resources is still evolving (Littlejohn et al. 2006). According to literature (Collis, Strijker 2004) the resources can be:

✓ Pure: Unedited, most commonly used materials (articles, book chapters, PowerPoint slides, animations etc.);
✓ Pure, combined: unedited resources combined with other resources (unedited materials with on-line or face-to-face discussion, or essay);
✓ Adapted: adapted, repurposed resources to fit teaching contexts;
✓ Dynamic: electronically assembled and structured and allows interaction and contribution (materials which can be edited and commented by students)

The usability of resources is determined by many features including durability, maintainability, availability at an appropriate cost and size, in a proper accessible format without legal restrictions that can be repurposed and reused (Littlejohn et al. 2006). When creating the learning materials and their learning environment, the learning management system, it is suggested to follow some rules or standards which may more likely lead to success. The range of different technology should be carefully selected by weighing several factors (Gaceu et al. 2010).

Implementing a successful e-learning environment requires high integration, availability, security, scalability and reliability which have to be provided in the whole life-cycle of the system. To describe this, the steps of software development life-cycle can be used: (1) program planning, (2) requirement definition, (3) design and development, (4) integration and testing, (5) installation and maintenance (Paulins 2010).

Since we are talking about software, ISO 9126 standard assuring software quality (functionality, reliability, usability, efficiency, maintainability and portability) can be taken into consideration (Al-Qutaish, 2009).

Computer systems have been evaluated for a long time based on ergonomics and ease-of-use, i.e. usability (Hornbaek 2006).

✓ UseLearn method is one of the methods to evaluate e-learning systems. It is a comprehensive checklist containing quality and usability evaluation perspectives. The UseLearn is a quantitative assessment model consists of dimensions like error prevention, visibility, flexibility, course management, interactivity, feedback and help, accessibility, consistency and functionality, assessment strategy, memorability, completeness, aesthetics and reducing redundancy each dimensions contain many checklist questions the persons evaluating the system have to answer (Oztekin et al. 2010).

Other useful tools and criteria are also available to maintain the quality of e-learning programmes, including:

✓ the Heuristic Evaluation Instrument and Protocol for E-learning Programs (Benson et al. 2001): This instrument lists twenty evaluation

factors and each of them can be assessed by answering specific questions. The factors are: the visibility of system status; match between system and the real world; user control and freedom; consistency and standards; error prevention; recognition vs. recall; flexibility and efficiency of use; aesthetics and minimalist design; help of users to recognise, diagnose and recover from errors; help and documentation; interactivity; message design; learning design; assessment opportunities; media integration; access to resources necessary to effective learning; access to performance support tools; learning management to monitor students' progress; feedback capabilities; content organization;

✓ the LMS Evaluation Tool User Guide (3waynet 2004) lists thirteen viewpoints to evaluate the e-learning management system: cost of ownership; maintainability; usability; vendor profile; openness; compliance with standards; integration capacity; Learning Object Metadata integration; reliability and effectiveness; scalability; security; hardware and software specifications; multilingual support.

5. COOSPACE

About eight years ago an administration system for teachers and students was introduced at all the faculties of University of Szeged which was later expanded with a system named CooSpace (Cooperation Space). This e-learning framework operates as the biggest virtual collaboration space for students and tutors in Hungarian higher education. CooSpace is used as a LMS and social media – an Internet-based application built on the foundations of Web2.0 that allow the creation and exchange of user generated content (Kaplan, Haenlein 2010) – mainly to

✓ store and distribute curriculum in different formats including plain to formatted text, video and audio files;

✓ provide one-way tutor-student communication with a billboard, tutor-student, tutor-tutor and student-student communication with forums, e-mail, questionnaire, voting and a text messaging system;

✓ manage attendance sheet of face-to-face and virtual classes;

✓ knowledge verification with exercises and tests;

Although CooSpace has its limitations (for example it cannot record the student's progress in acquisition of the curriculum), and student-tutor, student-student communication is not yet as extensively used as it could be, it became a popular and widely used system at the university.

6. CONCLUSION

We should take advantage of ICT and the opportunities offered by the new teaching methods utilizing e-learning techniques. To use e-learning effectively at the University of Szeged, the following things have to be taken into consideration:

✓ The network system and the servers are mostly up to date, but the workstations of the academic staff have to be modernized to be able to create e-learning content.

✓ Tutors should be motivated to digitize their materials and they should be enabled to use the LMS services more extensively.

✓ The LMS and the e-learning materials should be evaluated. There are several methods to do this. This can be even done by involving the students; CooSpace has services which can be used to achieve this goal.

✓ Students have to be persuaded to use the social media services of CooSpace. They can discuss the subjects, exchange ideas or cooperate while solving a task.

✓ Further development of the University LMS is necessary. It should be capable to follow students' progress of knowledge acquisition.

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[1.] *Andrea LEŠKOVÁ*

DESIGNING OF MANUAL WORKSTATION STRUCTURE WITH EMPHASIS ON ERGONOMICS

[1.] *Technical University in Košice, Faculty of Mechanical Engineering, Department of Technologies and Materials, SLOVAKIA*

Abstract: *Objective of ergonomic design is, among others, adaptation of manual workstations, workplace, working space, environmental conditions and lighting intensity to human properties and skills. Ergonomically designed workstation in production system with modular structure brings many benefits, e.g. increased motivation and satisfaction of employee, higher performance, productivity, efficiency, and processing quality. This article is a reference to help methodically plan, design and implement ergonomic workstations by considering variables such as employee size, type of task, lighting, and other key factors. The goal is to present the rules of ergonomic for work systems: body height and working height; work area; reach zone; parts presentation; range of vision; lighting; adjustment of work equipment. Using of the modular building- block system for designing individual workplaces enables flexibility and optimal adaptation to task and individual employee concerned.*
Keywords: *design principles; ergonomic rules; modular workstation; modelling*

1. INTRODUCTION

Workstations and assembly cells are at the heart of many manufacturing operations. Working space and workstations play a vital role in worker productivity. It is therefore critical that they are designed to be as ergonomic, flexible and efficient as possible. The goal for the design of workplaces is to design for as many personnel as possible. Traditional standard workstations in manufacturing system were bolted down and required workers to deal with a work surface that was in a fixed position. Ergonomic considerations often are not given priority. On the present, integration of the wide range of human characteristics (e.g. anthropometry, ability, proportion, strength) in the planning process is essential. Design of working systems by ergonomics is described under harmonized standards (e.g. EN ISO 6385). It is a known fact that the ergonomically ideal layout of workstations and workplaces not only stimulates the efficient manufacture of product in general, but also has direct benefits with respect to reducing the psychological demands placed on employees. Modular structure of equipments in manual production line can be easily modified to improve ergonomics, add or remove features, or change
dimensions, and the work area can be quickly rearranged for optimal productivity.

2. ERGONOMIC RULES TO DESIGNING OF MANUAL WORKSTATIONS

The term "ergonomics" is a combination of the Greek words "ergon" – work and "nomos" – law. The most important factors for designing work equipment are the working height, proper sizing of the reach zones and required leg room, as well as definition of the appropriate range of vision. All of these dimensions are derived from a "standardized" body height. Every workplace must be designed for a certain height range and not for one particular height of person. The aim when designing every workplace is to accommodate a range of heights (DIN 33406) from 1540 to 1871 mm (with shoes). [4] Further criteria that must be taken into account [5]:

- ✓ *Foot and leg room, depth and adjustment range of the footrest*
- ✓ *Size and variation of workpiece dimensions*
- ✓ *Occurring forces and weights*
- ✓ *Changing types of equipment and insert heights*
- ✓ *Greatly varying vision distances*
- ✓ *Local specifications (deviating body heights, legal requirements, etc.)*

✓ Aspects related to methods, safety, and efficiency.

2.1. Body height and working height

Manual workstations must accommodate a wide range of body heights to ensure that the largest percentage of the population is covered. The optimum working height is based on the body height range and the type of activity to be performed. The average optimum working height for average requirements is 1125 mm for sit-down/stand-up workstations. [4]

Height-adjustable workstations are the most flexible solution for dealing with extremely varied workpiece/component dimensions and large differences in employee heights. The concept permits changes in posture, which reduces stress and increases performance. [6]

2.2. Work area

The aim is for the distance of employee from the front edge of workbench to be as small as possible. The distance to the working area influences the following: position of the arms, viewing distance and inclination of the head. The work area height should always be between 800 mm and 1500 mm. [3] The following rules must be observed [5]:

✓ Avoid work above the heart (over 1500 mm): Otherwise, the circulation of blood and oxygen to the muscles is reduced, which leads to a drop in performance

✓ Work that requires bending (below 800 mm) exerts employees disproportionately and should be avoided

✓ Promote dynamic activities: static manual work (such as holding an object continuously) inhibits the circulation of blood and oxygen to the muscles. This can lead to a drop in performance and processing quality

✓ Allow for alternating physical exertion: for example, through sit-down/stand-up workstations or job rotation. Alternating physical exertion reduces stress on the employee and increases performance

✓ Minimize exertion: for example, through the use of manual roller sections or lifting aids, as well by selecting lighter weight materials.

2.3. Reach zone

The following rules apply for an ergonomic reach zone design: all containers, equipment, and operating elements must be easily accessible and arranged in the anatomic/physiological range of movement for the employee. All reach distances should be as short as possible to avoid redundant, non-value- added movements. Grab containers and parts containers that are in direct reach of the employee are ideal. Torso rotations and shoulder movements, particularly when under exertion (with weights ≥ 1 kg), should be avoided whenever possible. [4]

Characterization of the reach zones at workstation (see fig. 1) [3]:

Area A: Center of work, two-handed zone

✓ Optimum for working with both hands, as both hands can reach this zone and are in the employee's field of view

✓ For fine motor movements

✓ Area for workpiece support, workpiece pallet, or equipment

✓ Possible to handle lighter weights and also enables improved inspection and coordination activities

✓ Pure lower arm movements

✓ Smaller muscle groups are in use.
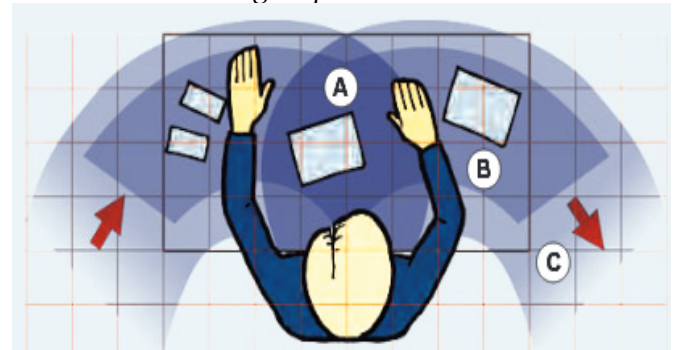
Figure 1. Reach zones at workstation. [3]

Area B: Large reach zone

✓ For gross motor movements

✓ Area for tools and parts that are often grabbed with one hand

✓ Upper and lower arm movements without use of the shoulders and rotation of the torso.

Area C: Extended one-hand zone

✓ For occasional handling, e.g. of empty containers or transferring parts to the range of movement for the next employee

✓ With shoulder and torso movement.

2.4. Range of vision

For optimal workstation design, it's important to follow recommendations on proper ergonomics for

vision. Can be differentiating between two vision areas (see fig. 2) [5]:

✓ In the field of view (red vision area), several objects can be seen in focus simultaneously without moving the eyes or head. Additional focusing for depth may be required here.

✓ In the visual field (light grey vision area) objects can be seen by moving the eyes but not the head. Additional focusing for depth may also be necessary here.
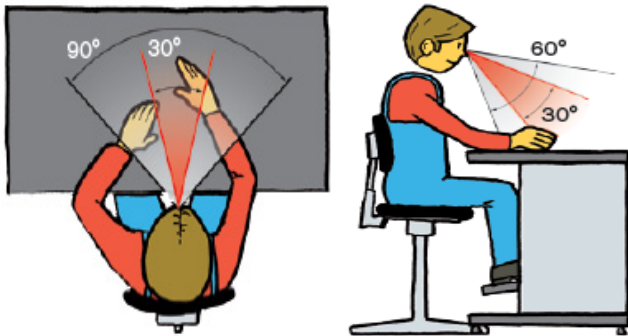
*Figure 2. Illustration of vision areas:
the field of view and the visual field. [5]*

The following aspects must be taken into account during planning [5]:

✓ Avoid unnecessary eye and head movements

✓ Implementing vision distances that are as identical as possible eliminates refocusing

✓ Avoid fastening locations not visible to the worker.

Complying with these three recommendations facilitates work and increases productivity.

2.5. Lighting

The right light, adapted to the activity at the workstation, is a basic prerequisite for high efficiency and processing quality. Optimum lighting prevents fatigue, improves concentration, and reduces the risk of errors. Match light intensity to the work task [9]:

✓ Standard assembly tasks: 500~750 lux

✓ Complex tasks (e.g. electrical assembly): 1000~1500 lux

✓ Delicate and/or critical work: 1500~2000 lux.

Important aspects for planning workstation lighting include [4]:

✓ Avoid strong contrasts
✓ Avoid glare and reflection.

For example, DIN EN 12 464 contains the required mid-range lighting intensities.

2.6. Adjustment of work equipment

To maintain performance and promote productivity, all work equipment near the workstation must be precisely adjusted to the employee and their activity. Correct adjustment of the table, chair, footrest, and grab containers, as well as the position of tools and material shuttles, minimizes movements, thus reducing physical exertion and employee absences (see fig. 3).
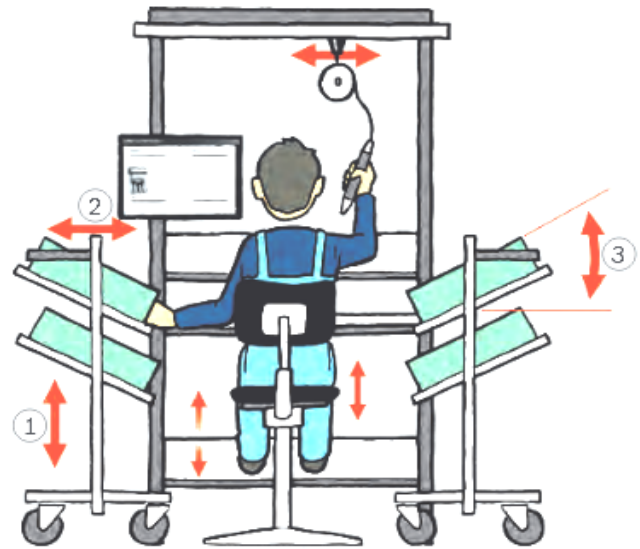
*Figure 3. Adjustable workstation to the employee
(1 = height, 2 = depth, 3 = angle). [5]*

A few important considerations [7]:

✓ When adjusting the chair and footrest, make sure that the thighs and calves form a right angle.

✓ Information boards should be hung at eye level to avoid unnecessary head movements.

✓ The angle of the shelves for material supply should be adjusted to create short, direct reach distances.

✓ Use lifting aids to supply heavy parts.

✓ With height-adjustable workstations, the optimum working height can be adjusted according to the size of the person or product.

✓ If processes, products, or employees change frequently, check the work equipment regularly to ensure proper ergonomic adjustment.

The general workstation design principles can be summarized as reference [4]:

✓ Make the workstation adjustable

✓ Locate materials box to reduce twisting

✓ Set work surface according to type of task

✓ Provide adjustable chairs

✓ *Allow workers to alternate between standing and sitting*
✓ *Support the limbs (elbow, wrist, arm, foot rest)*
✓ *Use gravity to move materials*
✓ *Design for proper arm movements*
✓ *Provide simple dials and displays*
✓ *Consider environmental conditions.*

If processes, products, or employees change frequently, check the work equipment regularly to ensure proper ergonomic adjustment. The worker must be protected from ergonomic problems.

A properly designed flexible workcell must be easy to reconfigure. The main benefit from using of adjustable ergonomic workstations is improve productivity – it has been demonstrated that providing employees with adjustable, ergonomically designed workstations can improve individual productivity by 20%, lowering stress and fatigue improves product quality. [7]

For example, applied modular structures from aluminium profiles system are not welded (see fig. 4); the design can be easily modified if ergonomic improvements are identified. Adjustable workstations allow users to adjust to their own comfort level, alternate between sitting and standing positions and adjust to accommodate different users in multi-shift operations. [6]

Manual flexible worktables are designed to provide a wide range of sizes and adjustments.

3. COMPUTER- AIDED DESIGN OF WORKSTATIONS ERGONOMICS

Ergonomic simulation can be used to evaluate a work cell to reviewing the interaction between the human model and the work environment such as reach analysis or posture requirements.

In addition to improving the performance of the production system, virtual ergonomic simulation can reduce engineering lead-time and cost by getting the ergonomic design right the first time and avoiding the need to go back and make changes later, when they will be more difficult and expensive. Simulation of human factors can lower the cost of work-related injuries by introducing ergonomics earlier in the design process. A wide range of manikins can be used in the simulation to determine how different types of people will interact with the work cell. Before anything is built or even ordered in the physical world, the virtual

workplace can be easily modified by reconfiguring the work cell layout, tooling and equipment to optimize the worker's motions. [8]

Figure 4. A few examples of adjustable workstations from aluminium profiles system. [6]
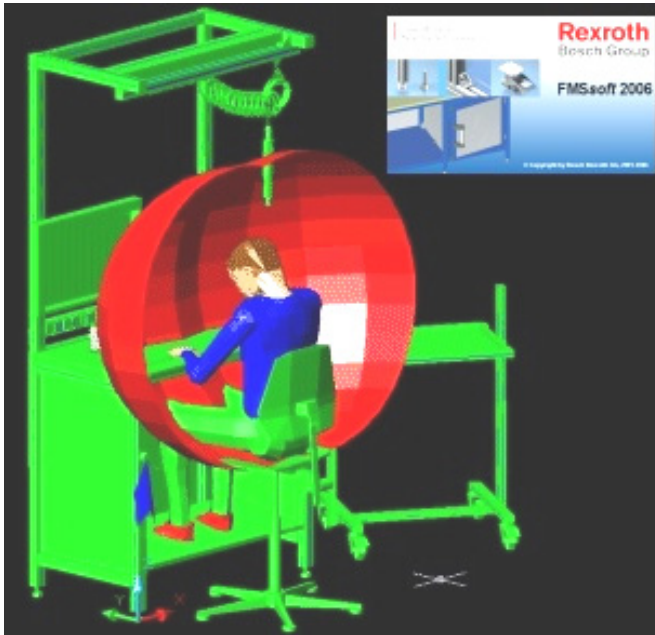
Figure 5. Example of software to modular workstation design modelling. [5]

Figure 5 presents the example of computer- aided application to visualise design of manual workstation based on profiles modular system and to modelling of ergonomics parameters.

The rapidly emerging technology of virtual ergonomics allows designers and engineers to overcome these issues by enabling the simulation of human interaction and ergonomic behaviour between production stations from the earliest stages of the design process. [8]

4. CONCLUSION

Ergonomic workstations are much more than just comfortable. They also support efficiency. An ergonomic workstation design plays a decisive role in reducing waste during production. If work tasks and equipment do not include ergonomic principles in their design, workers may have exposure to undue physical stress, strain, and overexertion, awkward postures, forceful exertions, repetitive motion, and heavy lifting.

The ergonomic design of work areas is crucial not only for compliance with health and safety regulations but also for employee comfort and efficiency. An ergonomically designed work area will reduce injuries and fatigue, while increasing productivity. Statistically, a disregard of ergonomic principles when designing workstations has been shown to result in reduced performance of between 5% - 20%, due to back and neck pain alone.

The modular workstations are designed to provide a balance between human well-being and performance. In addition, modular construction permits complete freedom in system configurations.

The building blocks from aluminium profile system provide all the modules that are need to ergonomically design and arrange of workstations in production plant.

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1. Ivana LONČAREVIĆ, 2. Biljana PAJIN, 3. Ljubica DOKIĆ,
4. Zita ŠEREŠ, 5. Aleksandar FIŠTEŠ,
6. Dragana ŠORONJA SIMOVIĆ, 7. Veljko KRSTONOŠIĆ

RHEOLOGICAL AND TEXTURAL PROPERTIES OF COCOA SPREAD CREAM WITH SUNFLOWER LECITHIN

1-6. Faculty of Technology, Department of Carbohydrate Food Engineering,
University of Novi Sad, Bul. Cara Lazara 1, 21000 Novi Sad, SERBIA
7. Faculty of Medicine, Department of Pharmacy, University of Novi Sad, Bul.
Cara Lazara 1, 21000 Novi Sad, SERBIA

Abstract: *Sunflower lecithin, together with commonly used soy lecithin, is a by-product of degumming of crude oil during refining process and can be defined as a mixture of phospholipids, residual oil and minor components. This paper investigated the influence of sunflower lecithin on rheological and textural characteristics of cocoa spread cream. Cocoa spread cream samples were made with the addition of 0.3, 0.5 and 0.7% of sunflower lecithin, with a milling time of 40 and 50 minutes in a laboratory ball mill. The results are compared with the results obtained for rheological and textural analyses of standard cocoa spread cream with soy lecithin added. Cocoa cream spread samples with the addition of all applied concentration of soy lecithin in milling time range of 40 to 50 minutes show lower values of thixotropic curve area, mean viscosity and Casson viscosity, but higher values of Casson yield stress, compared with cocoa cream samples with sunflower lecithin. Optimal concentration of soy lecithin is 0.5% with retention time of 40 minutes in laboratory ball mill, while addition of 0.7% of soy lecithin increases complexity of cocoa spread cream, but reduces Casson viscosity. On the other hand, the addition of 0.7% of sunflower lecithin and milling time of 50 minutes show the lowest values of rheological parameters. Cocoa cream samples with sunflower lecithin have lower values of textural parameters comparing with samples with standard soy lecithin.*

Keywords: *cocoa spread cream, sunflower lecithin, rheology, texture*

1. INTRODUCTION

Vegetable lecithins are commercially derived from oil-bearing seeds such as soybeans, sunflower kernels and rapeseed and primarily contain the following phospholipids: phosphatidylcholine (PC), phosphatidylethanolamine (PE), and phosphatidylinositol (PI). These lecithins with surface-active properties are used as emulsifiers in a vast range of foods, feed, pharmaceutical and technical applications (Nieuwenhuyzen & Tomas, 2008).

The majority of commercial lecithins are derived from soybean oil, typically containing between 0.5 and 3% phosphatides (Doig & Diks, 2003). On the other hand, the percentage of phospholipids in sunflower oil ranges from 0.02% to 1.5%, with an average of around 0.75%. Sunflower lecithin has a mild taste and similar emulsifying properties as

soybean lecithin. The composition of the phospholipids is similar to soybean lecithin, with a tendency to higher PC and lower PE ratios, which might be caused by crop varieties and processing conditions (Szuhaj, 2005).

In the food industry, lecithin represents a multifunctional additive in the manufacture of chocolate, bakery and instant products, margarines, and mayonnaise, due to the characteristics of its phospholipids (Cabezas et al., 2009). Lecithin helps to smooth the texture and serves as an emulsifying agent in margarine, chocolate, caramels, coatings (to control viscosity, crystallization, and sticking) (Ramadan, 2008).

Cocoa cream spread is confectionery product based on powdered sugar, vegetable fat, cocoa powder, milk powder and other ingredients. The basic characteristics of this type of product are: good

spread ability in a wide temperature range (from ambient to fridge temperature), rich creamy taste, smooth homogeneous structure with no fat phase separation, and good oxidative stability (Petković et al., 2013). Since cocoa spread cream contains over 30% of fat phase its physical and sensory properties are strongly influenced by the behavior of fat phase. Therefore, the fat selection for cream spreads requires a good knowledge of characteristics of fat and complex processes that may occur during manufacture and later in storage (Pajin et al., 2007).

The lecithin obtained from sunflower should be examined in different confectionery products with continuous fat phase and if appropriate emulsifying properties are achieved, it could be used in the confectionery production as well (Loncarevic et al., 2013).

This research examined rheological and textural characteristics of cocoa spread cream with the addition of lecithins from different sources – soybean and sunflower.

2. MATERIALS AND METHODS
Materials

- ✓ Cocoa-cream mass that passed through 3 roll mill in industrial conditions (mixture of powdered sugar, cocoa powder, milk powder, vegetable fat)
- ✓ Vegetable non trans fat NTFCP – produced in Oil Factory "Dijamant", Serbia
- ✓ Sunflower oil "Iskon" – produced in Oil Factory "Victoriaoil", Serbia
- ✓ Native fluid soybean lecithin – produced in Oil Factory "Victoriaoil", Serbia
- ✓ Native fluid sunflower lecithin – produced in "Cargill", Italy
- ✓ Hazelnut and vanilla flavor

Methods

Raw materials were added into a laboratory ball mill with a capacity of 5 kg. The temperature in the ball mill was 40°C, with a speed of 50 rpm.

Cocoa spread samples with the addition of different concentrations of soybean and sunflower lecithin depending on the milling time, were prepared according to the following scheme, presented in Table 1.

Rheological properties of cocoa spread cream samples were determined by rotational rheometer Rheo Stress 600, Haake, according to O.I.C.C. method. The tests were carried out at 35ºC using a concentric cylinder system (sensor Z20 DIN). The shear rate was increased from 0 s−1 to 100 s−1 , and then was kept constant at max. speed of 100 s−1 and after that was reduced from 100 s−1 to 0 s−1, each time within 240 s (OICCC 2000).

Table 1.

Cream spread with soy lecithin - Cs					
c (%)	0.3		0.5		0.7	
T (min)	40	50	40	50	40	50
Sample	Cs/0.3 /40	Cs/0.3 /50	Cs/0.5 /40	Cs/0.5 /50	Cs/0.7 /40	Cs/0.7 /50
Cream Spread With Sunflower Lecithin - Csu					
c (%)	0,3		0,5		0,7	
T (min)	40	50	40	50	40	50
Sample	Csu/0. 3 /40	Csu /0.3/50	Csu /0.5/40	Csu /0.5/50	Csu /0.7/40	Csu /0.7/5 0

*Concentration of lecithin (%); **Milling time (min)

Textural properties of fat samples were analysed using a Texture Analyser TA.XT Plus. The hardness and work of shearing were determined by penetration at temperature 20ºC, according to method Chocolate Spread – SPRD2_SR_PRJ (using software Exponent by Stable Micro Systems). The accessories included TTC Spreadability Rig (HDP/SR) using 5 kg load cell and Heavy Duty Platform (HDP/90). Each sample was placed into the cone sample holder and pressed down in order to eliminate air pockets. Any excess of sample was scraped off with a knife. Then the filled cone sample holder was put in base holder and 45 degree cone probe was used to penetrate the samples. The distance between cone sample and cone probe was 23 mm with test speed of 3 mm/s.

Results were expressed as mean of triplicate analyses.

3. RESULTS AND DISCUSSION
Rheological properties of cocoa spread cream samples

Fig. 1 shows flow curves of cocoa spread cream samples with addition of different concentrations of soybean and sunflower lecithin, with milling time of 40 and 50 minutes in laboratory ball mill.

All samples show very similar thixotropic flow. The rheological parameters of the samples are given in Table 2.

Samples with the addition of 0.3% of both soybean and sunflower lecithin have the highest values of thixotropy curve area, indicating the lowest homogeneity and spreadability of the system.
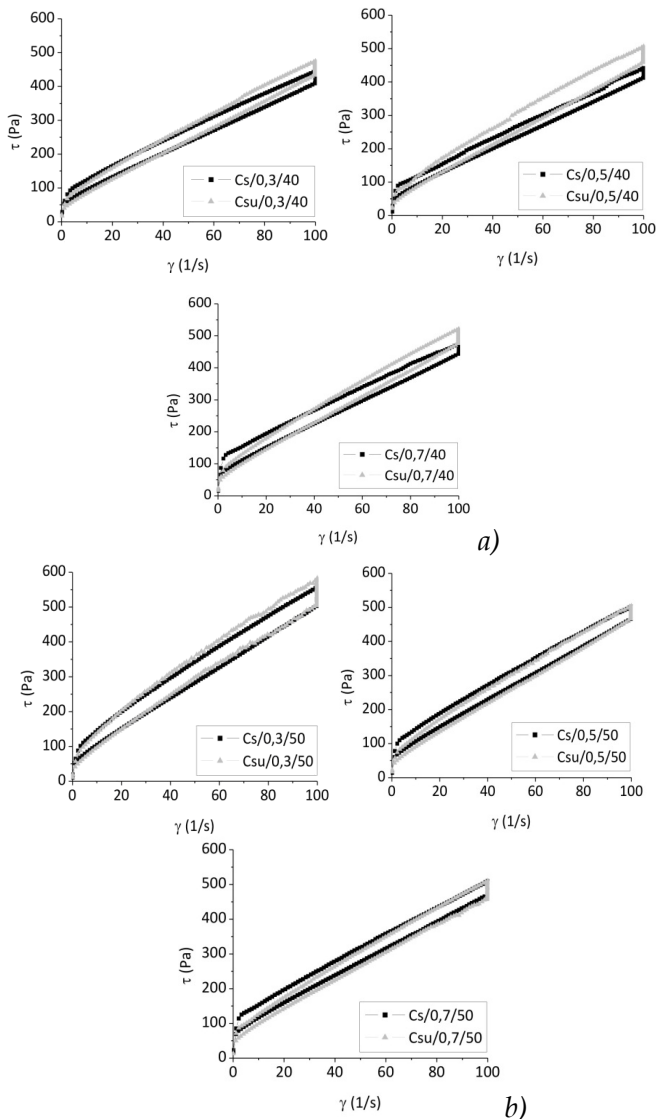
Figure 1. Flow curves of cocoa spread cream samples depending on different concentration of soybean and sunflower lecithin: a) 40 minutes, and b) 50 minutes in laboratory ball mill

Table 2. Rheological parameters determined by static measurements

Sample	Thixotropic curve area (Pa/s)	Yield stress (Pa)	Viscosity at maximum shear rate (Pas)
Cs/0,3/40	4678±37	17.50±0.54	4.54±0.74
Cs/0,3/50	5852±20	19.72±0.39	5.23±0.56
Cs/0,5/40	3109±73	17.54±0.69	4.25±0.62
Cs/0,5/50	4378±49	29.61±0.89	4.83±0.71
Cs/0,7/40	4425±59	23.17±0.28	4.57±0.98
Cs/0,7/50	4266±30	29.95±0.81	4.84±0.91
Csu/0,3/40	6268±34	21.09±0.77	4.97±0.68
Csu/0,3/50	7292±85	24.77±0.71	5.34±0.77
Csu/0,5/40	5261±65	25.72±0.59	4.82±0.91
Csu/0,5/50	4553±54	16.69±0.70	4.79±0.85
Csu/0,7/40	4598±45	16.54±0.95	4.96±0.79
Csu/0,7/50	4457±39	15.27±1.09	4.73±0.97

Values represent the means; n=3

The sample of cocoa cream spread with 0.5% of soybean lecithin with retention time of 40 minutes in ball mill has the most homogenous structure, with the lowest value of thixotropy curve area (3109 Pa/s), comparing to all samples. This sample has lower values of viscosity at the maximum shear rate (4.25 Pas) compared to samples with the same concentration of soybean lecithin, with milling time of 50 minutes.

On the other hand, cocoa spread cream samples with 0,5 and 0.7% of sunflower lecithin have lower rheological values with increasing the milling time on 50 minutes. Sample Csu/0,7/50 has a slightly smaller value of thixotropic curve area and viscosity comparing to sample Csu/0,5/50, however, the difference is very small and there is no need for the addition of a maximal concentration of sunflower lecithin.

Comparising to samples with soybean lecithin, cocoa spread cream samples with sunflower lecithin have higher values of thixotropic curve area.

Textural characteristics

Figure 2 shows hardness and work of shearing of cocoa spread cream samples depending on different concentration of soybean and sunflower lecithin and milling time in laboratory ball mill.
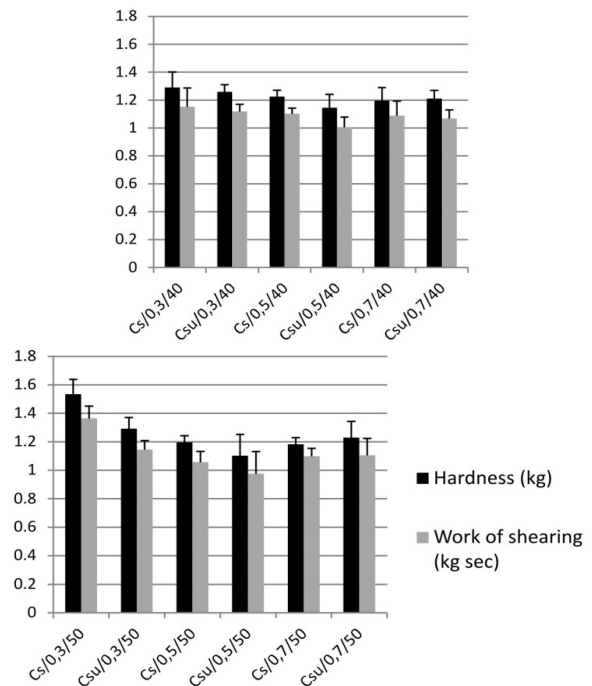
Figure 2. Hardness and work of shearing of cocoa spread cream samples depending on different concentration of soybean and sunflower lecithin: a) 40 minutes, and b) 50 minutes in laboratory ball mill

Samples with the addition of sunflower lecithin have lower textural values, comparing to samples with soybean lecithin added, at all concentrations and retention time in a ball mill (with the exception of a sample Csu/0.7/50).

Increasing the milling time from 40 to 50 minutes leads to increasing the values of hardness and work of shearing.

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1. Zoltán FABULYA

ANALYSIS OF THE LOAD-EFFICIENCY GRAPH OF THE BOILER

1. *Institute of Economy and Rural Development, Faculty of Engineering, University of Szeged, H6724, Mars tér7,Szeged, HUNGARY*

Abstract: *The rentability and quality of preserved food (besides the quality of the basic materials, the good recipe and the features of the production belts) are determined by their heat-treatment and its organization. The production process which was not planned carefully can imply quality problems and considerable increase of expenses. To support work organization with computer has not been in practice in Hungary so far. My main objective in case of technologies with an autoclave group is to elaborate a program system based on simulation which could help reduce the direct costs of heat-treatment and improve the quality of products. For this objective it is necessary to carry out further sub-tasks and examinations whose results should be utilized in the system. One of these is to analyse with simulation the load-dependent efficiency graph of gas boiler which provides the necessary amount of steam and then to use the results to find the conditions of optimal operation and to calculate costs reduction arising from it.*

Keywords: *boiler, load-efficiency, heat-treatment*

1. INTRODUCTION

Heat treatment of canned goods and especially of meat products requires large quantities of energy as these products require long treatment at around 120 degree Celsius. Reducing the use of natural resources is an important goal in industrial processes – a few years ago this only meant saving energy, today it includes the paradigm of environment management and the paradigm of sustainable development – the goal is to reduce the energy usage or at least to produce more products without increasing energy usage (Kerekes et al 1996). Although reduction in the use of these resources (water, electricity, heat energy) obviously decreases the cost of manufacturing and increases the economy of manufacturing, it is not trivial to implement in many production plants as the cost of these resources is not calculated or measured at all, thus wasting resources is not visible. Similarly, increased quality and nutrition parameters might also remain undetected.

In the field of heat treatment, general heat loss was an important field around 1970 (Rao et al 1976, Rao et al 1978, Singh 1978). Around 1980, the heat utilization and heat intake ratio were important issues (Bhowmik et al 1985, Sielaff et al 1982, Singh et al 1986). If the insulation is changed on the equipment, the technological processes must be changed in accordance with engineering calculations. Because of the above mentioned reasons, and because of the many parameters and many different processes, modelling and simulation should be combined with engineering calculations.

According to my assumption, the boiler-load which is constant in time guarantees the possible maximum average efficiency, while loads of bigger fluctuation and deviation result in lower average efficiency with the same average load, namely with heat-treatment of products of the same quantity.

2. MATERIALS and METHODS

The diagram (Figure 1) which shows the section with a critical, more intensive change in efficiency of the graph, necessary for the examination, was available in documentation of the boiler of the company which provided me with the data. It has a text complement which says that the efficiency continuously increases over the load of 50% and it reaches 90% at the load of 100%. The efficiency on the vertical ordinate of the figure means that how

many percentages of the heat amount calculable from the gas amount utilized to heat up the boiler is found in the heat-energy of the steam coming out of the boiler. It means that in case of lower efficiency, the heat-energy necessary for heat-treatment can be provided only by fuel gas of bigger amount. In the figure on the horizontal ordinate the percentage of the boiler- load shows that how many percentages of the heat amount, which can be maximally guaranteed in the unit of time, and which comes out in the form of steam, the boiler is loaded with.
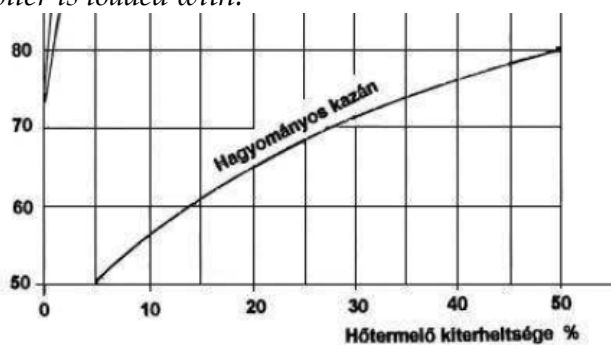
Figure 1 The efficiency of the boiler
as a function of loading

It was necessary to simulate boiler-load data of different dispersion with random number generator (Monte Carlo method) in order to be able to analyse the effect of uneven boiler-load on the expenses, on the basis of the results. The essence of the Monte Carlo method is that instead of the measured data we utilize their simulated (generated as random number) value on the input of the computer model, and we evaluate these results instead of the measured effect.

3. RESULTS and DISCUSSION

To get the efficiency automatically for the given load I needed the function of mathematical form which defines the graph. Thus, I aimed to find a function which attaches the efficiency values shown by the chart to the values of [0, 1] interval (corresponds to the [0%, 100%] load domain). I chose the $f(x)=x^n$ power function with exponents between 0 and 1 which adjusts itself to the nature of the graph. It was necessary to dislocate the function downwards (transformation) by 10%, so it is regarded as a parametre to find the precise value. All in all, the function which shows the connection between load and efficiency is the following:

$$y = f(x) = x^n - d, \qquad (1)$$

where: *x – load, y – efficiency, n, d – parametres in demand.*

I used the Solver complement of the Excel program to find the values of the parametres, applying the smallest squares method. Thus, I had the following function:

$$y = f(x) = x^{0,2} - 0,09. \qquad (2)$$

The chart formed, on the basis of the known data, on efficiency and the function used as its model (Figure 2) showed that there is no need to examine the statistic congruency of the two data series. By means of the function, the efficiency can be calculated to the load of any values.
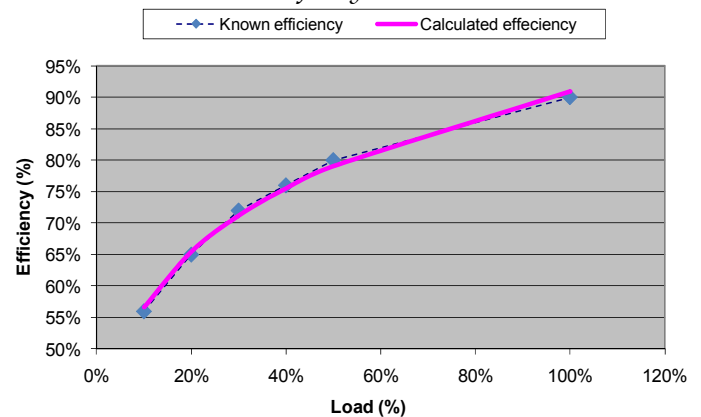
Figure 2. Graphs of known and calculated efficiency
as a function of loading

Table 1. Analysis of the boiler efficiency
with different loads

Average load	Dispersion of load	Average efficiency	Relative loss of efficiency
70%	70%-70%	84,11%	0,0%
	65%-75%	84,06%	0,1%
	40%-100%	82,66%	1,8%
50%	50%-50%	78,06%	0,0%
	30%-70%	75,83%	2,9%
	20%-80%	75,39%	3,5%
	10%-90%	74,39%	4,9%
30%	30%-30%	69,60%	0,0%
	10%-50%	65,58%	6,1%

During analysis I tried to find out what efficiency of average value the boiler loads of a given average value but of different deviation, dispersion result in (Table 1). It can be calculated from this that the heat-treatment of the given amount of products can be guaranteed by what degree of efficiency and thus, by what gas consumption depending on the evenness of loading. The relative loss of efficiency shows that what loss can be experienced in

percentage with the given average load, as compared to the maximum available efficiency. Dispersion of load means the value domain the boiler load moves in.

To generalize the data of boiler loads in percentage the average values possible in practice and their approximate dispersion were taken into consideration. The average of the boiler load per year is around 50%. One of the main reasons for uneven load is seasonality when certain products need heat-treatment with a fairly big deviation. Of course, in this case there is no possibility to balance the load. The other, a more important case from the aspect of my research, is when different products are made at the same time which need different loading, and it is not taken into consideration while scheduling the production, as I have experienced in the present practice. In this case, for example, instead of the average load of 50% per shift it is typical that average loads of 30% and 70% can be experienced in successive shifts. Nevertheless, there can be big deviations within a given shift when the heat-treatments in parallel autoclaves are not scheduled.

Consequently, dispersion of loads is on a very large scale but it cannot be regarded as a normal one, for example. For this reason, I generalized a data series of even dispersion between different limits which is typical to the unevenness of loading. I determined the average of the efficiencies arising from it and the relative deviation in relation to the balanced position. This relative loss of efficiency is the loss of gas consumption of the boiler, too.

During examination at each efficiency of 30, 50 and 70% I examined that how much the standard deviation effects the efficiency. The last column of Table 1 shows that how much the relative deviation of efficiency and thus, the costs are from the case which can be maximally attained without the standard deviation, in case of the given average load.

It can be seen from the results that in parallel with the growth of unevenness of load the loss increases, too. With smaller average loads the equalization of load has greater importance since in this case the relative loss can reach 6%. With the load of 50% which can be regarded as the annual average there was almost 5% loss in the worst case which means

the additional expenditure of 5 million Fts if the annual gas fee is 100 million Fts.

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1. G. ADEDOKUN, 2. T.K. AJIBOYE, 3. O.R. OYENIRAN

QUALITY ASSURANCE AS A STRAGETIC APPROACH TO MINIMISE MAINTENANCE COST

1, 3. Department of Electrical/Electronic Engineering Technology, Faculty of Engineering, Osun State College of Technology, Esa-Oke, NIGERIA
2. Department of Mechanical Engineering, Faculty of Engineering and Technology, University of Ilorin, Ilorin, NIGERIA

Abstract: Entrepreneur's primary objective is to firmly established itself, maximize profit and minimize maintenance cost of its low-cost best quality products that will generate high demand while maintaining a continuous focus on cost-containment and operating efficiencies. This objective can only be achieved if the products' quality meets standard demand of end users. Many approaches to quality control are not effective. Nonconformities in the factory testing are caused basically by excessive process variation and mistakes. Some approaches to quality control can effectively control process variation, but it cannot prevent most mistakes because mistakes are frequently the dominant source of nonconformities. Since maintenance cost of any product is inversely proportional to its quality;hence, the quality and maintenance of any products cannot be over emphasized to attract their high demand. Experience shows many industrial activities collapsed when they were expected to be at the peak of their production performances and theoutcome effect is that, they start to run at a huge loss when they were expected to make profit. Investments on structures will have impact on industrialization when the trend leading to this collapse could be reversed in order to enjoy the full benefits derived from it. Meanwhile, the only strategic approach to minimize maintenance cost is to maximize the quality. An attempt has been made in this paper to discuss maintenance cost minimization from the basics that detect mistakes and enable corrections before nonconformities are generated, achieving the highest degree of quality at minimum maintenance cost.

Keywords: maximize, profit, minimize, maintenance, cost, products, profit

1. INTRODUCTION

The main objective of any entrepreneur is to exploit profit and lessen maintenance cost of their products. Meanwhile, this objective can only be achieved if the products' quality meets standard and specification of end users. Hence, the importance of possessions quality and maintenance cannot be over emphasized to achieve maximum assets availability at minimum cost.

The modern thought of maintenance system is known as tero-technology, which is a total systems concept of maintenance. The British standards, BS 3811 (1993), defines tero-technology as a combination of management, financial, engineering, and other practices applied to physical assets in pursuit of economic life cycle costs. Industrialists have various ways on how to organize maintenance activities but there are no single best ways.

Quality is defined by Cauchy as conformance to requirement. It is also defined as the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs by International Standard Organization (Jimoh, 2011).

Over the years, many industries are set up with the aim of making profit on investment. But, these have not translated into any significant impact on the country's industrial development and the bane of industrialists has not been due to lack of investments on industry but to the collapse of the available one, as a result of lack of maintenance cultures. Examples in this respect abound in all the public and private established sectors (Obi, 2007).

The course to give way is inherited from the following factors:

Product are conceived and brought with 'congenital' defects and malformations.

The product shows instant signs of worsening after delivery, and is left unattended to keep the product in its innovative form.

Thus, the maintenance cost to return the structure to its inventive form continues to rise in geometrical proportions which may lead to collapse of the structure.

Experience has shown that many industrial activities collapse when they were expected to be at the peak of their production performances. Outcome effect is that, industries start to run at a huge loss when they were expected to make profit. Investments on structures will have impact on industrialization when the trend leading to this collapse could be reversed in order to enjoy the full benefits derivable from it.

Maintenance cost of any product is inversely proportional to its quality (Obi, 2007); the only strategic approach to minimize this cost is to maximize the quality. An attempt has been made in this paper to discuss maintenance cost minimization from the basics and these basic tools can be used to appraise all resources (men, materials, machines, methods and processes) that will assist in maintaining the desired results.

2. OBJECTIVES OF MAINTENANCE

Many industries are set up with aim of making profit. In order to achieve this corporate objective, maximum outputs and good quality of their products have to be achieved at minimal cost (Olaleye, 2003). Maintenance is schedule to service production to achieve these goals. This involves ensuring the effort of the maintenance personnel in close collaboration with production staff:

That the obtainability and efficiency of facility for quality production at minimal cost index are maximized

That the means of assessing equipment performance through record keeping and formulation of equipment improvement action are achieved

The founding of safe working environment

That the designed life span of equipment is realized; and

The quick gaining of manpower.

If these functions are not executed, production would be jeopardized.

In decision support, it is important to ask if maintenance is to modify the existing design, or is it for plant improvement modification design? These questions need to be answered and then an institution can proceed on to the next step. The next steps now include repairs either within the workshop capacity or beyond workshop capacity, spare parts procurement, and equipment weak point evaluation.

3. ENGINEERING MAINTENANCE PROBLEMS

It should be pointed out that maintenance, generally in this part of the world; has some constraints which hinder the smooth and effective running of any industrial set up. The most important of these constraints include:

Non-availability of spare parts and consumables

Lack of understanding of the maintenance crew

Inadequate experience of engineering staff

Inadequate training of engineering personnel thereby resulting in lack of exposure

Manpower shortages

Difficulty in getting foreign exchange to update equipment and procure spare parts

Inadequate re-numeration for engineering personnel which leads to their non-commitment and at times nonchalant attitudes to work

Lack of modern fault detecting equipment to monitor sensitive parts of machines like bearing and gears before resulting to failure leading to costly breakdowns.

4. QUALITY OF PRODUCT AND MAINTENANCE COST RELATIONSHIP

The less the defects or deformities in a structure at time of conception and delivery, the less the cost of maintenance during its life (Obi, 2007). Hence, the usefulness and longevity or otherwise of the life of a structure and the cost of upholding it, when in use, is determined by its quality at delivery. Thus, quality and maintenance cost are linked and inter-related. It can be noted that maximizing the former is the central means of minimizing the later. Since conception and delivery proceeds life, the strategic approach to minimize maintenance cost during life is therefore to maximize quality during conception, planning and delivery.

Therefore, if maintenance cost is to be minimized, the central thrust of approach is to ensure that the project response to these conception goals.

a. *Fruitful delivery of the structure with no or minimum flaws*
b. *Competence of being put the structure into wanted used over a long period of time with little or no maintenance.*

5. MINIMIZATION OF MAINTENANCE COST OF THE PRODUCT TECHNIQUES

In constructing any structure, the main resources involved are funds, personnel, equipment/tools and materials. In as much as maximization of quality results to minimization of maintenance cost, any strategies to minimize maintenance costs will dwell eventually on the effective use and application of these stated factors. The application of personnel and equipment on materials produces the structure, while funds are used to procure the other three.

Therefore, if a healthy qualitative structure is to be delivered, it is practically important to ensure the following from the basics (Obi, 2007).

✓ *Good planning and design*
✓ *Employment of appropriate personnel*
✓ *Provision of appropriate equipment*
✓ *Provision of adequate funds and judicious use of it*
✓ *Quality assurance on materials and workmanship*
✓ *Effective enforcement of measures on budgetary control and quality assurance*

Good Planning and Design

For any works, a proper plan and design must be touched and checked by professionals that are trained in the pertinent field, for if the design is faulty, the project will be delivered with congenital defects, which will increase maintenance's costof the product during its life cycle.

Employment of appropriate personnel

The personnel are most important resource in executing any project. This is so, because they are to manage the resources, funds, operate equipment and also keep the equipment in operable conditions. Thus, if competitive projects are to be delivered on schedule and in healthy state, utmost importance, are the personnel.

Therefore, the employer must show and demonstrate ability in setting up and managing modern organization comprising of professionals of various categories. There must be the preparedness to invest on the recruitment, training and motivation of personnel; that is, the head of the team must possessed special skills and ability to organize, control, motivate, train and develop staff. Furthermore, the right categories of personnel must be employed.

All with primary aim of maximizing and sustaining their interests and, hence, enhance the quality of their works.

In addition, the employer must keep a happy work force such as there must be in place adequate immediate compensations for the skilled, semi-skilled/unskilled staff as they are to manage the resources on theproject

Procurement of appropriate Equipment

Having the appropriate equipment is important if good quality product is to be delivered.When funds are available, necessary equipment can be procured, but when funds are not sufficiently available, the necessary equipment could be hired. They must, at all times be in operable conditions. In order to attain this optimum condition:

(i) There must be a good storage of spare parts for the machineries/equipment
(ii) A pool of experienced technicians who can effect, immediate repairs or replacement on this equipment must be taken into consideration.

This is a factor that bears significant, albeit indirect effect on the status of the delivery of the structure, and hence on subsequent maintenance costs.

Provision of adequate funds and judicious use of it

Availability of funds is an importantfactor tothe success of any initiative product development.

For those who have been involved in product developments, the complaint is that insufficient funds are usually provided by policy makers. As a result, the operators end up with low quality, defective products with subsequent high cost of maintenance.

The view of this writer is that the failure of such operators to deliver has not been centrally due to lack of funds. Rather, the failures have been due to lack of accountability, and further to the lack of physical evidence to show, for the funds made available. Even, in the cases where there are

physical evidences on ground, these are usually of low quality. The result of this is that the public and the policy makers are neither impressed nor discouraged.

The situation on funding for product, especially in public institutions will improve when operators show results for every fund made available.

The above does not remove the fact that conscious efforts must be made to allocate sufficient funds for project so identified.

Budgetary Control

One of the major reasons for low quality product is due less to inadequate funding, but more to lack of financial discipline. The overall imprint is that funds for project developments are usually siphoned away through vouchers, with no consequences on ground. Invariably, policy makers do not allocate enough funds, all in belief that it is not worth it. Thus, to break this series, there must be a preparation that ensures a minimum level of expenditure control, so as to restore the sureness of the policy makers and the public.

When this sureness is restored, there will be fewer reserves to allocate or provide adequate funds. Operators can then proceed to produce good quality works.

In order to achieve this, before the beginning of works on any project

(i)   All work matters must be ascertained and obviously defined

(ii) The quantities/amounts of each of the items must be recognized or at least fairly precisely projected by experienced personnel

(iii) The cost of unit of each work item must be established using current market prices

(iv) All these three factors will then be engaged to develop a 'Bill of Works Measurements and Evaluations' (BWME) and to obtain an overall estimate for the project in question.

Further in proceeding with the development of the project:

a. Claims for all works executed must be backed by a BWME, specifying details and costs

b. The work done so claimed must be inspected and certified by an Independent Department within or from outside the client's organization

c. When the presentations claimed to have been done, have been adjudged satisfactory, both in

terms of the quantity and quality, the next level of request can be entertained by the funding authority.

Quality Assurance on Materials and Workmanship

Funds, personnel and equipment are applied to materials in numerous ways to produce the project. If the final product of these applications is to be healthy the procedures for the applications must meet professional standards; and the materials on which these resources are being applied must be of the standard quality. The same applies to workmanship. The standards are there, well-defined, and documented.

Good workmanship on poor materials result in poor quality product, so also is the application of poor workmanship; on good materials.

Thus, project leaders must at all times during execution comply with established standards both on materials and workmanship.

Enforcement of Quality Assurance and Budgetary Control Measures

The public is always deeply negative about investment on project as such investments either do not deliver, or in few cases, deliver with serious congenital defects. Either in the public or private sector, one fundamental drawback in the development of good quality job is lack of adequate budgetary and quality control measures. In most cases, the same department identifies the project, prepares the request for the project, prepares the request for the funds, receives the fund, executes the project, monitors and certifies the project. The drawback in this arrangement is obvious.

Therefore, if quality is to be assured, there must be an arrangement that provides for the enforcement of quality assurance and budgetary control measures:

✓ A section, separate from, and independent of, the executing section must be responsible for quality/budgetary

✓ The subdivision will be responsible for verifying, inspecting and certifying quantity and quality of work done.

If need be, the client may engage agents from outside the organization to undertake the assignments listed above. This is particularly so if there are not sufficient of the required personnel

within the organization. The Due Process Office is performing functions close to what is described above.

However, the present Due Process arrangement emphasizes more on budgetary than on quality control, and this is particularly so at the federal level. The texture, quantity and quality of the project is left with the Implementing Agency.

The thrust of the message here is how budgetary control can be employed as additional muscle to ensure and enhance quality.

It is instructive to note that the Osun State Due Process Office is a step ahead in this respect. Apart from budgetary control aspects, the office engages external experts in various disciplines to monitor and ensure quality of project being put in place by the government (Obi, 2007).

6. SUMMARY/CONCLUSION

In spite of the enormous investments of the country on infrastructures, the expected spin-off on industrialization remained indefinable, because, not long after installation, the structures collapse owing to lack of maintenance caused by prohibitive cost of putting aright inherent and congenital defects.

As the cost of maintenance tolerates inverse proportion to quality, the tactical approach to minimize maintenance cost, and safeguards catalytic effect of infrastructure developments on industrialization is to augment and exploit quality. Therefore, thought fullabors must be made from beginning of works on the project through to completion to safeguard good quality works at every phase.

In command to attain this:
a. A good plan of the project must be in place with clear descriptions of all work matters to be implemented.
b. Appropriate Personnel and Equipment must be active in putting the project in place.
c. Normal tests must be conducted on resources to inaugurate quality; also the rules and guidelines on workmanship must be severely engaged and trailed.
d. There is need for restoration of mutual confidence between the operators and the policy makers.
e. A preparation must be in place that provides for the implementation of budgetary control and quality assurance measures.

The general conclusion, so, is that:
✓ Decent planning and design,
✓ Service of appropriate Personnel and Equipment
✓ Provision of adequate funds and judicious use of its
✓ Quality assurance on materials and workmanship
✓ Real implementation of measures on budgetary control and quality assurance are vital active measures, which should be taken to maximize quality and ensure that projects are brought in healthy state. Consequently, the life of the product will be protracted, and the cost of custody it in its unique form will be reduced to the minimum. The product will therefore be in the place to play the expected catalytic role in the process of industrialization.

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1. Imre Zsolt MIKLOS, 2. Cristina Carmen MIKLOS, 3. Carmen Inge ALIC

DRIVE MECHANISM ANALYSIS OF DOOR WINDOWS TO ROAD VEHICLES

1-3. Department of Engineering and Management, Faculty of Engineering Hunedoara, University Politehnica Timişoara, Revolutiei, 5, Hunedoara, ROMANIA

Abstract: This paper is meant to present a description as well as a classification of the mechanisms for manipulating the windows of road vehicles. A life-size 2D modeling was performed for the handling mechanism with two arms crossed and motorized drive. A structural, kinematic and kinetostatic computer assisted analysis was made using SAM in actual operating conditions.
Keywords: mechanism, kinematic analysis, kinematic joint

1. INTRODUCTION

With the development of the car making industry, in addition to an increase in cars' technical performance, as well as the development of engines, transmissions, the improved aerodynamics of bodywork, the electronic systems (on-board computer) or of the passive safety features, automobile manufacturers insist increasingly more on the driver and passenger comfort, the cabin ergonomics, and on the idea that the driver in particular and passengers make a minimal effort to handle various parts of the vehicle systems. This can be achieved by "mechanization" of these systems, as well as by placing the actuation commands within the driver's reach.

One of these systems is the motorized drive mechanism to the windows. With different vehicles we can find several variants for the drive of the windows. Some of these are presented below.

One of these systems is the motorized drive mechanism to the windows. With different vehicles we can find several variants for the drive of the windows. Some of these are presented below.

- Window actuator mechanism with cable reel and drum (Figure 1): is a mechanism that is directly connected to the window carrier rail, and is activated by a drum. This type of mechanism is used primarily to drive the rear door windows of motor vehicles.

- Window drive mechanism with hydraulic cylinder (Figure 2): it is a mechanism with fixing points close to the window, guided on either side by the rail fixed to the door of the vehicle. The guiding rail of this mechanism can be curved following the curvature of the window glass.

- Window drive mechanisms with articulated bars, single arms, (Figure 3), with two arms crossed with motorized drive (Figure 4), and with manual drive (Figure 5).
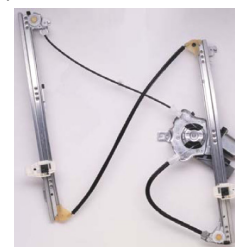
Figure 1. Drive mechanism with cable reel and drum
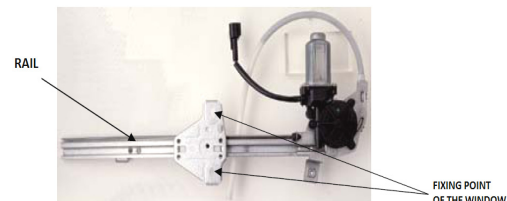
Figure 2. Drive mechanism with hydraulic cylinder

Figure 3. Single arm driver mechanism
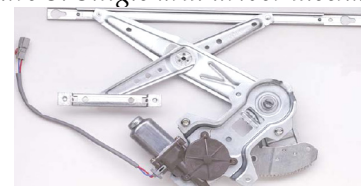
Figure 4. Two arms crossed mechanism with motorized drive
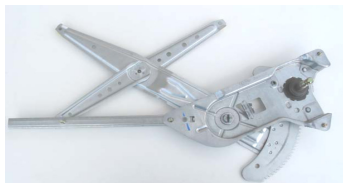
Figure 5. Two arms crossed mechanism with manual drive

The variant of window driver mechanism to road vehicles under study beneath is that with articulated bars, with two arms crossed with motorized drive (Figure 4).

Since both front doors (if applicable the rear ones two) of the vehicle are equipped with motorized mechanism for manipulating the windows, they will have a symmetric structure (Figure 6).
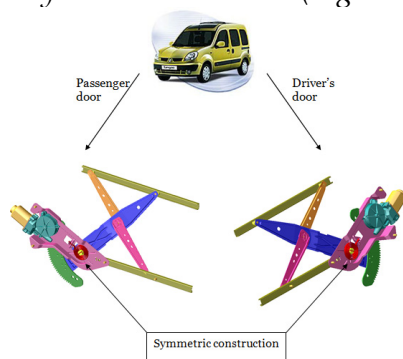
Figure 6. Symmetric construction of the drive mechanism

With the kinetostatic study and analysis of the drive mechanism of the window, its external loads must be taken into account, i.e. the weight of the glass (P = 30) and the resistance of the window guide (Rg). The layout of these external loads for lifting and lowering movements is shown in Figure 7.
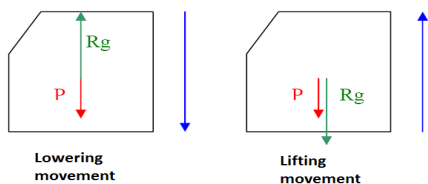
Figure 7. External loads of the mechanism

To end with, for the study of the mechanism of the motorized window drive the following is considered:

✓ The mechanism should operate smoothly and vibration free
✓ The tare weight of the glass is P = 30
✓ The estimated resistance force of the window guide: Rg = 50 N
✓ The most adverse condition, from the point of view of loads, is when lifting the window (P + Rg = 80N)

2. STRUCTURAL ANALYSIS OF THE HANDLING MECHANISM

The kinematic diagram of the mechanism for handling the windows in the doors of road vehicles is shown in Figure 8, and has the following technical characteristics (from the design theme) and geometric dimensions (resulting from the design of the mechanism):
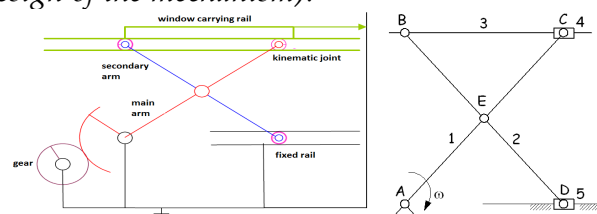
Figure 8. Kinematic scheme of the drive mechanism

✓ lifting/lowering strokes – 510 mm
✓ time for window lifting – 10 s
✓ time for window lowering – 10 s
✓ the angle of rotation of the driving element for the lowering stroke - 97 degrees, and for the lifting stroke - 97 degrees
✓ loading of the mechanism for lifting stroke (adverse event) - 80 N

Geometrical dimensions of the constitutive kinematic elements:

- $l\,1$ (main arm) = 340 mm
- $l\,2$ (secondary arm) = 340 mm
- $l\,3$ (window carrying rail) = 400 mm

By analyzing the kinematic diagram of the mechanism (Figure 8) the following may be specified:

✓ The mechanism consists of five mobile cinematic elements (n), main arm (1), secondary arm (2), window carrying rail (3) and background (4) and (5).
✓ The mechanism consists of seven kinematic couplings class V (C5), A (R 0-1), B (R 2-3), C (R 1-4), C (T 3-4), D (R 2-5), D (T 0-5) and E (R 1-2)
✓ The mechanism can be considered plane, so the family will be three.

Thus: f = 3; n = 5; C_5 = 7.

The number of degrees of mobility of the mechanism is given by the equation (1):

$$\mathrm{M} = 3\mathrm{n} - 2\mathrm{C}_5 = 3\cdot5 - 2\cdot7 = 1 \qquad (1)$$

The number of degrees of mobility being equal to 1, the drive mechanism is well defined (desmodrom), i.e. each position of the leading element has specified positions of the other kinematic elements.

Kinematic analysis of the driving mechanism
The kinematic analysis of the drive mechanism using the program SAM51 was done for the kinematic cycle consisting of the lifting phase, as well as the lowering phase of the window and implies the following steps.

- Modeling of mechanism: the mechanism will shape the least extreme position, based on the coordinates of kinematic couplings, resulting from the geometric synthesis: Coupling 1-A (0,0); Coupling 2 - E (112.44, - 127.5); Coupling 3 (R + T) - C (224.89,-255); Coupling 4 (R + T) - D (224.89, 0); Coupling 5 - B (0,-255)

Geometric model of the mechanism is shown in Figure 9:
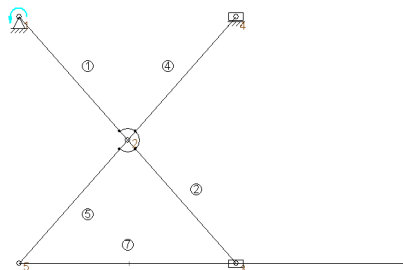
Figure 9. Geometric model of the driving mechanism

- specifying the drive movement of the mechanism: the drive movement of the mechanism will be a uniform rotation with kinematic coupling 1 (angular acceleration ε_1=0), according to Figure 10, consisting of two components: for the lifting phase - rotation angle "+97"degrees, lifting time 10", whereas for the lowering phase - rotation angle "-97" degrees, lowering time 10". We considered for analysis 360 calculation intervals for each phase of the movement.
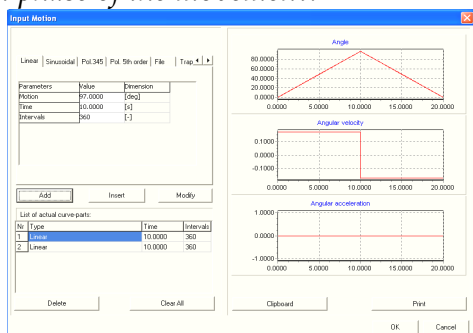
Figure 10. Motion of the drive mechanism

Actual kinematic analysis
What is aimed at is obtaining, in the form of graphics, variations of the kinematic dimensions of the component kinematic elements in the time frame in which the lifting / lowering stroke of the window is performed. With demonstration

purposes Figure 11 shows the variation of the position, velocity, as well as of the acceleration of the window carrying rail (driving element)
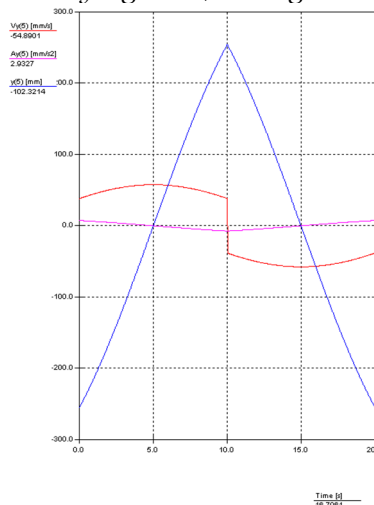
Figure 11. Kinematics of the window carrying rail

3. KINETOSTATIC ANALYSIS OF THE DRIVING MECHANISM

The kinetostatic analysis of the driving mechanism has been developed for the lifting phase of the window, considered unfavorable in terms of loads compared to the lowering phase, and presumes the following steps:

- Establishing the external load of the mechanism (Figure 12a) - what is taken into account is the force that loads the mechanism, F = 80 N, concentrated on the window carrying rail.

- Defining the masses, the moments of inertia and the position of the gravity centers of the kinematic elements - it will be developed individually for each item as shown in Figure 12b. Although the kinematic elements have no considerable masses, in calculations, their forces of gravity will still be taken into account. For simplicity's sake the centers of gravity will be positioned at half of the length of the elements, while the moment of inertia around an axis passing through the center of gravity will be considered equal to 1.
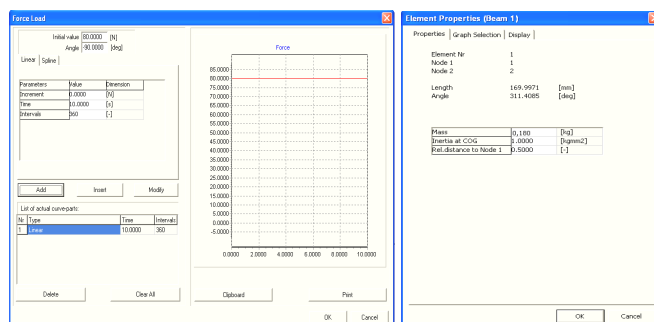
Figure 12. Establishing and defining

The loading scheme of the driving mechanism in the lowest position, developed in the above described way is shown in Figure 13.
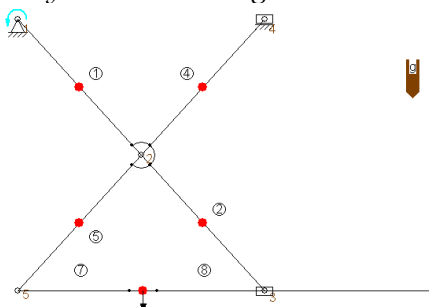
Figure 13. Scheme of the mechanism loading

- obtaining graphical form variations of the reactions in the kinematic couplings for the lifting phase of the window from the lowest position to the highest (10"). With demonstration purposes Figure 14 shows the case of the kinematic coupling A (drive).
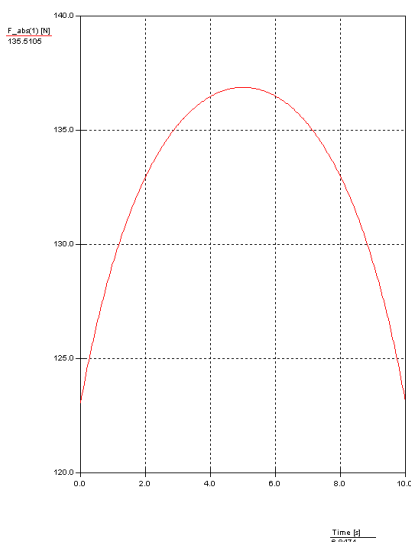
Figure 14. Reaction force variation in coupling A

The maximum values of the reaction forces in the kinematic couplings obtained in this way are:
- ✓ *Reaction force in coupling 1 (A): RA = 136,9 N*
- ✓ *Reaction force in coupling 5 (B): RB = 0,30;*
- ✓ *Reaction force in coupling 3 (C): Rc = 0,45 N*
- ✓ *Reaction force in coupling 4 (D): RD = 54 N;*
- ✓ *Reaction force in coupling 2 (E): RE = 1,5 N*

Sizing the bolts of the kinematic couplings

Using the highest values in reactions, sizing calculations of the bolts (pins) materializing the rotational kinematic couplings have been made. The scheme of the bolt strain is shown in Figure 15, the main strain being one of shearing in the contact area between the two kinematic elements which make that particular coupling.
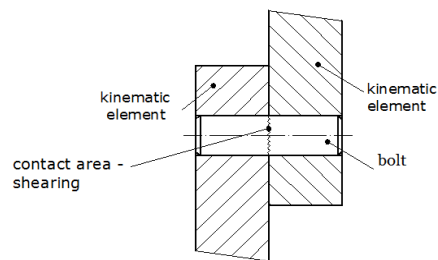
Figure 15. The scheme of the bolt strain

The diameter of bolt results of the shear strength condition (2).

$$\tau_f = \frac{R}{A} \Rightarrow A_{nec} = \frac{\pi d_{nec}^2}{4} = \frac{R}{\tau_{af}} \Rightarrow d_{nec} = \sqrt{\frac{4R}{\pi \cdot \tau_{af}}} \quad (2)$$

where: R – the maximum values of the reaction force in the kinematic couplings; τ_{af} – the allowable shear stress for the bolt material; for the material the bolts - OL50, τ_{af} = 112 MPA (N/mm²)

Results the following diameters: coupling 1 (A) - d_1 = 6 mm; coupling 2 (E) - d_2 = 6 mm; coupling 3 (C) - d_3 = 6 mm; coupling 4 (D) - d_4 = 6 mm; coupling 5 (B) - d_5 = 6 mm

4. CONCLUSION

The kinematic and kinetostatic analysis of the handling mechanism of the door windows of road vehicles has been carried out with the help of SAM application. After analyzing we developed the variation of the kinematic parameters of kinematic elements, as well as the reactions in the kinematic couplings both in the form of graphics. The kinematic parameters developed in this way are in concord with reality and fit into the requirements of the design theme

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¹· *Mohamed A. A. El-SHAER*

SEISMIC LOAD ANALYSIS OF DIFFERENT R.C. SLAB SYSTEMS FOR TALL BUILDING

¹· *Civil and Construction Engineering Department, higher Technological Institute,*
10ᵗʰ of Ramadan City, EGYPT

Abstract: *This paper introduced the lateral analysis for tall buildings due to the seismic performance for different reinforced concrete slab systems. It study three systems, flat slab, ribbed slab, and panelled beam slab. The three systems are from the most attractive and commonly used floor systems, especially in high-rise constructions. In high seismicity regions, the declared non-ductile flat slab system poses a significant risk, brittle punching failure arises from the transfer of shearing forces and unbalanced moments between slab and columns that may trigger a progressive building collapse. This system is inherently flexible due to the non-rigid slab-column connections, and the building high aspect (height/width) ratio. Hence, in regions of high seismic risk, design codes recommended the use of slab-column frames to resist slabs, and require another stiffer system to resist lateral wind and seismic forces. From this standpoint, the choose of a system that provide rigid concrete slab than flat slab to resist lateral wind and seismic forces. This system is chosen to be the ribbed slab, and the panelled beam slab. These two systems of concrete slabs are ductile, and balanced moments between slab and columns. As the different types of seismic load resisting systems generally presented. Then, three systems of slabs performance for systems high-rise buildings during seismic loads are introduced. Some seismic design, analysis and performance assessment aspects of flat slab, and ribbed slab, and panelled beams systems for high-rise buildings are subsequently discussed. Finally, suggestions to improve the seismic performance of high - rise buildings horizontal members in slabs (ribs or beams-column) buildings are presented. ETABS version 9.5 is for analysis under lateral loads. ETABS is a programmer for linear, nonlinear, static and dynamic analysis, and the design of building systems. Multistory buildings constitute a very special class of structures and therefore deserve special treatment. The program is used to calculate the drifts for the systems and we noticed that the minimum drift was occurred in the ribbed slab system.So that, in high seismic risk regions, ribbed-slab-column frames is recommended to be gravity load resisting systems for building of high values of height/width ratios.*
Keywords: Flat slab; Beam-column; Ribbed slab; Seismic load; Drift

1. INTRODUCTION

The flat slab system since its inception in the USA by Turner in 1906 has been gaining popularity all over the world, as evidence of the large portion of the newly constructed buildings which employ that system. Flat slab systems in current construction practice are commonly used for relatively light residential loads and for spans from 4.5m to 6m. For heavy industrial or office building loads and/or for larger spans, flat slabs are used with drop panels or column capitals. The flat slab type of construction provides architectural flexibility, more clear space, less building height, easier formwork, and consequently, shorter construction time. However, flat slabs are susceptible to significant reductions in stiffness as a consequence of slab cracking that can arise from construction loads, service gravity loads, temperature and shrinkage effects, and lateral loads. Due to their inherent flexibility, flat slab/plate systems (especially in multi-story high-rise buildings) experience excessive lateral drifts (displacement) when subjected to wind loads or seismic excitations. Also they possess non-ductile overall response, local seismic hysteretic response, and poor energy dissipations. Furthermore, their potential of brittle punching failure at the slab-column connections. Therefore in regions of high seismic risk, modern seismic design codes prohibit the use of flat slab/plate as a lateral load resisting system, but allow its use as a vertical (gravity) load resisting system.

After that, this paper introduces several systems that is used in high rise building of 30 stories.

Three types are selected, flat slab, paneled beams and ribbed slab floor systems, with the same lateral loads resistance systems (core &shear wall system).

2. LATERAL LOADS RESISTING SYSTEM

Lateral loads resisting system may be on or more of the following systems: Braced frame, Rigid frame, Infilled frame, Shear walls, Wall frame, Frame tube, Outrigger braced, Suspended, Space structures, and Core system. The last system (Core system) is the subject of the study in this search.

Response Analysis

The analysis of seismic response of tall buildings under seismic loads can be carried out by one of the following methods:

a. Elastic static analysis

This procedure is generally used in the preliminary stages of planning the building, where the suitability for number of choices for the lateral load resisting systems is being investigated. The analysis is carried out on the system model subject to the equivalent static seismic forces

b. Modal response spectrum

This procedure is more appropriate to flexible structures where the first mode alone is not able to reasonably represent the system response. Therefore, higher modes (second, third, fourth, etc.) contribution to the response shall be considered. This method is more appropriate for high-rise buildings the previous method during the preliminary planning process.

The different modes of vibrations and their frequencies (or their natural periods of vibrations) are needed to conduct the modal analysis. Therefore the free vibration analysis of the lateral load resisting system shall be performed prior to the modal response analysis.

c. Elastic dynamic time-history

The adequacy of the selected lateral load system for the serviceability limit state shall be checked under earthquake of 10 years return period. Seismic design codes require the system to continue its elastic behavior and sustain no damage, maintaining mits elastic behavior. It can also be used to approximate the seismic response of the building when subject to larger earthquakes of 50 years return period, where the building is expected to suffer minor structural damages.

Response Spectrum analysis for earthquakes

In order to perform the seismic analysis and design of a structure to be built at a particular location, the actual time history record is required. However, it is not possible to have such records at each and every location. Further, the seismic analysis of structures cannot be carried out simply based on the peak value of the ground acceleration as the response of the structure depend upon the frequency content of ground motion and its own dynamic properties. To overcome the above difficulties, earthquake response spectrum is the most popular tool in the seismic analysis of structures. There are computational advantages in using the response spectrum method of seismic analysis for prediction of displacements and member forces in structural systems. The method involves the calculation of only the maximum values of the displacements and member forces in each mode of vibration using smooth design spectra that are the average of several earthquake motions.

This paper deals with response spectrum method and its application to various types of the structures.

Response spectra are curves plotted between maximum response of SDOF system subjected to specified earthquake ground motion and its time period (or frequency) as in figure (1). Response spectrum can be interpreted as the locus of maximum response of a SDOF system for given damping ratio. Response spectra thus helps in obtaining the peak structural responses under linear range, which can be used for obtaining lateral forces developed in structure due to earthquake thus facilitates in earthquake-resistant design of structures.

Usually response of a SDOF system is determined by time domain or frequency domain analysis, and for a given time period of system, maximum response is picked. This process is continued for all range of possible time periods of SDOF system. Final plot with system time period on x-axis and response quantity on y-axis is the required response spectra pertaining to specified damping ratio and input ground motion. Same process is carried out with different damping ratios to obtain overall response spectra.

Consider a SDOF system subjected to earthquake acceleration, the equation of motion is given by:

$$m\ddot{x}(t) + c\dot{x}(t) + kx(t) = -m\ddot{x}_g(t) \qquad Eq.(1)$$

where: $m\ddot{x}(t)$: is mass times acceleration; $c\dot{x}(t)$: is the damping term and equals to zero for undampedmotion; $kx(t)$: displacement times stiffness.
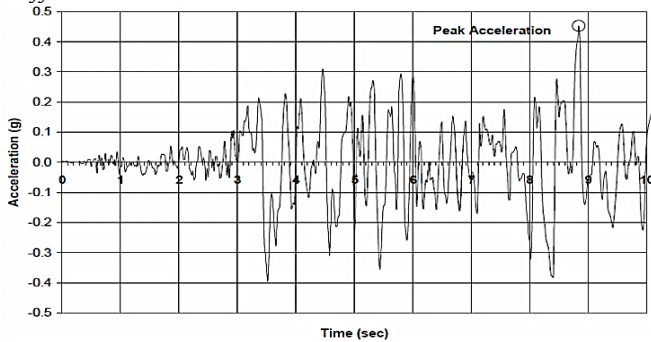
Fig.1. Response spectra curve

Substitute $\omega_o = \sqrt{K/m}$ and $\xi = \dfrac{c}{2m\omega_o}$ and $\omega_d = \omega_o\sqrt{1-\xi^2}$

where: ω_o: circular frequency; ξ: damping ratio. Therefore, eq.1 can be written

$$\ddot{x}(t) + 2\xi\omega_o\dot{x}(t) + \omega_o^2 x(t) = -\ddot{x}_g(t)$$

Using Duhamel's integral, the solution of SDOF system initially at rest is given by (Agrawal and Shrikhande, 2006), [20]

$$x(t) = -\int_0^T \ddot{x}_g(\tau)\frac{e^{-\xi\omega_o(t-\tau)}}{\omega_d} i_{ns}\omega_d(t-\tau)d\tau$$

The maximum displacement of the SDOF system having parameters of ξ and ω_0 and subjected to specified earthquake motion, is expressed by $\ddot{x}_g(t)$.

The relative displacement spectrum of earthquake ground motion is defined as,

$$|x(t)|_{max} = \left|\int_0^t \ddot{x}_g(\tau)\frac{e^{-\xi\omega_o(t-\tau)}}{\omega_d} i_{ns}\omega_d(t-\tau)d\tau\right|_{max}$$

$$s_d(\xi,\omega_o) = |x(t)|_{max}$$

Similarly, the relative velocity spectrum, S_v and absolute acceleration response spectrum, S_a are expressed as,

$$s_v(\xi,\omega_o) = |\dot{x}(t)|_{max}$$

$$s_a(\xi,\omega_o) = |\ddot{x}_a(t)|_{max} = |\ddot{x}(t) + \ddot{x}_g(t)|_{max}$$

The pseudo velocity response spectrum, S_{pv} for the system is defined as

$$s_d(\xi,\omega_o) = |x(t)|_{max}$$

Similarly, the pseudo acceleration response, S_{pa} is obtained by multiplying the S_d to ω_0^2, thus

$$s_{pa}(\xi,\omega_o) = \omega_o^2 s_d(\xi,\omega_o) \qquad Eq.(2)$$

$\xi = 0$ i.e. $\ddot{x}s(t) + \omega_o^2 x(t) = -\ddot{x}_g(t)$

Consider a case where

$$s_a = |\ddot{x}(t) + \ddot{x}_g(t)|_{max} = |-\omega_o^2 x(t)|_{max} = \omega_0^2 |x_{max}| = \omega_0^2 s_d = s_{pa}$$

The above equation implies that for an undamped system, $S_a = S_{pa}$.

The quantity S_{pv} is used to calculate the maximum strain energy stored in the structure expressed as

$$E_{max} = \frac{1}{2}Kx_{max}^2 = \frac{1}{2}m\omega_0^2 s_d^2 = \frac{1}{2}m s_{pv}^2 \qquad Eq.(3)$$

The quantity S_{pa} is related to the maximum value of base shear as

$$V_{max} = Kx_{max} = m\omega_0^2 s_d = m s_{pa} \qquad Eq.(4)$$

The relations between different response spectrum quantities is shown in the table (1).

Table (1). Relation between displacement, velocity, and acceleration

Relative displacement, $|x(t)|_{max}$	$= S_d$	$\simeq \dfrac{S_v}{\omega_0}$	$\simeq \dfrac{S_a}{\omega_0^2}$ *	$= \dfrac{S_{pv}}{\omega_0}$	$= \dfrac{S_{pa}}{\omega_0^2}$
Relative velocity, $|\dot{x}(t)|_{max}$	$\simeq \omega_0 S_d$	$= S_v$	$\simeq \dfrac{S_a}{\omega_0}$	$\simeq S_{pv}$	$\simeq \dfrac{S_{pa}}{\omega_0}$
Absolute acceleration, $|\ddot{x}_a(t)|_{max}$	$\simeq \omega_0^2 S_d$ *	$\simeq \omega_0 S_v$	$= S_a$	$\simeq \omega_0 S_{pv}$	$\simeq S_{pa}$ *

(* If $\xi = 0$ these relations are exact and the sign $\simeq$ is valid up to $0 < \xi < 0.2$)

As limiting case consider a rigid system i.e. $\omega_o \to \infty$ or $T_o \to 0$, the values of various response spectra are:

$$\lim_{\omega_0 \to \infty} S_d \to 0$$

$$\lim_{\omega_0 \to \infty} S_v \to 0$$

$$\lim_{\omega_0 \to \infty} S_a \to |\ddot{x}_g(t)|_{max}$$

The three spectra i.e. displacement, pseudo velocity and pseudo acceleration provide the same information on the structural response. However, each one of them provides a physically meaningful quantity and therefore, all three spectra are useful in understanding the nature of an earthquake and its influence on the design. A combined plot showing all three of the spectral quantities is possible because of the relationship that exists between these three quantities. Taking the log of equations (3) and (4)

$$\log S_{pv} = \log S_d + \log \omega_0 \qquad Eq.(5)$$

$$\log S_{pv} = \log S_{pa} - \log \omega_0 \qquad Eq.(6)$$

From the Equations (5) and (6), it is clear that a plot on logarithmic scale with $\log S_{pv}$ as ordinate and $\log \omega_0$ as abscissa, the two equations are straight lines with slopes $+45^o$ and -45° for

constant values of $\log S_d$ and $\log S_{pa}$, respectively. This implies that the combined spectra of displacement, pseudo velocity and pseudo acceleration can be plotted in a single as in figure2 Multi degree of freedom (MDOF) systems are usually analyzed using Modal Analysis. A typical MDOF system with 'n' degree of freedom is shown in Fig.3. This system when subjected to ground motion undergoes deformations in number of possible ways. These deformed shapes are known as modes of vibration or mode shapes. Each shape is vibrating with a particular natural frequency. Total unique modes for each MDOF system are equal to the possible degree of freedom of system. The equations of motion for MDOF system is given by:

$$[m]\{\ddot{x}(t)\}+[c]\{\dot{xo}(t)\}+[K]\{x(t)\}=-[m]\{r\}\ddot{x}_g(t) \quad Eq.(7)$$

where, $[m]$ = Mass matrix ($n \times n$); $[k]$ = Stiffness matrix ($n \times n$); $[c]$ = Damping matrix ($n \times n$); $\{r\}$ = Influence coefficient vector ($n \times 1$); $\{x(t)\}$ = relative displacement vector; $\dot{x}(t)$ =relative velocity vector, $\ddot{x}(t)$ =relative acceleration vector, and $\ddot{x}_g(t)$ =earthquake ground acceleration.
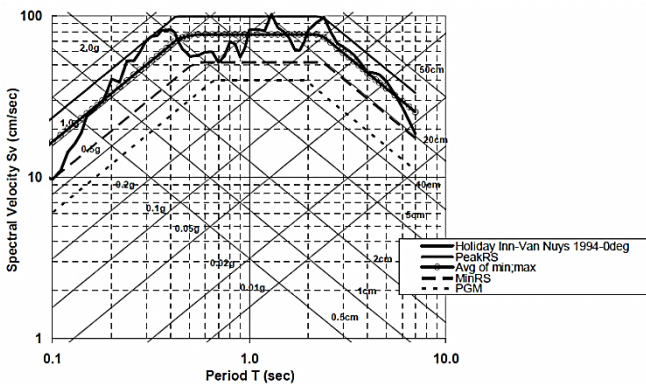
Fig.2. Spectra of displacement, pseudo velocity and pseudo acceleration
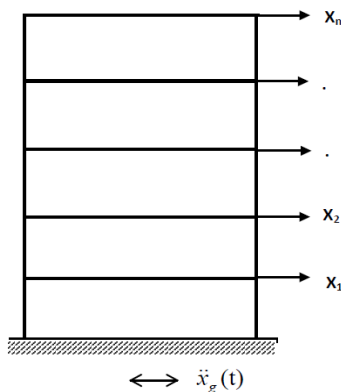
Fig.3. A typical MDOF system with 'n' degree of freedom

The undampedeigen values and eigen vectors of the MDOF system are found form the characteristic equation

$$\{[K]-\omega_i^2[m]\}\phi_i=0 \quad i=1,2,3,\ldots,n \quad Eq.(8)$$

$$\det\left|\{[K]-\omega_i^2[m]\}\right|=0 \quad Eq(9)$$

where, ω_i^2 eigen values of the i_{th} mode; ϕ_i eigen vector or mode shape of the i_{th} mode; ω_i natural frequency in the i_{th} mode.

Let the displacement response of the MDOF system is expressed as

$$\{x(t)\}=[\phi]\{y(t)\} \quad Eq.(10)$$

where $\{y(t)\}$ represents the modal displacement vector, and $[\varphi]$ is the mode shape matrix given by

$$[\phi]=[\phi_1,\phi_2,\ldots\ldots\phi_n]$$

Substituting $x(t)=[\phi]\{y(t)\}$ in eq.7 and pre-multiply by

$$[\phi]^T[m][\phi]\{\ddot{y}(t)\}+[\phi]^T[c][\phi]\{\dot{y}(t)\}+[\phi]^T[K][\phi]\{y(t)\}=-[\phi]^T[m]\{r\}\ddot{x}_g(t)$$

The above equation reduces to

$$[M_m]\{\ddot{y}(t)\}+[c_d]\{\dot{y}(t)\}+[K_d]\{y(t)\}=-[\phi]^T[m]\{r\}\ddot{x}_g(t) \quad Eq.(11)$$

where:

$[\phi]^T[m][\phi]=[M_m]$= generalized mass matrix;

$[\phi]^T[c][\phi]=[c_d]$=generalized damping matrix;

$[\phi]^T[K][\phi]=[K_d]$=generalized stiffness matrix.

By virtue of the properties of the $[\varphi]$, the matrices $[M_m]$ and $[K_d]$ are diagonal matrices. However, for the classically damped system (i.e. if the $[C_d]$ is also a diagonal matrix), the Eq.11 reduces to the following equation;

$$\ddot{y}_i(t)+2\xi_i\omega_i\dot{y}_i(t)+\omega_i^2 y_i(t)=-\Gamma_i\ddot{x}_g(t)\ (i=1,2,3,\ldots,n) \quad Eq.(12)$$

where,

$y_i(t)$=modal displacement response in the i_{th} mode;

ξ_i=modal damping ration in the i_{th} mode;

Γ_i=modal participation factor for i_{th} mode expressed by

$$\Gamma_i=\frac{\{\phi_i\}^T[m]\{r\}}{\{\phi_i\}^T[m]\{\phi_i\}}$$

eq.12 is of the form of eq.1 representing vibration of SDOF system, the maximum modal displacement response is found from the response spectrum i.e.

$$y_{i,\max}=\left|y_i(t)\right|_{\max}=\Gamma_i s_d(\xi_i,\omega_i) \quad Eq.(13)$$

The maximum displacement response of the structure in the i_{th} mode is

$$x_{i,\max}=\phi_i y_{i,\max}\ (i=1,2,\ldots\ldots,n) \quad Eq.(14)$$

The maximum acceleration response of the structure in the i_{th} mode is

$$\{\ddot{x}_a\}_{i,\max}=\{\phi_i\}\Gamma_i s_{pa}(\xi_i,\omega_i) \quad (i=1,2,\ldots\ldots,n) \quad Eq.(15)$$

Fig. 3 Flat slab plan system

The required response quantity of interest, r_i i.e. (displacement, shear force, bending moment etc.) of the structure can be obtained in each mode of vibration using the maximum response obtained in eq.14 and eq.15. However, the final maximum response, r_{max} shall be obtained by combining the response in each mode of vibration using the modal combinations rules.

A- Flat slab floor

For the lower range of high-rise flat slab/plate buildings (up to15 stories), the framing action of the slab-columns can provide the necessary stiffness and strength to resist wind and seismic forces. Flat slab/plate -columns subject to lateral loads are analyzed as unbraced two-dimensional equivalent frames using two methodologies; the torsional member method and the effective slab width method. Our Flat slab system consists of a flat plate 28.00 cm resting on five models of columns with marginal beam of 90cm. The slab was checked against deflection, flexural and punching stresses and it was fully safe.

B- Panelled beams floor

Panelled beams slab system consists of thin two way solid slabs 10-12 Cm thickness rested on rigid pannelled beams 30 x 85 Cm sectional area working by grid action where each beam works as an elastic support for the other at the intersection

area between them. The paneled beams are supported on external beams 40 x 90 Cm sectional area.

Fig. 4 Panelled beams slab plan system
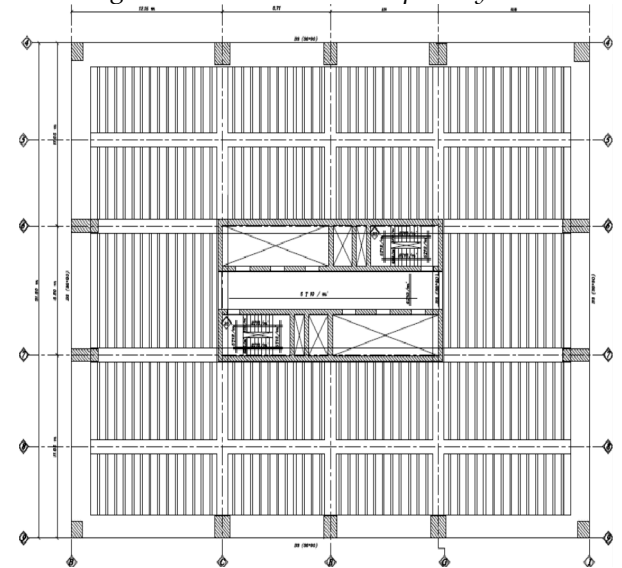
Fig. 5.a Ribbed slab plan system
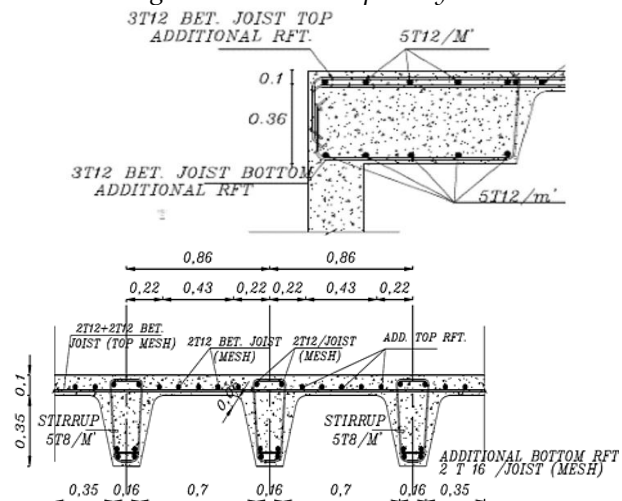
Fig. 5.b Beams & Ribs details for Ribbed slab

3. ANALYSIS PROCEDURE

There are three models of a residential building of 30 stories and total area of 1313.55 m2, the three models (Core system) represent flat slab system, pannelled beams system, ribbed slab system respectively. This systems of slabs were fabricated and analysis by ETABS 9.5 in the current study. All models have the same architecture plan and the same columns sections and also the same area, figure 6 represents the 3D – models from ETABS program.
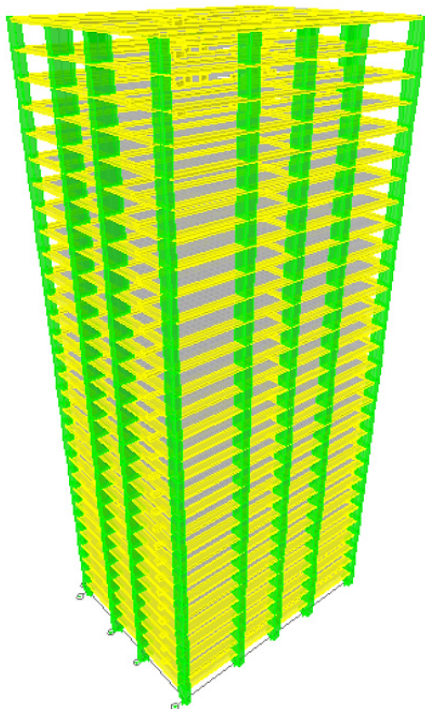
Fig. 6 ETABS 3-D model

Detected Response Parameters from ETABS 9.5 - Detected INTER STORY DRIFT in the three systems

Drift ratio is the ratio between drift and building height in percent, and the inter-story drift ratio is the ratio between the change of drift in the story and the story height.
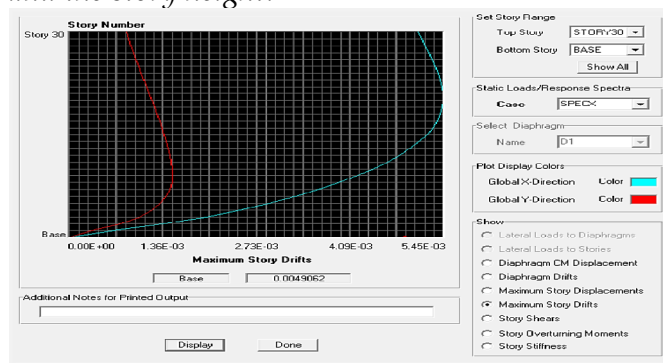
Fig. 7 Inter Story Drift in X-direction for Flat slab system
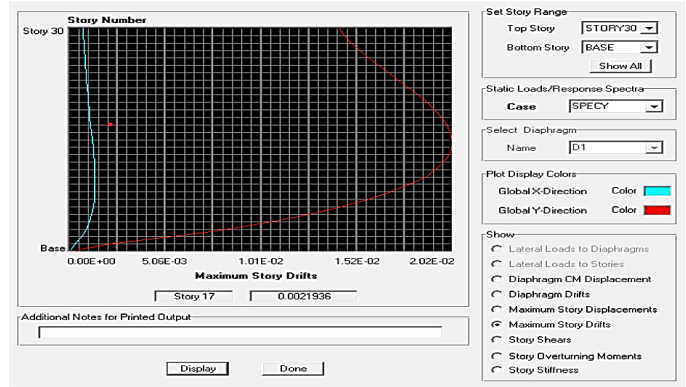
Fig. 8 Inter Story Drift in Y-direction for Flat slab system

B-For Pannelled beams system
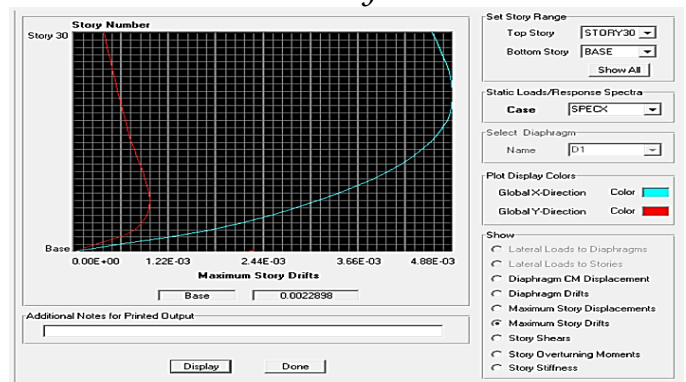
Fig. 9 Inter Story Drift in X-direction for Pannelled beams system
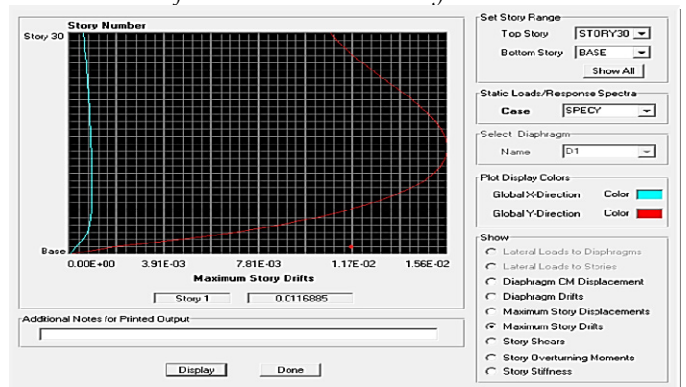
Fig. 10 Inter Story Drift in Y-direction for Pannelled beams system

C-For Ribbed slab system
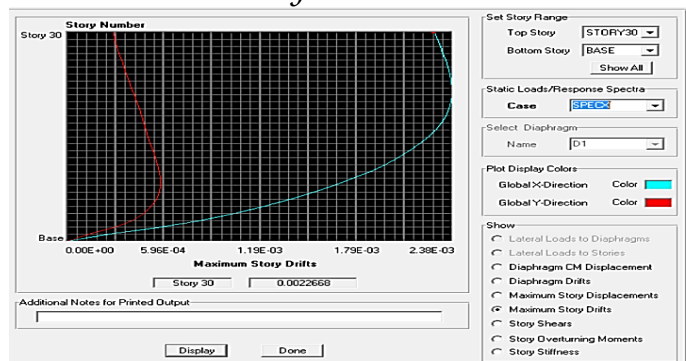
Fig. 11. Inter Story Drift in X-direction for Ribbed slab system
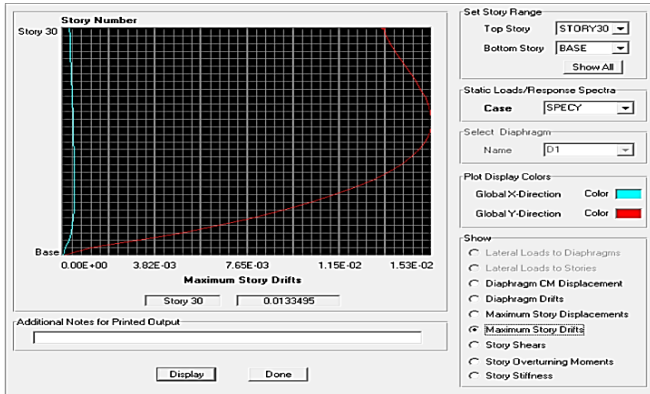
Fig. 12 Inter Story Drift in Y-direction
for Ribbed slab system

Detected BASE SHEAR in the three systems
A- For Flat slab system
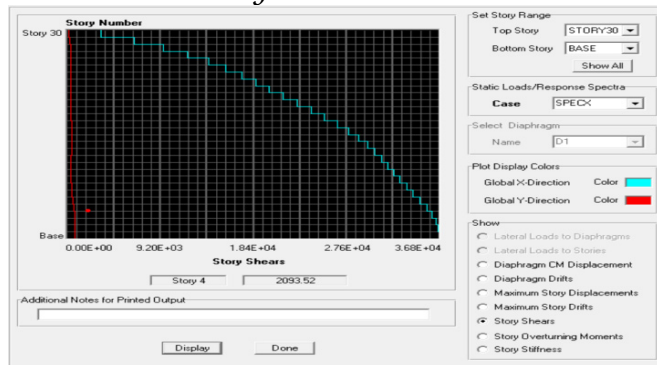
Fig. 13 Base Shear in X-direction
for Flat slab system
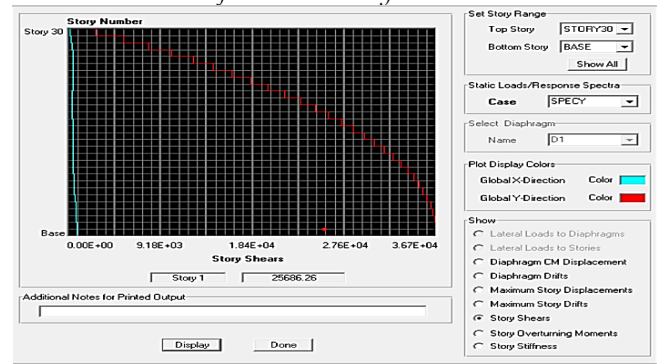
Fig. 14 Base Shear in Y-direction for Flat slab system
B- For Pannelled beams system
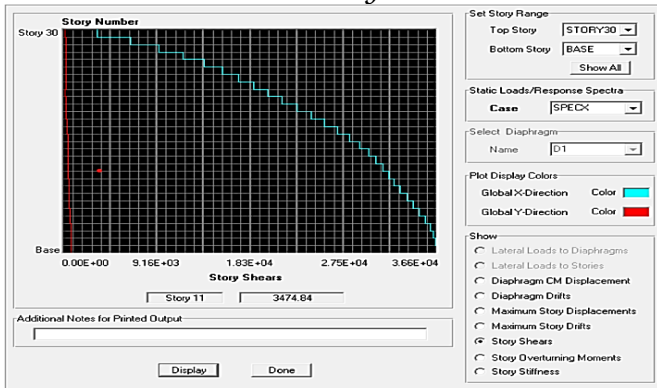
Fig. 15 Base Shear in X-direction
for Pannelled beams system
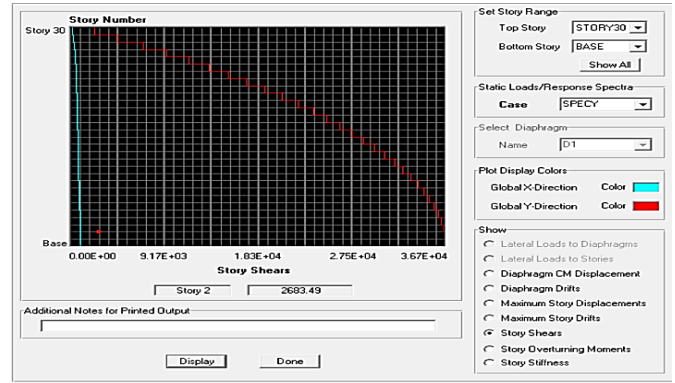
Fig. 16 Base Shear in Y-direction
for Pannelled beams system

C-For Ribbed slab system
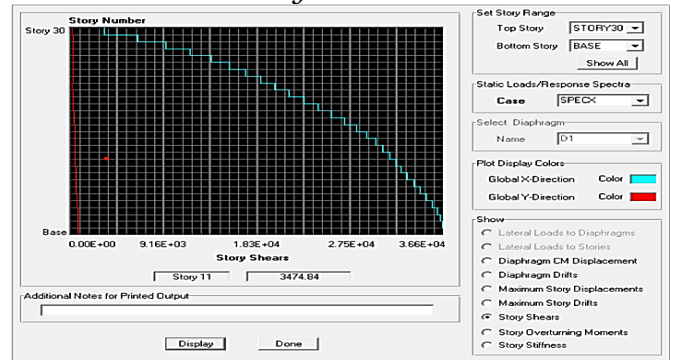
Fig. 17 Base Shear in X-direction
for Ribbed slab system
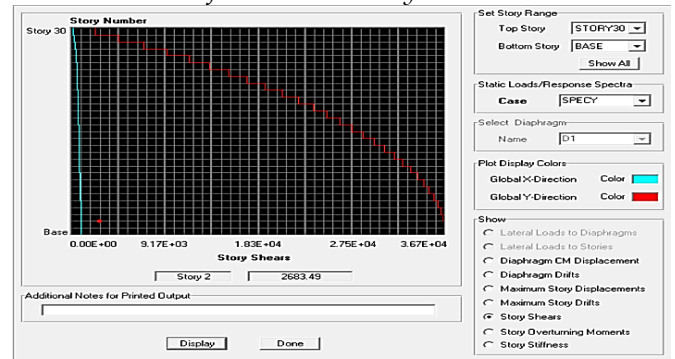
Fig. 18 Base Shear in Y-direction
for Ribbed slab system

Detected OVERTURNING MOMENT in the three systems
A-For Flat slab system
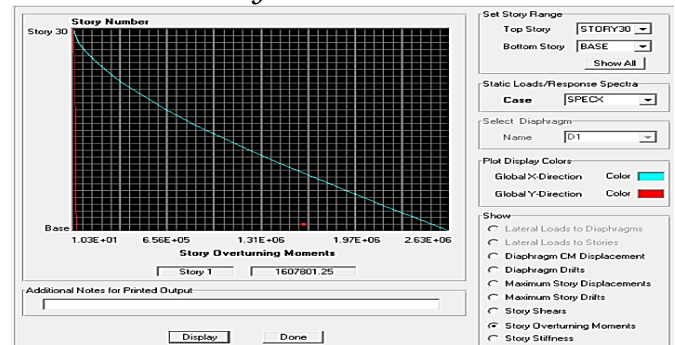
Fig. 19 Overturning Moment in X-direction
for Flat slab system
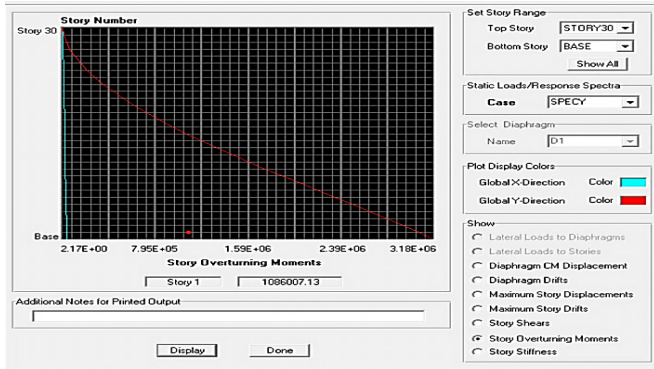
*Fig. 20 Overturning Moment in Y-direction
for Flat slab system*

B- For Pannelled beams system

*Fig. 21 Overturning Moment in X-direction
for Pannelled beams system*

*Fig. 22 Overturning Moment in Y-direction
for Pannelled beams system*

C- For Ribbed slab system

*Fig. 23 Overturning Moment in X-direction
for Ribbed slab system*
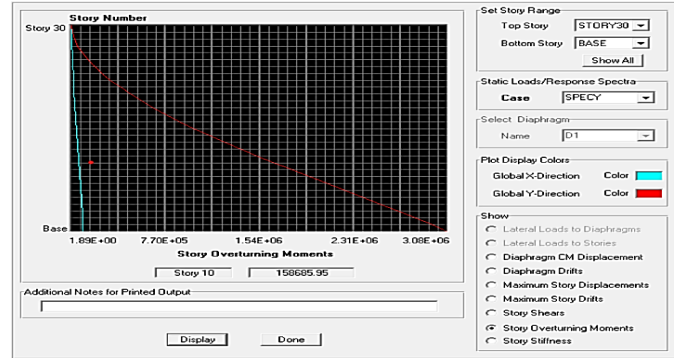
*Fig. 24 Overturning Moment in Y-direction
for Ribbed slab system*

Detected DISPLACEMENT-in the three systems
A-For Flat slab system
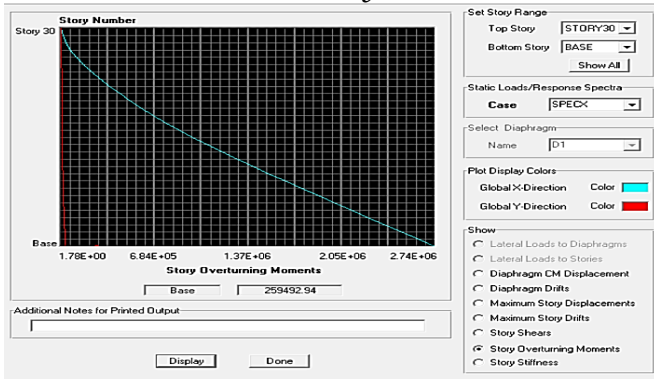
*Fig. 25 Displacement in X-direction
for Flat slab system*
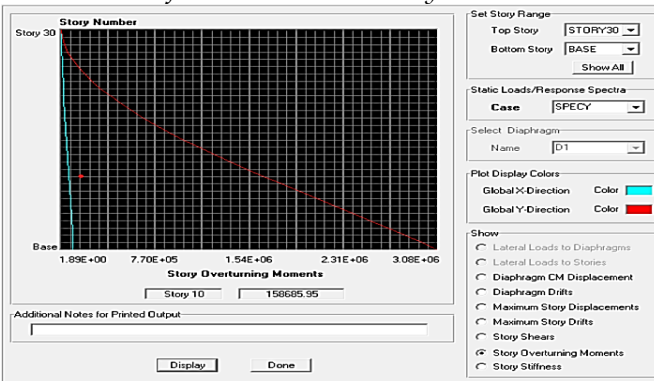
*Fig. 26 Displacement in Y-direction
for Flat slab system*
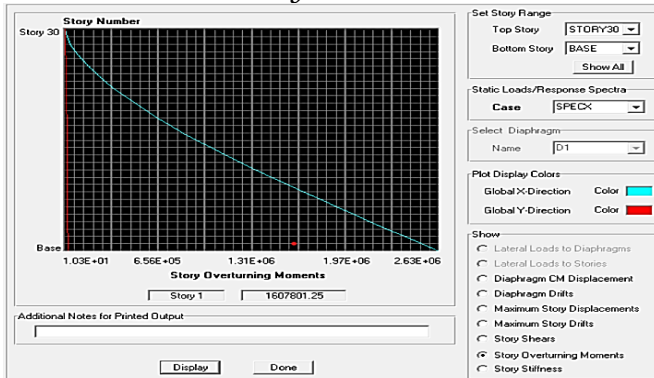
B-For Pannelled beams system
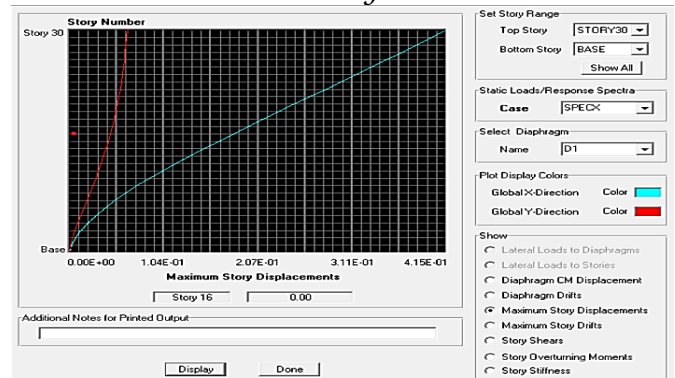
*Fig. 27 Displacement in X-direction
for Pannelled beams system*
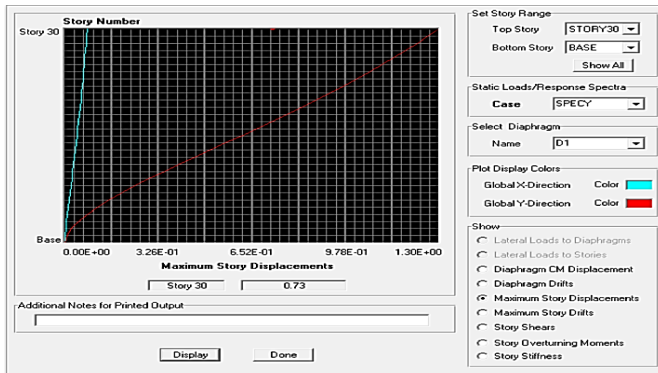
Fig. 28 Displacement in Y-direction
for Pannelled beams system

C-For Ribbed slab system
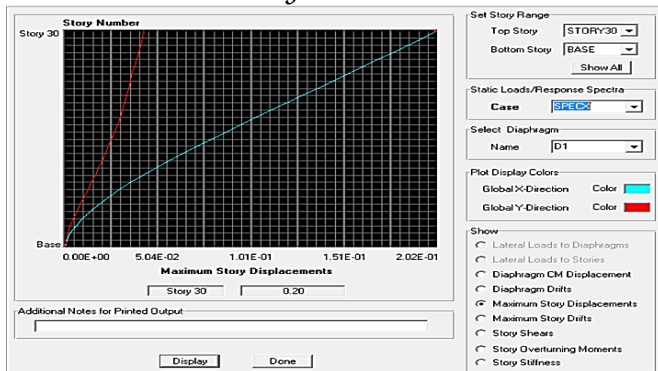
Fig. 29 Displacement in X-direction
for Ribbed slab system
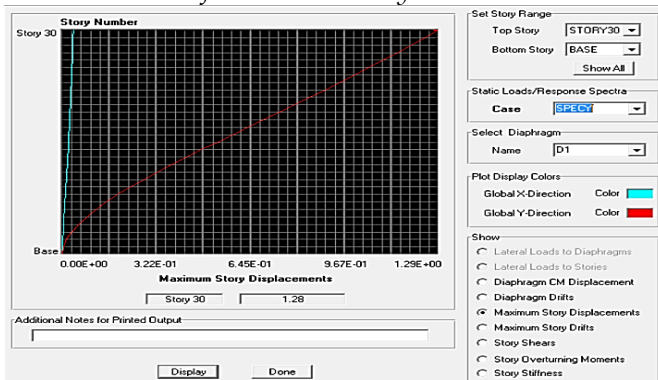
Fig. 30 Displacement in Y-direction
for Ribbed slab system

4. ANALYTICAL RESULTS AND DISCUSSION

Results of the analysis three systems of slabs are presented, analyzed and discussed in this section. Topics to be covered include the Inter Story Drift, the Base Shear, Overturning Moment, and Displacement in two directions X and Y of the analysis systems. Tables from 2 to 5 lists the results.

Table (2): Inter Story Drift in X&Y-direction for three systems

Direction	Flat slab	Pannelled beams	Ribbed slab
(m)X	0.00545	0.00488	0.00238
(m)Y	0.0202	0.0156	0.0153

Table (3): Base Shear in X&Y-direction for three systems

Direction	Flat slab	Pannelled beams	Ribbed slab
(KN)X	36800	36600	36600
(KN)Y	36700	36700	36700

Table (4): Overturning Moment in X&Y-direction for three systems

Direction	Flat slab	Pannelled beams	Ribbed slab
YX (KN.m)	2630000	2740000	2630000
(KN.m)	3180000	3080000	3080000

Table (5): Displacement in X&Y-direction for three systems

Direction	Flat slab	Pannelled beams	Ribbed slab
(m)X	0.466	0.415	0.202
(m)Y	1.68	1.3	1.29

The seismic response parameters of buildings are the structure deformations (displacements and rotations), internal forces in structural elements, and ductility demand of members with plastic behavior.

Top story lateral displacement (drift) and the inter-story lateral displacement (story drift) are the seismic response parameter of prime importance for systems of slabs in high rise buildings. Large values of drift could affect the stability and resistance of tall buildings.

The system of Ribbed slab reduced the inter-story drift by 56% than the system of flat slab and by 51% than the system of Pannelled beams in the main direction (X direction). And the system of Ribbed slab reduced the Displacement by 57% than the system of flat slab and by 51% than the system of Pannelled beams in the main direction (X direction).

5. CONCLUSIONS

Based on the results the following conclusions could be drawn:

1. *The choice of the system for slab in the tall building is very important to resist the internal forces and stability.*
2. *The system of Ribbed slab reduced the inter-story drift, and Displacement by grater than 51% for core system.*
3. *The Ribbed slab systems resists the punching shear failures, and increase the ductility capacity.*
4. *The flat slab cases, large inter-story drift which cause brittle punching shear failures, reduces the ductility capacity*

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[1.] *Carmen BRĂCĂCESCU,* [2.] *Cristian SORICĂ,*
[3.] *Dragos MANEA,* [4.] *Bogdan IVANCU,* [5.] *Sorin POPESCU*

THEORETICAL RESEARCHES ON KINEMATICS AND DYNAMICS OF VIBRATING SIEVES ELECTROMAGNETICALLY DRIVEN

[1-4.] *INMA Bucharest, ROMANIA*
[5.] *Transilvania University of Brașov, ROMANIA*

Abstract: *The paper presents the diagram and the operational principle of electromagnet driven vibrating sieves and the constructive and functional factors influencing the working parameters of this type of equipment. The diagram is represented by the automatic amplitude and frequency control systems of the vibrations generated by the studied electromagnetic device, in view of its utilization for driving vibrating sieves design to milling industry for cereal seeds primary processing.*
Keywords: *Vibrating sieves, elastic system, electromagnet, amplitude, frequency*

1. INTRODUCTION

Vibrating sieves are used as vibrating feeders in technological primary processing of cereal seeds. The vibrating feeders are made of a vibrating chute (channels) that are fixed elastically on stands that receive oscillating movements from rod-crank mechanisms (Figure 1.a) or from vibrating units with eccentric masses (Figure 1.b) or from electromagnets (Figure 1.c). [1,2] Magnetic drive systems (Figure 1.c), which are used as free vibrating or with steering suspension features, make use of the operation at resonance conditions with a safer excitation energy and leading to very compact units.
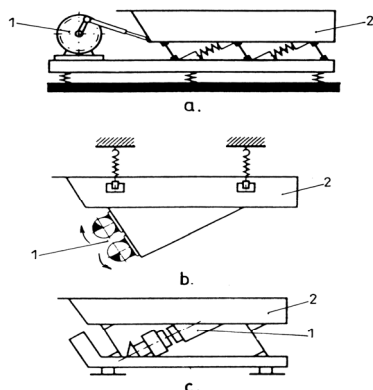
Figure 1. Basic types of vibrating feeders:
a - with rod-cran mechanism; b - with eccentric mass;
c - with electromagnetic vibrator: 1 - vibration generating mechanism; 2 - vibrating mass with transporting chute.

Vibration sieves feeders consist of a conveying device which carries the bulk solid layer of cereal seeds and the drive unit for the vibration excitation supported by a spring suspension. The function of vibration feeders is based on the micro-cast effect. The vibration agitation is usually induced by a flute vibrating inclined by 20…45^0 to the horizontal. The particles are accelerated starting from definite vibration frequency / amplitude; these acceleration conditions are used to execute a parabolic ejection motion inclined upwards and strike the flute again after an adequate displacement.

This effect (micro-cast) is repeatedly induced at the exciting frequency with the result that the bulk solid layer which is pre-adjusted by the outlet clearance of the feeder is discharging quasi steadily. The necessary excitation condition for the micro-cast effect to develop is that the vertical upwards directed acceleration induced by the flute vibrations on the particles is larger than the gravitational acceleration (vertical downwards). Important parameter influences on this displacement process are the vibration frequency and amplitude, the angle between the excitation and the flute axis and the bulk solid properties such as particle size, distribution and shape as well as friction.

2. MATERIAL AND METHODS

On a world level the companies having a long tradition in this field use the electrovibrator for cereal seeds primary processing equipments design to milling industry. In order to operate the shaking sieves designed to drive the technical equipment

used in technological primary processing of agricultural products, the electromagnetic vibrators (named electrovibrators), manufactured by specialized companies can be used as single elements or pair elements, generating the sieve frame vibration.

By comparing with vibrating sieves driven by eccentric mass, the electrovibrators use leads to many advantages: simplifies the kinematic chain, by eliminating the following negative factors: many specific parts, assembling difficult and laboriously to control, unaesthetic guards, rigorous maintenance, big reparation costs, reduced reliability, mechanic shocks (especially when wear appears); intensifies the separating process; diminishes the stress transmitted to foundation; their volume is minimum, which enables their mounting on active parts of equipment so that the vibration direction passes through the mass center of sieves shaker loaded with material (or by its immediate proximity); allows the modification of disturbing force direction any time. The electromagnetic vibrators advantages consists in absence of friction and rotating parts when the productivity is regulated, as disadvantages, we can mention the small amplitude (0,5-2 mm) which excludes the transport of powder loads, as well as the transport little length of vibrator (up 2,5-6 m).
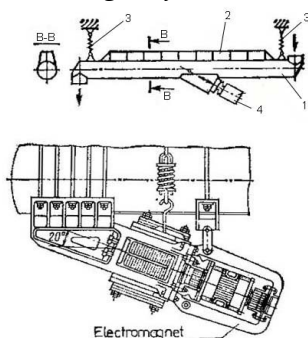
Figure 2. Vibrating sieve electromagnetically driven

The vibrating sieve electromagnetically driven comprises the frame (Figure 2), freely hung on elastic elements, frame which receives oscillations transmitted by electromagnetic vibrator 8. The oscillating frame is supported by a rigid longitudinal beam 7. The electromagnetic vibrator can be with simple or double drive, with mobile (induced) and reactive (inductor) part. Being endowed with small mass and power (up to 1 kW), the electromagnetic vibrators simply acted can be used to light conveyors. The connecting support of

vibrating feeder bear (hang) the auger and ensure the oscillations according to dynamic calculation. There are used single sheet (lamella) springs or many sheets springs. The sheet crossing rigidity must be several times less than the longitudinal rigidity. In terms of bumpers and elastic connections there are used parts which are submitted to shearing, compression and distortion and metallic and rubber blocks. The rubber blocks are characterized by high elasticity and endurance. When metallic and rubber parts are manufactured, it is necessary to ensure the rubber free deformation, which, it is well known, is incompressible within close spaces. The helical and plane springs can also be considerate as elastic elements. The spring sheets thickness is $\delta = 2\ldots6$ mm.
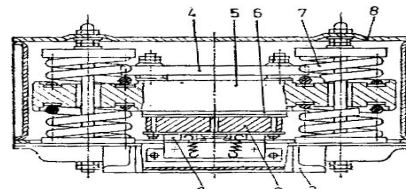
Figure 3. Construction of electromagnetic vibrator

The above vibrating system comprises a simple drive electromagnetic vibrator (Figure 3) including a fixed coil of electromagnet 1 with coils 2, connected to network by a rectifier, the induced 5, rigidly connected to auger 3 of conveyor through the crossing bar 6, endowed with elastic connections 7 and a set of adjusting weights 4, closed alongside with springs in housing 8.

In compliance with the equivalent scheme calculating the vibration of one mass vibrating system shown in figure 4, the system movement equation is:

$$m\,\ddot{S} + \mu c\,\dot{S} + c_1 S = F(t) \qquad (1)$$

where: m is the auger reduced mass (equivalent) which includes the induced mass and the adjusting mass; $c1 = (c + c_0)$ – reduced rigidity (equivalent) of the system, formed of principal elastic elements rigidity c and rigidity c_0 of vibrator elastic connections.
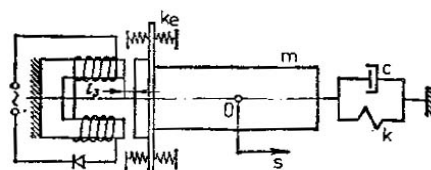
Figure 4. Equivalent scheme for calculating the one mass system vibration system

By replacing the expression of traction force F(t) in equation (1) and taking into account the sinusoidal low of feeding current variation and influence of air variability (interstice) l_j we obtain a differential movement equation which is very difficult to solve. In order to simplify this problem it is supposed a certain constant size of air. Then, the relation (1) acquires the form of a non-homogenous linear equation:

$$m\,\ddot{S} + \mu c\,\dot{S} + c_1 S \;=\; F\,(1 + \cos\,2\,p_T t) \qquad (2)$$

where: $F = k_F B_m^2 S_c / 2$ is steady component of vibrator excitation force, in N; $k_F = 3{,}98 \cdot 10^5$ – proportionality coefficient; B_m – amplitude of magnetic induction, in T; S_c – the area of crossing section of coil core, in m^2; p_T – feeding alternating current frequency.

The equation particular solution (2) is:

$$S = A_0 + A_1 \cos(2\,p_T t - \varphi) \qquad (3)$$

Where: $A = F/c_1$ is the steady displacement of mass center O of mass m; A_1 – amplitude of oscillations of center O; φ – angle of phase difference between variable parts of mass center O and disturbing force, given by the relations:

$$A_1 = (F/m)\sqrt{(c_1/m - 4p_1^2)^2 + 4\mu^2 c^2 p_T^2 / m^2} \qquad (4)$$

$$\varphi = arctg\;\frac{2\mu c p_T}{c_1 - 4mp_r^2} \qquad (5)$$

The resonance of oscillating system appears for pulsation: $p_T = \sqrt{c_1/m}$. For current of industrial frequency, f = 50 Hz, the part supporting the load (the auger) oscillates by a double frequency, namely f = 6000 1/min, which is generally inadmissible. In order to diminish the auger frequency up to 3000 1/min, a semi-period rectifier (Figure 3) is introduced, and the rectified voltage modifies the magnetic flow action and shock movement type. This movement is described as another equation of a disturbing force represented by a circular function Fourier.

Vibration feeders can be considered as two masses spring systems (Figure 5) [3;4]: the mass of the part feeding the bulk solids m_a consists of the vibrating flute or pipe 1, the bulk solid mass 10 and the magnetic vibrator (positions 2, 3 and 4). The second mass m_f involved is that of the free side consisting of the mobile body 5 and 6. Both masses are connected by springs 7. The electronic control unit 8 is connected with the normal AC voltage

supply. Normal 50 Hz excitation will yield a 100 Hz vibration frequency, with thyristor control 25 and 50: efficient control of the vibration amplitude is possible.
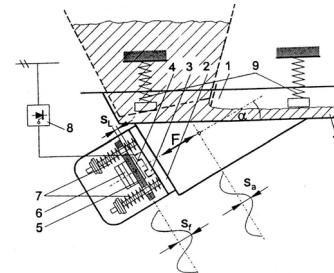
Figure 5. Magnetic vibration feeder. 1 - vibration flute; 2 - vibrator housing and other components; 3 - electromagnet; 4 - mobile magnetic coreplate; 5, 6 - additional masses; 7 - spring; 8 - control device; 9 - suspension springs; 10 - transported material - vibration amplitude (free side); S_a - vibration amplitude (working side).

Amplitude s_0 of the chute depends on the constructive and functional parameters, as well as on the type of the transporting material.

The displacement of the vibrating mass can be considered with sufficient approximation, as a harmonic sinusoidal oscillating movement, with elongation s given by relation:

$$s = s_0 . \sin(\omega t) \qquad (6)$$

Where: s_0 is the oscillating amplitude; ω – oscillating pulsation: $\omega = 2\pi f$ (were f is the oscillation frequency, in Hz.)

The velocity of the oscillating movement is given by relation:

$$v = s_0 . \omega \cos(\omega t) \qquad (7)$$

Where $v_0 = s_0 . \omega$ are the amplitude of the velocity and the acceleration of the oscillating movement is expressed by relation:

$$a = -s_0 . \omega^2 \sin(\omega t) \qquad (8)$$

where $a_0 = -s_0 . \omega^2$ is the amplitude of acceleration.

The oscillating frequency f of the vibrator is given by the well known relation: f=ω/2π. If the value of the amplitude's acceleration a_0 is in ratio with the gravitation acceleration g, is obtained the characteristic of the machine K_M, given by relation:

$$K_M = \frac{a_0}{g} = -\left|\frac{s_0 . \omega^2}{g}\right| \qquad (9)$$

The natural frequency f_e of the spring-mass system without attenuation can be determined with the masses m_a and m_t and the spring constant c.

$$f_c = \frac{1}{2\pi} . \sqrt{\frac{c}{m_r}} \qquad (10)$$

$$m_r = \frac{m_a \cdot m_f}{m_a + m_f} \qquad (11)$$

The vibrating system responds to an excitation frequency f_a with adequate amplitudes which grow the nearer f_a approaches the natural frequency f_e ($f_a/f_e=1$, resonance). The natural frequency decreases with growing attenuation (Figure 6), the amplification factor V is very strongly influenced by attenuation. In order to operate vibration feeders close to resonance the system has to be adequately tuned (masses 6, Figure 5). The effective attenuation is induced by friction, e.g. internally in the bulk solids, and externally at surfaces.
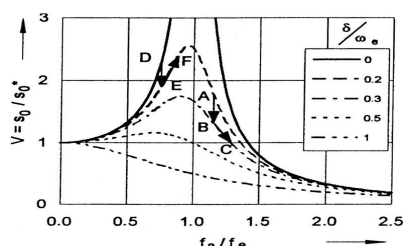
Figure 6. Amplification factor of vibration amplitudes V depending on the excitation frequency ratio (f_a/f_e)
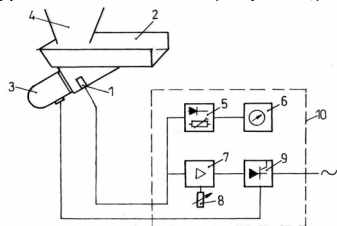
Figure 7.Automatic control of the vibration amplitude: 1 - acceleration sensor; 2, 4 - vibration feeder; 3 - vibrator; 5… 10 - controller.
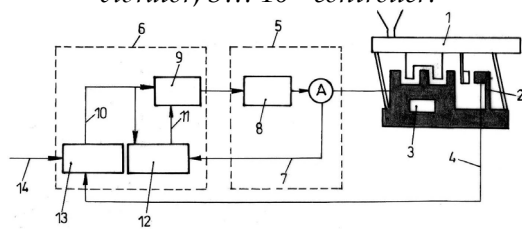
Figure 7. Combined control of vibration amplitude and resonance frequency:
1 - vibration feeder; 2 - vibration transducer; 3 - magnetic drive; 4 - feedback signal;5 - power unit; 6 - control system; 7 - current signal; 8 - amplifier; 9 - AD converter;10 - set-point amplitude; 11 - set-point frequency; 12 - frequency control (slow); 13 - amplitude control (fast); 14 - input signal

For metering purposes close to resonance conditions the automatic control of the vibration amplitude is strongly recommended to keep the disturbance potential within narrow limits [4; 5]. The measurement of the set vibration amplitude can be achieved by acceleration sensors (Figure 7)

or by stationary vibration displacement transducers (Figure 8). With the combined control system for the vibration amplitude which automatically keeps the operational conditions close to the resonance frequency it is possible to obtain good linear and reproducible vibration feeder characteristics.

CONCLUSIONS

1. Taking into account the technical and economic advantages of the vibrating systems with electromagnets (electrovibrators) they are used not only at vibrating conveyors for grain matters (including seeds) but also at driving the vibrating sieves for cereal seeds primary processing equipments design to milling industry;

2. The theoretical study of system of sieves mounted on vibrating frame operated by electrovibrators can be achieved by replacing the real systems with equivalent vibrating dynamic systems with external excitation, comprising one or two vibrating masses;

3. By solving the differential movement equations of vibrating systems with one or two vibrating masses and their applicability for concrete situations, we can study by computer simulation the kinematic and dynamic behaviour of systems endowed with existing or in course of designing vibrating sieves;

4. The results of theoretical researches performed on basis of those presented in the paper allow the optimization of constructive and functional parameters of systems of vibrating sieves, in view of manufacturing state-of the art installation.

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1. D. RAJENTHIRAKUMAR, 2. T. KARTHIK,
3. V. JANARTHANAN, 4. S. NANTHAKUMAR

DEFECT REDUCTION IN GAS TUNGSTEN ARC WELDING PROCESS USING FAILURE MODE EFFECTS ANALYSIS

1-4. Department of Mechanical Engineering, PSG College of Technology, Peelamedu, Coimbatore – 641004, Tamil Nadu, INDIA

Abstract: To improve production quality and productivity by reducing potential reliability problems early in the development cycle, manufacturing industries are using the Failure Mode and Effects Analysis (FMEA) technique. It is a method that evaluates possible failures in the system, design, process or service. It aims to continuously improve and decrease these kinds of failure modes. In this present work, Process FMEA is done on Gas Tungsten Arc Welding (TIG) process of American Iron and Steel Institute (AISI) Type 304L Stainless Steel material. A series of welding process with different sample pieces are done and the potential failures and defects are categorized based on FMEA and Risk Priority Number (RPN) is assigned. The most risky failure according to the RPN number is found and the cause and effects along with the preventive measures are established. Since FMEA is a proactive approach to solve potential failure modes, this work serves as a failure prevention guide for those who perform the welding process towards an effective weld.
Keywords: Welding, Failure Mode and Effects Analysis, Risk Priority Number, Defect

1. INTRODUCTION

Demands are increasing on companies for high quality, reliable products. The increasing capabilities and functionality of many products are making it more difficult for manufacturers to maintain the quality and reliability. The challenge is to design in quality and reliability early in the development cycle.

FMEA is used to identify potential failure modes, determine their effect on the operation of the product and identify actions to mitigate the failures. A crucial step is anticipating what might go wrong with a product. While anticipating every failure mode is not possible, the development team should formulate as extensive a list of potential failure modes as possible. The early and consistent use of FMEA in the design process allows the engineer to design out failures and produce reliable, safe, and customer pleasing products.

Similarly, Root Cause Analysis (RCA) is a method of problem solving that tries to identify the root causes of faults or problems that cause operating events. RCA practice tries to solve problems by attempting to identify and correct the root causes of events, as opposed to simply addressing their symptoms. By focusing correction on root causes, problem recurrence can be prevented. RCA recognizes that complete prevention of recurrence by one corrective action is not always possible. There may be several effective measures that address the root causes of a problem. Thus, RCA is often considered to be an iterative process, and is frequently viewed as a tool of continuous improvement.

The role of joints whether welded, brazed, soldered or bolted is the most critical aspect to hold any assembly together especially in materials like Type 304L Stainless Steel. Joints are usually the weakest link in the total assembly and decide the overall integrity of equipment. Joint failures are as specific as the nature of joining process. Welded joints can fail due to lapses during the welding parameters, operational skills or merely because of properties inferior to base metal. These may be the failures caused as a result of welding but it is very important to analyze the failure modes, and effects of welding processes. Prior notification of these failures can prevent them by following control measures. This paper addresses the defect reduction in gas tungsten arc welding process using RCA and FMEA. Here, the prime objective is to evolve and test several strategies to eliminate defects

thereby improving quality. The methodology followed was that of continuous improvement which uses RCA and FMEA.

The rest of the paper is organized in the following manner. In Section 2, the relevant literature reviewed during this work is discussed. Section 3 gives a brief idea about the product and process. The various stages of operations practiced on the product are described in this section. An overview of FMEA is described in Section 4. In Section 5, the defect reduction methodology is discussed. Subsequently, implementation procedures along with results obtained are explained in Section 6. Section 7 concludes the paper with final remarks.

2. BRIEF LITERATURE REVIEW

Failure mode and effects analysis (FMEA), first developed as a formal design methodology in the 1960s by the aerospace industry [1] has proven to be a useful and powerful tool in assessing potential failures and preventing them from occurring [2]. FMEA is an analysis technique for defining, identifying and eliminating known and/or potential failures, problems, errors and so on from system, design, process and/or service before they reach the customer [3]. When it is used for a criticality analysis, it is also referred to as failure mode, effects and criticality analysis (FMECA). The main objective of FMEA is to identify potential failure modes, evaluate the causes and effects of different component failure modes, and determine what could eliminate or reduce the chance of failure. The results of the analysis can help analysts to identify and correct the failure modes that have a detrimental effect on the system and improve its performance during the stages of design and production. Since its introduction as a support tool for designers, FMEA has been extensively used in a wide range of industries, including aerospace, automotive, nuclear, electronics, chemical, mechanical and medical technologies industries [4-6]. This paper explains a Process FMEA done on Gas Tungsten Arc Welding (TIG) process of Type 304L Stainless Steel material.

3. PROBLEM DEFINITION

The procedure that has been followed for quality improvement is given in Figure 1. The selected product for this work is called "Vent port" and it is

an acid storing container [Figure 2]. It is fabricated from four main sub parts welded by TIG Welding process. Due to poor weld quality and weld defects, the quality of product declines and rate of defect increases. The primary aims are: (1) Improve the quality of the product by reducing the defects and improving welding process quality (2) Implementation of process sheets in the fabrication that will pave way easy traceability of components. A detailed process study is performed to understand the current state process flow and the same is illustrated in Figure 3.
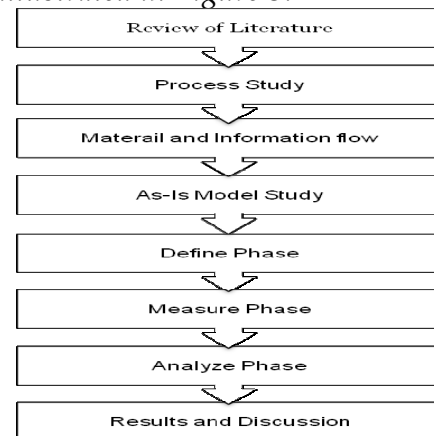
Figure 1. Methodology
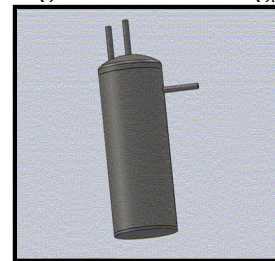
Figure 2. Vent port

4. OVERVIEW OF FMEA – Importance of FMEA in welding process

A FMEA is often the first step of a system reliability study. It involves reviewing as many components, assemblies, and subsystems as possible to identify failure modes, and their causes and effects. For each component, the failure modes and their resulting effects on the rest of the system are recorded in a specific FMEA worksheet.

The role of joints whether welded, brazed, soldered or bolted is the most critical aspect to hold any assembly together in S.S 304L materials. Joints are usually the weakest link in the total assembly and decide the overall integrity of equipment. Joint failures are as specific as the nature of joining process. Welded joints can fail due to lapses during

the welding parameters, operational skills or merely because of properties inferior to base metal. These may be the failures caused as a result of welding but it is very important to analyze the failure modes, and effects of welding processes. Prior notification of these failures can prevent them by following control measures.
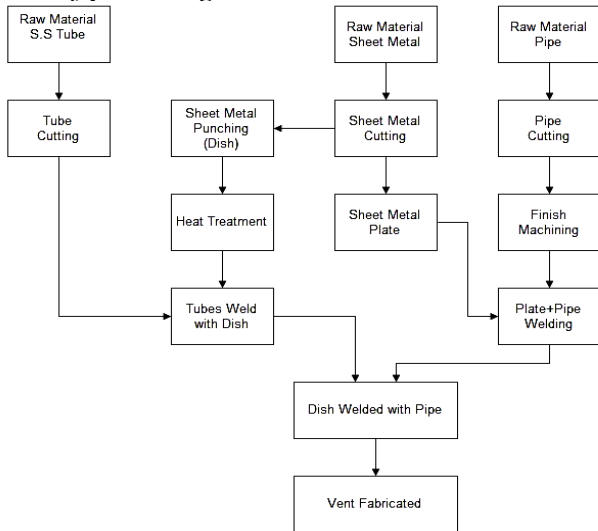
Figure 3. Process flow – vent port
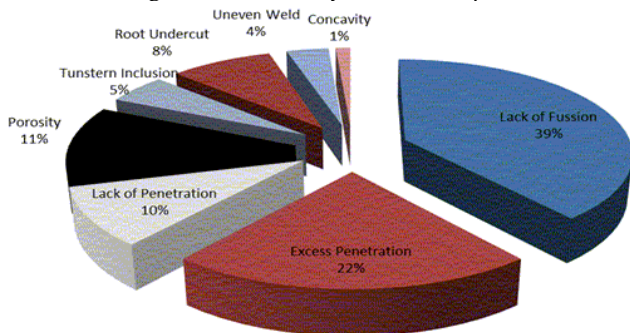
Figure 4. Types of welding defects
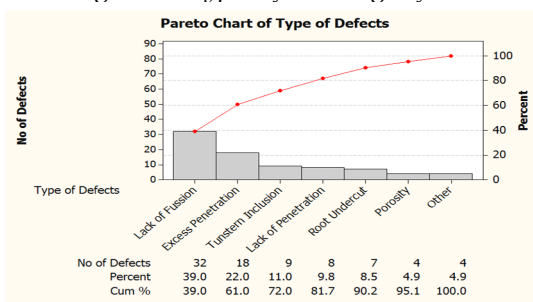
Figure 5. Major constituents of welding defects

5. DEFECT REDUCTION METHODOLOGY

Defects are of various types in welding [Figure 4]. Finding the type of defect will narrow down the eradication of major problems. Pareto Chart [Figure 5] is drawn using Minitab 16.0 Software to find the major constituents of defects which affect the quality of the product. It depicts that 80% of defects are due to 20% of causes. So if we

eliminate the 20% of causes, we can reduce the 80% of total defects.

6. ROOT CAUSE ANALYSIS

Root Cause Analysis (RCA) is a method of problem solving that tries to identify the root causes of faults or problems that cause operating events. RCA practice tries to solve problems by attempting to identify and correct the root causes of events, as opposed to simply addressing their symptoms. By focusing correction on root causes, problem recurrence can be prevented. Considering this aspect, the cause and effect diagram for root cause identification is done and the same is illustrated for one of the major cause of welding defects "lack of fusion" in Figure 6.
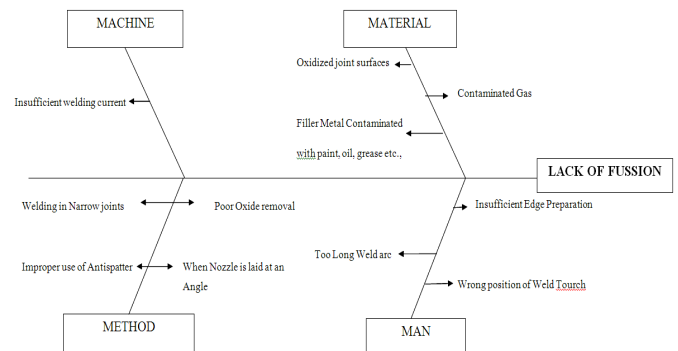
Figure 6. Cause and effect diagram showing major causes for the welding defect "lack of fussion"

Table 1. FMEA chart - Lack of fusion
A=Severity; B=Occurrence; C=Detection

A	B	C	Cause	Solution	RPN
	7	6	Insufficient Welding Current	Parameters Should be set	378
	6	4	Improper joint cleaning surfaces	Weld Material -cleaned	216
	4	3	Contaminated Gas	Gas Quality	108
	4	5	Filler Metal Contaminated	Good Quality Filler Metal	180
	8	8	Narrow Welding Groove	Proper Groove Cutting	576
9	5	4	Poor Oxide removal	Weld Material -cleaned	180
	4	5	Improper use of Antispatter	Gas Quality	180
	7	8	Joint Configuration	Proper Groove Cutting	504
	4	6	Too long weld arc	Labour should be trained	216
	6	7	Insufficient Edge Preparation	Proper Groove Cutting	378
	6	6	Incorrect Torch Angle	Labour should be trained	324

Potential effect: Leads to breakage under High Temperature

Similarly, FMEA is used to identify potential failure modes, determine their effect on the operation of the product, and identify actions to

mitigate the failures. A crucial step is anticipating what might go wrong with a product. Welded joints can fail due to lapses during the welding parameters, operational skills or merely because of properties inferior to base metal. Keeping these things in mind, the FMEA chart is prepared. A sample chart related to the problem "lack of fusion" is presented in Table 1.

7. OPPORTUNITIES FOR IMPROVEMENT AND IMPLEMENTATION

After identifying the root cause of major problems, the following improvement opportunities are identified and implemented.

➢ Updating work instructions is done to check the welding current whenever there is sheet thickness change

➢ Rust over material and moisture is cleaned before welding as a part of standard work procedure

➢ Root of weld joint and edge preparation is made standard for all parts

➢ Welding current is set before welding as per instruction

➢ For better traceability, process sheet is entered with the employee ID Part

➢ Drawing along with process sheet with complete process parameters for welding

Further, training to welder is provided to know how to study the drawing attached with the process. As a result of continued enhanced practices the defect level is reduced to a greater extent from 42 defects to 4 defects for the work order. The summary of improved sigma level is given in Table 2.

Table 2. Improved Sigma Level

Description	
No of parts/work order	185 units
Total no. of Welds/work order	1880 welds
Total no. of defective welds/order	4
Defects per 1880 opportunities	4
Defects per million opportunities	1596

8. CONCLUSION

The following conclusions are made:

➢ The major rate of defect is due to low skilled worker and no proper standards in production

➢ Pareto Chart states that lack of fusion, lack of penetration and porosity are the three major defects

➢ Process parameters play a vital role in eliminating the defects.

➢ From RCA, it is clearly visible that root gap and edge preparation impact the defect rate.

➢ From FMEA, it is found that the edge preparation, root gap fixation, welding current setting, gas flow have high RPN

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[1.] *Marina ŠĆIBAN*, [2.] *Dragana KUKIĆ*, [3.] *Mile KLAŠNJA*,
[4.] *Sándor BESZÉDES*, [5.] *Jelena PRODANOVIĆ*

ADSORPTION CAPACITIES OF DIFFERENT LIGNOCELLULOSIC MATERIALS FOR COPPER IONS

[1-3,5.]*University of Novi Sad, Faculty of Technology, Bul. Cara Lazara 1, 21000 Novi Sad, SERBIA*
[4.] *University of Szeged, Faculty of Engineering, Moszkvai krt. 9, H-6725 Szeged, HUNGARY*

Abstract: *Different lignocellulosic waste materials was able to sorb heavy metal ions, and other polutants, for example dyes, from aqueous solutions. In this study the efficiencies of adsorption of copper ions from water by poplar wood sawdust and sugar beet pulp were investigated. Adsorption experiments were performed at room temperature, with four different biosorbent doses of 2.5 g/l, 5 g/l, 10 g/l and 15 g/l, which were added in the model water with different initial copper ion concentration from 10 mg/l to 250 mg/l. The initial pH of model water was 4 and contact time of model water and the biosorbent was 90 min. The sugar beet pulp is shown as better adsorbent for copper ions than poplar wood sawdust. The adsorption were considered by the Langmuir and the Freundlich adsorption model. The results demonstrate that the efficiency of copper ions removal from the water is better at higher dose of adsorbent, but maximal adsorption capacities have to be estimate with lower doses of adsorbent. Langmuir adsorption isotherm better describes the adsorption of copper ions than Freundlich adsorption isotherm. This means that the surfaces of both investigated adsorbents are homogeneous, i.e. with the same active sites for adsorption of copper ions.*
Keywords: adsorption, copper, sugar beet shreds, poplar wood sawdust

1. INTRODUCTION

Considering the harmful effects of heavy metals, it is necessary to remove them from liquid wastes at least to a limit accepted by national and international regulatory agencies. There are many processes that can be used for heavy metal ions removal from water and wastewaters. One of them is biosorption, adsorption by different materials of organic nature, which should be renewable and low-cost.

Various waste microorganisms (Arief et al., 2008; Wang and Chen, 2009), forestry and agroindustrial wastes (Sciban and Klasnja, 2004; Johnson et al., 2008) and natural polymers (Son et al., 2004; O´Connell et al., 2008; Guo et al., 2008; Klimaviciute et al., 2010) can be used as efficient biosorbents. The efficiency of the adsorption of heavy metal ions by some solid adsorbent is dependent on a number of parameters: the amount of the adsorbent, the adsorbent surface area and porosity, the concentration of adsorbate, initial pH of water, contact time of the adsorbent and water, temperature, the presence of competitive ions, etc.

The first and most important step in testing of new biosorbents is to determine their adsorption capacity. For determination of adsorption capacity and explanation of the adsorption process at equilibrium conditions, the adsorption isotherms are used (Foo and Hameed, 2010). They are the most appropriate method in designing and assessing the performance of the adsorption systems.

In this paper, the influence of biosorbent doses on values of adsorption constants in adsorption models, are considered. It was investigated adsorption of copper ions by two biosorbents, poplar wood sawdust and sugar beet pulp, from metal ion solutions of different concentrations. The obtained results are fitted with Langmuir and Freundlich, two, the most common adsorption isotherms.

2. MATERIALS and METHODS
2.1. Materials

Dry sugar beet shreds, from one local sugar factory, were milling on Miag laboratory cone mill. Milled sugar beet shreds and poplar wood sawdust were sieved on the Bühler laboratory sifter (gyratory in a horizontal plane), model MLU-300. Part of the stock having particles in the range 224-400 μm was used in adsorption experiments. Specific surface areas of sugar beet shreds and poplar wood sawdust were 0.80 and 1.05 m²/g, respectively, which obtained via low-temperature nitrogen adsorption measurements (Micrometrics, ASAP 2000).

Model waters with different initial copper ion concentrations from 10 mg/l to 250 mg/l, was prepared by dilution of stock solutions with demineralised water. The stock solution of copper (0.25 mol/l) were prepared by dissolving of certain amount of $CuSO_4 \cdot 5H_2O$ in demineralised water. pH in model water was adjusted to 4, by adding 0.5 mol/l acetic acid, in accordance with previous investigations (Šćiban and Klašnja, 2004). All chemicals used were of analytical reagent grade.

2.2. Adsorption experiments

Batch adsorption experiments were carried out by shaking of 5 g of biosorbent with 1 litre of model water, from 3 hours, in accordance with previous investigations (Šćiban and Klašnja, 2004). After that, the biosorbent was removed from water by vacuum filtration through Gooch G3 crucible. Concentrations of metal ions before (C_o) and after adsorption (C) were determined komplexometrically (Sajo, 1973). On the base of the measured values, adsorption efficiency (E) and amount of adsorbed metal ions per specified amount of adsorbent (q) can be calculated:

$$E\ (\%) = ((C_o – C)/C_o) \cdot 100 \qquad (1)$$
$$q = (C_o – C)/m \qquad (2)$$

where m is the amount of adsorbent per litre of model water.

To determine the adsorption capacity of investigated adsorbents, the Langmuir (3) and the Freundlich (4) adsorption models were used:

$$q = (q_m \cdot K_L \cdot C)/(1 + K_L \cdot C) \qquad (3)$$
$$q = K_F \cdot C^{1/n} \qquad (4)$$

where q is the amount of ions adsorbed per specified amount of adsorbent in equilibrium, C the ions equilibrium concentration, q_m the Langmuir constant which represent the amount of ions required to form a monolayer on the adsorbent surface, K_L the Langmuir equilibrium constant related with the enthalpy of adsorption, and K_F and n the Freundlich equilibrium constants.

Langmuir adsorption isotherm refers to homogeneous adsorption, which each adsorbate possess constant enthalpies and adsorption activation energy (all adsorption sites possess equal affinity for the adsorbate), with no transmigration of the adsorbate in the plane of the adsorbent surface. Freundlich isotherm is the earliest known, empirical model,with non-uniform distribution of adsorption heat and affinities over the heterogeneous surface.

Computer simulation technique was applied to fit the linear form of Langmuir and Freundlich equations for the adsorption data. The goodness of fit of investigated adsorption models was estimated by coefficients of determination (R^2).

3. RESULTS and DISCUSSION

The adsorption capacities of sugar beet shreds and poplar wood sawdust for copper ions were determined by constructing the corresponding equilibrium isotherms (Figs 1 and 2).
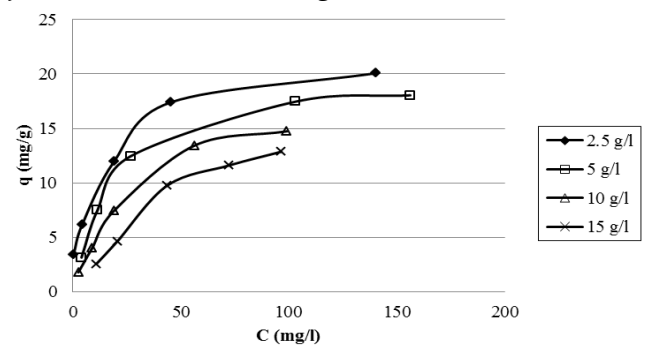
Figure 1. Adsorption isotherms of Cu(II) ions adsorption onto sugar beet shreds
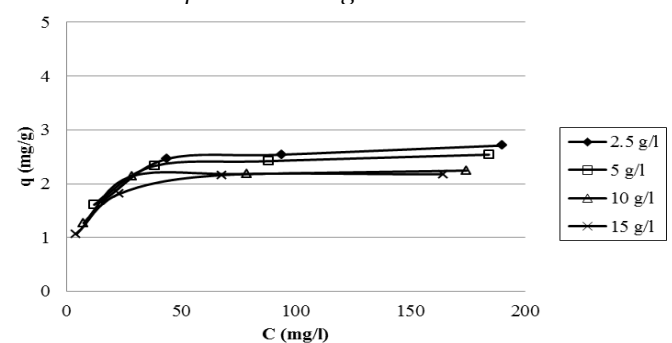
Figure 2. Adsorption isotherms of Cu(II) ions adsorption onto poplar wood sawdust

Figs. 1 and 2 show that the copper ions adsorption per unit mass of biosorbent (q) increased as the biosorbent concentration decreased. On the other hand with the smaller amount of biosorbent the lower adsorption efficiency (E) is achieved, what is direct result of smaller available surface area. Also, the results show that the adsorption of copper ions is better by sugar beet shreds than by poplar wood sawdust, esspecially from the solutions with higher concentration of copper ions.

According to the shape of isotherms, it can be concluded that the adsorption on these two biosorbents is quite different. The reason for this phenomenon is probably their different chemical composition. Specifically, the sugar beet shreds contain much more pectin and less lignin than sawdust of any wood, and consequently have different kinds and position of adsorption sites.

On the base of presented results, the constants in Langmuir and Freundlich adsorption isotherms are calculated and presented in Tables 1 and 2.

Table 1. Constants in Langmuir and Freunlich adsorption isotherms for adsorption of copper ions by sugar beet shreds

m (g/l)	q_m (mg/g)	K_a (l/mg)	R^2	K_f	n	R^2
2.5	21.19	0.110	0.993	4.56	3.24	0.974
5	19.57	0.075	0.987	2.08	2.16	0.919
10	19.34	0.034	0.990	1.09	1.67	0.979
15	26.11	0.011	0.912	0.74	1.58	0.971

Table 2. Constants in Langmuir and Freunlich adsorption isotherms for adsorption of copper ions by poplar wood sawdust

m (g/l)	q_m (mg/g)	K_a (l/mg)	R^2	K_f	n	R^2
2.5	2.86	0.105	0.999	1.093	0.183	0.843
5	2.61	0.147	0.999	1.146	0.163	0.842
10	2.29	0.236	0.999	0.998	0.175	0.768
15	2.22	0.223	0.999	0.853	0.204	0.900

It is evident from the results presented in Tables 1 and 2 that maximum capacity (q_m) of sugar beet pulp is almost ten times larger than capacity of poplar wood sawdust, and in general, than capacities of sawdust of any kind of wood (Sciban and Klasnja, 2004; Low et al., 2004; Božić et al., 2009) or wood bark (Aoyama et al., 1993; Seki et al., 1997). As expected, increase in biosorbent quantity results in maximal capacity decrease.

An exception is the increased adsorption capacity of sugar beet shreds when it is appled in quantity of 15 g/l. Fig. 1 shows that the curve for the 15 g/l is not yet reached plateau, and this results in increased adsorption capacity for this case. The conclusion of these consideration would be that the investigation of adsorption efficiency of some biosorbent should be done with higher adsorbent dose, and determination of maximal adsorbent capacity with lower adsorbent dose.

If it is compared the coeficients of determination (R^2) it can be seen that the Langmuir adsorption isotherm better describes adsorption both at sugar beet shreds and poplar wood sawdust, than Freundlich adsorption isotherm. In that case, the assumption is that the surface of both biosorbents are homogenous, i.e. all active sites for the adsorption are of the same type, although these complex biomaterials have got a few different functional groups. This is the case with many other raw biosorbents, for example different types of wood (Sciban and Klasnja, 2004; Rafatullah et al., 2010), peanut hulls (Brown et al., 2000), hazelnut shell (Cimino et al., 2000) etc. However, this is not the general case, because for adsorption by papaya wood (Basha et al., 2008), mustard oil cake (Ajmal et al., 2005) etc. it was established the similar fit both for Langmuir and Freundlich adsorption isotherms, with experimental results.

4. CONCLUSIONS

In this study the efficiency of adsorption of copper ions from water by sugar beet pulp and poplar wood sawdust was investigated. Adsorption experiments were performed at room temperature with four different biosorbent doses of 2.5 g/l, 5 g/l, 10 g/l and 15 g/l, which were added in the model water with the different initial copper ion concentration. The contact time of model water and the biosorbent was 90 min. The adsorption constants were determined by the Langmuir and the Freundlich adsorption model.

Considering adsorption capacity, the sugar beet shreds are better biosorbent than poplar wood sawdust. The results demonstrate that the efficiency of copper ions removal from the water was better at higher dose of adsorbent, and at low metal ion concentrations. On the other hand, adsorption capacity should be determine by using lower adsorbent dose. Langmuir adsorption isotherm better describes the adsorption of copper

ions than Freundlich adsorption isotherm, and that means the surface of investigated biosorbents are homogeneous, with the same active sites for the copper ions adsorption.

Acknowledgement

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1. Sami MASADEH, 2. Amin Al-ROBAIDI, 3. Nabil ANAGREH

ELECTROCHEMICAL CHLORIDE EXTRACTION FROM CONCRETE STRUCTURE EXPOSED TO DEAD SEA WATER

1-3. Materials Engineering Department, Faculty of Engineering, Al-Balqa Applied University, Al-Sult 19117, JORDAN

Abstract: Eighteen concrete samples with different concrete mixes, overlay thicknesses, and w/c ratios were cast and immersed in Dead Sea water bath. Potential readings were recorded over 7-month time period and results were plotted on a time-potential scale. Electrochemical chloride extraction (ECE) treatment was applied for one month, potential values recorded again and final results were plotted and compared. Data collected along 8 months clearly showed that higher w/c ratio (0.7 w/c), lower overlay thickness (2 cm), and the use of a more concentrated Cl- water (i.e. Dead Sea water) increased corrosion. ECE treatment has proved to be a successful technique to minimize the destructive effect of corrosion.
Keywords: Corrosion, Electrochemical chloride extraction, Deadsea water, Concrete, Steel reinforcement

1. INTRODUCTION

The Dead Sea lies between Jordan and Israel. Its water is unique because it contains a number of salts with compositions different than any other sea water in the world. The composition of Dead Sea water is as follows: 14.5% MgCl, 7.5% NaCl, 3.8% CaCl2, 0.5% MgBr2, 1.2% KCl, and rest is water. Some industrial and tourist structures lay at sea coast; severe corrosion problems encounter sea water due to high chlorides content. In many cases, corrosion can not be controlled unless very special alloy steel is used.

Contrary to common belief, concrete itself is a complex composite material. It has low strength when loaded in tension and hence it is a common practice to reinforce concrete with steel, for improved tensile mechanical properties.

Concrete structures such as bridges, buildings, elevated highways, tunnels, parking garages, offshore oil platforms, piers, and dam walls all contain reinforcing steel (rebar). The principal cause of degradation of steel reinforced structures is corrosion damage to the rebar embedded in the concrete. Iron is unstable in nature, and because reinforcing steel used in pre-cast concrete is made largely of iron, it, too, becomes unstable when exposed to corrosive agents such as salt.

Sound concrete is an ideal environment for steel but the increased use of deicing salts and the increased concentration of carbon dioxide in modern environments principally due to industrial pollution, has resulted in corrosion of the rebar becoming the primary cause of failure of this material. Corrosion of reinforcing steel in bridges and parking garages is a well-known and costly problem. In the presence of chlorides, moisture and oxygen, corrosion takes place at appreciable rates. The resulting corrosion products, which are more than twice the volume of the original uncorroded steel, create tensile stresses in the surrounding concrete. When these internal stresses are excessive, the concrete in the vicinity of the reinforcement cracks and eventually spalls or delaminates.

Until recently, rehabilitating concrete bridge piers involved only removing the damaged concrete and then patching. However, this practice was found to lead to the introduction of new electrochemical cells between the new chloride-free concrete in the patches and the surrounding old concrete that contained varying amounts of chloride [1].

Once chloride-induced corrosion of the reinforcing steel bars has initiated in a concrete bridge, the only truly effective means of stopping corrosion in

the structure is by applying either cathodic protection or the relatively new electrochemical chloride extraction. Electrochemical chloride extraction extends the functional life of the treated structure, but does not require the long-term commitment generally required in other used systems. Electrochemical chloride extraction is operated without requiring the excavation of structurally sound concrete that is contaminated with chlorides. This can provide an advantage that does not exist with other restoration techniques [2].

2. ELECTROCHEMICAL CHLORIDE EXTRACTION (ECE)

Since steel corrosion is an electrochemical process, once it occurs in a concrete structure an electrochemical measure, such as electrochemical chloride extraction (ECE) can stop it or slow it down to a significant extent The ECE process is as follows:

(1.) A suitable metal is placed or attached to the surface of a concrete structure,

(2.) An electrical field is applied between this metal and the embedded steel bars by the passage of a direct current through the concrete in such a manner that the bars become negatively charged and the metal becomes positively charged, and

(3.) The negatively charged chloride ions (Cl⁻) in the concrete are drawn away from the steel bars toward the surface of the concrete.

The outward migration of the chloride ions accompanies the movement of other mobile ions in the concrete, each in the direction dictated by its electrical charge, contributing to the conduction of the electric current through the top layer of concrete. Adverse effects are: increased permeability in the concrete, a decreased concrete-to-steel bond, and cracking in the concrete. Concerns for these effects halted research on the application of ECE. These studies, conducted on concrete specimens and small sections of several concrete bridge members, found that by maintaining the applied current to less than $5A/m^2$, the treatment would have no adverse effect on the concrete [3]. Further, the treatment removed 20 to 50 percent of the admixed chloride from the test concrete slabs and redistributed the remaining chloride well away from the steel bars [4].

Electrochemical treatment of concrete is becoming more popular as a repair and restoration option to stop corrosion and extend the service life of existing reinforced concrete structures. This paper will discuss the theory behind Electrochemical Chloride Extraction (ECE) as well as a number of important services and components required to successfully complete an ECE project [5]

The objectives of this work are:

– To study marine corrosion and its effect on reinforcement steel in concrete due to the severe deterioration of reinforced concrete structure in Dead Sea area.

– To study the effect of w/c ratio; overlay thickness and type of mixing effect on corrosion through the interpretation of potential readings of reinforcement steel bars in concrete.

– The effectiveness of electrochemical chloride extraction in rehabilitation of steel reinforcements by applying ECE to concrete structures having severe corrosion.

3. EXPERIMENTAL PROCEDURE

3.1. Concrete Casting

Eighteen concrete cylinders were cast with the following mix: (31% percentage by volume for both fine aggregate and cement, 38% coarse aggregate) into molds after inserting steel bars at different distances (2,3 and 4 cm respectively) from mold wall as shown in Figure (1).
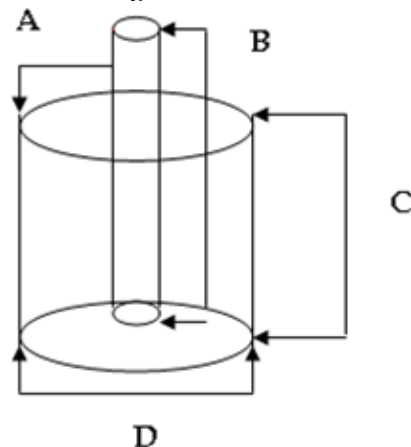
Figure (1): Specimen design showing overlay thickness, height of steel bar as variables and height and diameter of concrete sample as constant.
A: overlay thickness; B: height of steel bar C: height of concrete D: diameter of concrete

After hydration process took place (48 hours) later, concrete cylinders were removed from mold, and left to cure (by wetting them) for 28 days.

Different W/C ratios (0.5, 0.6 and 0.7), mixing water (Tap water and Dead Sea water) were used and different overlay thicknesses. Potential readings were recorded using (Cu-CuSO₄) reference electrode and according to ASTM C876-80 and plotted versus time.

3.2. Electrochemical chloride extraction

After three-month exposure to Dead Sea water solution bath, samples were removed from solution bath and each sample was wrapped with three layers of sponge, galvanized steel wires and sackcloth then enveloped with nylon sheets (Figure 2, Figure 3). Electrochemical chloride extraction was applied by using an external Dc-power supply. Steel reinforcements were connected to the negative and galvanized steel wires (acting as anodes) to the positive terminal of the DC-power supply. Frequent potential readings were taken; results were recorded, plotted, and analyzed.
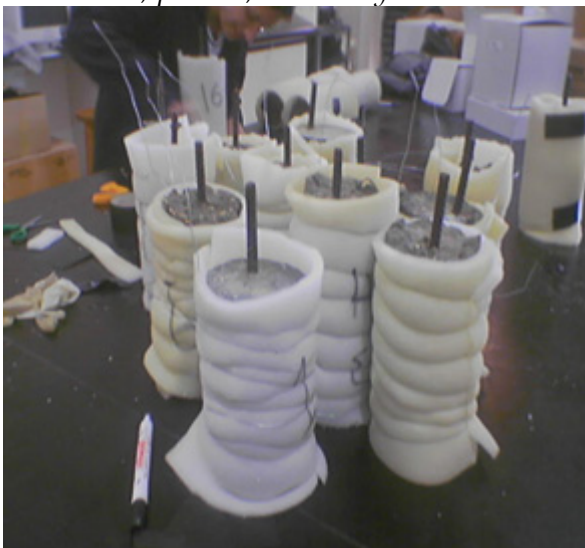
Figure (2): Wrapping with sponge and galvanized steel wires
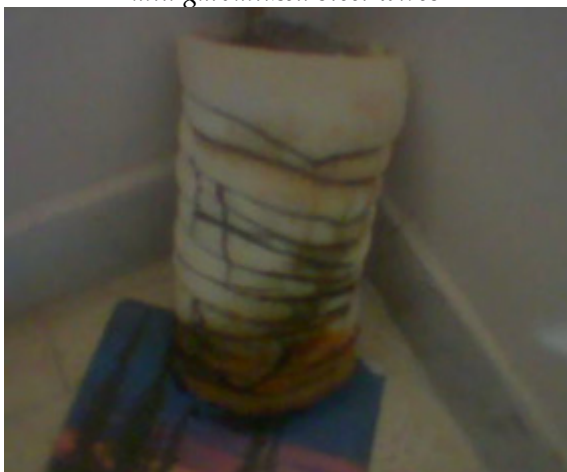
Figure (3): Final appearance after ECE application

4. RESULTS AND DISCUSSION

4.1. Effect of mixing water

The potentials of concrete blocks prepared by Dead Sea water showed more negative potentials than those prepared by tap water. This behavior was observed for specimens with different W/C ratios and having different concrete overlay thickness.
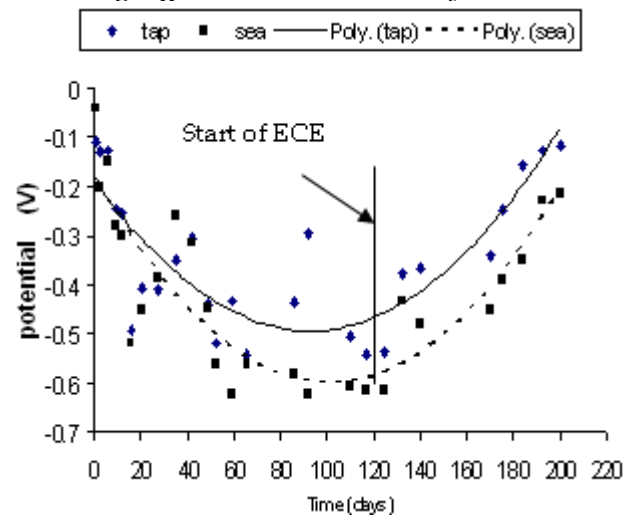
Figure (4): Potential of steel reinforcement Vs time for 0.5w/c ratio and 2 cm thickness and variable mixing water type

4.2. Effect of overlay thickness

This figure shows the behavior of steel reinforcement exposed to Dead Sea water and tap water having different overlay thickness for various concrete samples. Potential readings interpreted show that steel reinforcements with higher overlay thickness had more positive potentials.
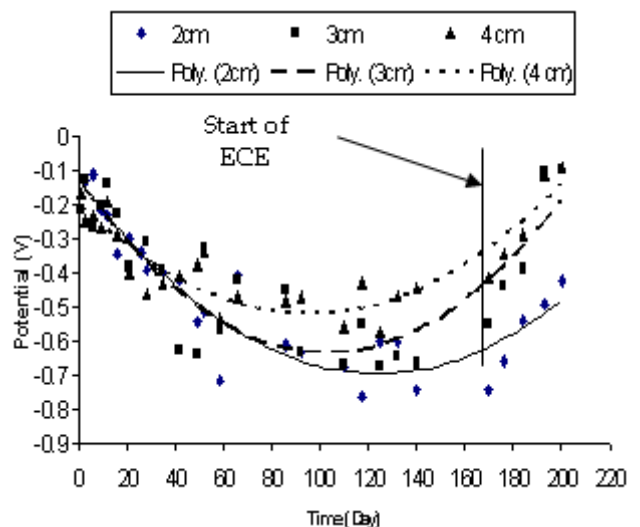
Figure (5): Potential of steel reinforcement Vs time for 0.7 w/c ratio and seawater and different over lay thickness

4.3. Effect of w/c ratio

Figure (6) show the behavior of steel reinforcement exposed to Dead Sea water and tap water having different w/c ratios for various concrete samples.

For the same overlay thickness and concrete mix (i.e. type of water used), 0.7w/c ratio gave more negative potential readings compared to both 0.6 and 0.5 w/c ratios.
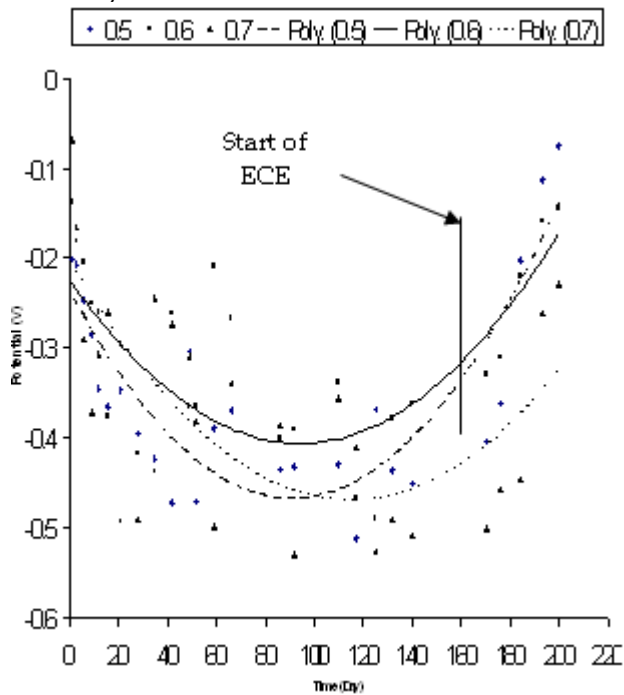
Figure (6): Potential of steel reinforcement Vs time for 3cm over lay thickness and tap water for different w/c ratio

5. DISCUSSION

5.1. Effect of mixing water

Concrete cylinders made by mixing with Dead Sea water showed more negative potentials than those mixed with tap water due to:

a. *Chloride effect: - Higher Cl- ions concentrations destroy the oxide film on the steel bar that formed on the metal surface. Due to high alkalinity, the Fe-2 produced at the steel-concrete interface combines with the OH- from the cathodic reaction to ultimately produce a stable passive film. Chloride ions in the solution, having the same charge as OH ions, compete these anions to combine with the Fe-2 cations. The resulting iron chloride complexes are thought to be soluble (unstable); therefore, further metal dissolution is not prevented, and ultimately the buildup of voluminous corrosion products takes place*

b. *Corrosion mechanism in samples using tap water as their mix is mainly due to the slow dominating diffusion process.*

c. *The effect of chlorides is two folds, in that both the pH and the electrical resistivity of the concrete are lowered. Normally, the pH of concrete is 12 or 13, and steel usually becomes passive in environments having pH greater than 11.5. With the addition of chlorides, however, the pH of concrete may drop to 6 or 7, in which steel will corrode readily. The lowered resistivity also enhances corrosion. Concrete cylinders prepared by both mixing water showed severe potential drop but was less negative for samples mixed with tap water.*

5.2. Effect of overlay thickness

Higher overlay thickness impedes the chloride ions penetration and oxygen enrichment into the depth of the sample and consequently into the steel bar due to shorter path required for the attacking corrosive chloride ions to travel in order to reach the steel bars thereby accelerating corrosion, so, samples with 2 cm thickness experiment showed higher corrosion than those of 3 or 4 cm thicknesses. Inadequate cover is invariably associated with areas of high corrosion risk due to both carbonation and chloride ingress

5.3. W/c ratio Effect

a. *Higher w/c ratio explicitly indicates larger water volumes used in the concrete mix, which produces more porous concrete making it suitable for corrosion to take place,*

b. *Oxygen enrichment: The portion of steel bar directly exposed to atmosphere is surrounded by higher oxygen concentration which will lead to a significant difference in potential with the steel bar embedded in concrete thus forming galvanic corrosion cells and initiating corrosion. With the decrease in the w/c ratio the quantity of permeation oxygen decreases. Therefore decreasing w/c restrains the cathodic reaction, which leads to a decrease in the corrosion rate.*

c. *Porosities in higher w/c ratio sample are higher volume thus allowing oxygen and water to penetrate into the depth of the sample, reach the steel bar easier and corrode it. Air and gases may move fairly easily in the pores of dry concrete-if the pores are interconnected-but with*

increasing relative humidity, first the fine, then the coarser pores will be filled with water, and this slows down diffusion.

5.4. Electrochemical Chloride Extraction

a. Electrochemical chloride extraction process began after 170 days of exposure of concrete cylinders to DSW bath in order to rehabilitate and protect steel bars against corrosion by removing chloride ions. Potential readings began to increase (i.e. become less negative, more positive) because of the use of a DC impressed current supply that accelerated the extraction process in 4 weeks to simulate the conditions of concrete under real prolonged service life time and reversed the direction of Cl⁻ ions movement from inner steel bar, leaching it to the outer environment of galvanized steel which acts as an anode.

b. Effects of the three main variables (mixing water, overlay thickness, and w/c ratio) are reversed after the application of electrochemical chloride extraction. Samples mixed with Dead Sea water having lower overlay thickness and higher w/c ratio made the ECE process easier and more effective as expected.

c. As a result of the applied potential difference between the anode and cathode water was reduced to hydroxyl ions at the reinforcement. After the available oxygen had been consumed, the cathodic reaction produced hydrogen gas. In porous concrete, it may simply diffuse harmlessly to the atmosphere through the pores of the steel-concrete interface. Externally, water or hydroxide was oxidized to oxygen and hydrogen ions. These reactions are referred to as electrolysis, which results in a pH increase around the reinforcement and is an important process for electrochemical process of ECE as shown in the equations (1-5).

d. The resultant electro deposition helps to passivate the reinforcing steel after current application, and it also suppresses the corrosion of the reinforcing bar in the concrete. Electro deposition had an effect of recovering alkalinity of concrete.

This seemed because of the salt solution in the vicinity of the reinforcing bar that became the high alkali atmosphere by generation of hydroxyl ions

by electrolysis and integration of metal ions to the reinforcing bar.

At the cathode

$$2H^+ + 2e^- = H_2 \dots\dots\dots\dots\dots\dots\dots\dots \quad (1)$$
$$O_2 + 2H_2O + 4e^- = 4OH^- \dots\dots\dots\dots \quad (2)$$
$$Na^+ + e^- = Na \dots\dots\dots\dots\dots\dots\dots\dots (3)$$

Anode

$$Cl_2 = 2Cl + 2e^- \dots\dots\dots\dots\dots\dots\dots\dots \quad (4)$$
$$2H_2O = O_2 + 4H^+ + 4e^- \dots\dots\dots\dots\dots \quad (5)$$
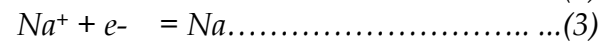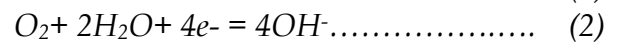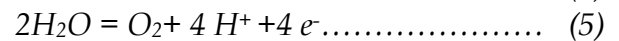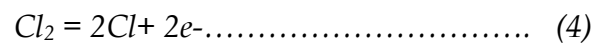
6. CONCLUSIONS

1. Increasing the w/c ratio increases corrosion holding overlay thickness and type of water used in concrete mix constant. 0.5 w/c ratio samples were last to corrode compared to both 0.6 and 0.7 w/c ratios.

2. Lower overlay thickness allows higher corrosion of steel bars due to shorter path for Cl⁻ ions that has to be traveled for the same w/c ratio and type of water used in the mix.2, 3, and 4 cm overlay thicknesses corroded respectively.

3. Mixing with Dead Sea water encourages higher corrosion of steel bars at both constant w/c ratio and overlay thickness.

4. Reinforcement in concrete exposed to Dead Sea water would corrode irrespective of the w/c ratio used in concrete preparation.

5. The results of ECE showed that electro deposition made the reinforcing bar surface into the re passivation and that it also suppressed the corrosion of the reinforcing bar in concrete due to high alkalinity of the steel bar as a result of applied potential difference.

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1. Slobodan STEFANOVIC, 2. Imre KISS,
3. Damjan STANOJEVIC, 4. Nenad JANJIC

ANALYSIS OF TECHNOLOGICAL PROCESS OF CUTTING LOGS USING ISHIKAWA DIAGRAM

1,3,4. Department of Mechanical Engineering,
Higher School of Applied Professional Studies, Vranje, SERBIA
2. Department of Engineering & Management, Faculty of Engineering –
Hunedoara, University Politehnica Timisoara, ROMANIA

Abstract: *The quality management system standards of the ISO 9000:2000 series are based on the eight quality management principles. Principle No. 6 says: "Continual improvement of the organization's overall performance should be a permanent objective of the organization". Applying this principle requires having knowledge of methods and tools for solving problems and/or continual improvement. One of these tools is "The Cause & Effect Diagram". It is used to document the possible causes of a given event. "The Cause & Effect Diagram" is also known as a "Fishbone Diagram" because of its appearance or an "Ishikawa Diagram" after its originator, Dr Kaoru Ishikawa. In order to ensure its place at the market an organization has to produce such products and services that meet wishes and expectation of customers. It has to meet demand of customers and other interested parties (workers, owners, suppliers, community). However, due to strong competition and increased customer's requirements for higher quality, the organization could lost its place at the market if fails to make continuous improvements. Continuous improvements are not possible without knowing how to correctly implement both tools and methods. Task of management is to recognize the importance of tools and methods for management of quality, what is the subject of this paper.*
Keywords: Ishikawa diagram, management of quality, tools and methods, improvement

1. INTRODUCTION (*Kaoru Ishikawa – Cause – Effect diagram creator*)

Kaoru Ishikawa (1915 – 1989) is the most famous Japanese scientist in the field of quality, a typical representative of a successful takeover of all U.S. experiences, their immediate implementation in the study. Binding U.S. knowledge with the Japanese practice, Kaoru Ishikawa is a pioneer in winning new, own techniques that will celebrate Japan in the world.

For his work Ishikawa received a number of Japanese and international recognition, and it is enough to point out Deming Prize and the Shewhart Medal, Award of the Japanese Association for Standardization and Grants award of the American Society for Quality Control. In addition to a large number of papers and classes on videotape, Kaoru Ishikawa also wrote a series of books of which are still two world bestseler:

✓ *How to take quality circle activities,*
✓ *What is total quality control - the Japanese way.*

It is particularly important his work of introducing quality basis on practical circuits actions in Japan and worldwide, primarily in the United States. American Society for Quality is in 1993. established an annual award for the Ishikawa human aspect in the introduction and implementation of activities related to quality. The basic elements of learning and practice Kaoru Ishikawa are as follows:

1. *Quality begins and ends with learning*
2. *The first step is to find consumer demands*
3. *The ideal state of quality control occurs when inspection is no longer needed.*
4. *You must remove the causes of the problem, not the symptoms.*
5. *Quality control is the responsibility of all workers and all divisions.*
6. *Must not confuse means and ends.*
7. *Quality should be a priority and should seek to realize profits in the long term*
8. *Marketing is input and output for quality*

9. *Top management must not show anger when facts subordinate amounts.*
10. *95% of the problems in the organization can be solved using a simple tool for analyzing and troubleshooting.*
11. *The data do not indicate to the dispersion (ie. variability) were incorrect data.*

With the full support of the Association of Japanese scientists and engineers Ishikawa has proposed the implementation of quality statistics in three basic levels:

✓ *for all employees,*
✓ *for the leadership at all levels of superior quality managers,*
✓ *for professional statisticians.*

He advocated collection and analysis of data using simple visual tools, statistical techniques and teamwork as the basis for the introduction of total quality. Deming took the famous Shewhartov cycle (PDCA – Plan, Do, Check, Act) and adapt it to his way of thinking so that today is usually talking about the Deming cycle in four steps.

Kaoru Ishikawa further expanded it to six steps under the motto 'always (at least) one step further'. Ishikawa circle of improving quality consists of the following six steps:

1. *determine (define and detect) targets,*
2. *find methods to achieve goals,*
3. *get involved maximum in education and training,*
4. *achieve the goal (model products or services, processes, systems),*
5. *check and correct the results of the implementation of all existing improvements,*
6. *finally realized envisaged goal (improvement, new product or service, process, system)*

Move 'one step further', according to Ishikawa is pure fiction unless there is full support for all levels indicators that management must demonstrate their full commitment to quality. Kaoru Ishikawa is in a way a complete Japanese version and amendments Edward Deming. His role and importance in the development of quality in Japan is crucial and fundamental.

Combining the best of the West and the East, Ishikawa, along with top American experts charted the path will go complete Japanese economy and not just one. With all achieved practical success in statistics, quality control circles and total quality control of the entire company, Ishikawa will remain known as a top promoter of new techniques and technologies and harnessing more importantly as a convinced supporter of paying special attention to the man, his environment and the democratization of all production processes.

2. CAUSE – EFFECT DIAGRAM

2.1. Areas of application

Cause – effect diagram is the result of a general analysis of the impact (cause) that cause a particular outcome observed phenomena (work processes). In an effort aimed at boosting the quality of products and processes companies and service organizations, the present method has a wide range of applications in the processes of quality assurance processes of all functions of the company in terms of:

✓ *Identification of the actual causes of a particular condition (**outcome**) results from the operation of the company or service organizations*
✓ *Identification and analysis of **cause – effect** relationship in the flow of materials, energy and information, which provide the basis for effective troubleshooting if as a result is observing the situation – the outcome of the work beyond the limits of tolerances os set objective function.*

2.2. Description

Diagram of the **causes – effects** is, as noted, a method for detailed analysis of the relationship between a state system in observation (effects) and the influential variables that cause the occurrence of a given condition (**cause**). When given in the analysis related to improving the quality of the products and processes of companies and service organizations, the expression:

✓ *EFFECT – means a certain **outcome** of the work of the observed view of the system at a given time and under given circumstances; as impact outcomes related to the effect of temperature and disorder in the process, it is clear that the size of the random character and can be classified into two main categories – **both inside and outside** the limits of tolerances placed objective function,*
✓ *CAUSES – means a set of environmental conditions and processes of the system that result in a particular state of the **outcome** of the*

work: from the standpoint of achieving the projected state – effects that are the size of circulation resulting character.
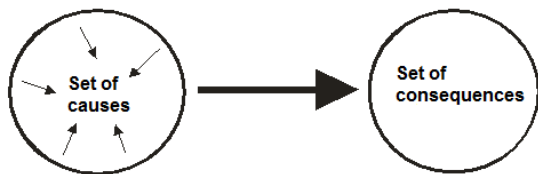
Figure 1. The main connection CAUSES – EFFECT

Diagram of **Causes – Effect** as a set of causes on the one side and effect at the other side shall be regulated by the principles of:

✓ **Selection –** the separation of the true causes of a particular outcome of the work process – one effect,

✓ **Sorting –** grouping selected causes by character, importance and effection mode,

✓ **Logical connection** of the observed effects and causes of isolated.

2.3. Procedure

Step 1: Defining the problem

In most cases the diagram **CAUSES – EFFECTS** are used for the case that resulted in defining a specific problem – poor quality parts, assemblies or products, the occurrence of **FAILURE CONDITIONS**, the long duration of the production cycle, low coefficient of rotation of capital, and a series of other related problems. Then it is necessary to verify the identity of the causes of occurrence of a trouble as a result. It is possible, also, a situation that results in a defined and particular effect. In this case seeking identification of the conditions that lead to the realization of the given effect as a result.

EFFECT (problem or effect) must be defined on the basis of objective data in the form of a completely clear. In the process of defining the problem helps Brainstorming analysis.

Graphically present the given consequence – the usual symbol is a rectangle in the right part of the drawing in the manner shown in Figure 2, leaving the left side area of the diagram of the future introduction of the cause
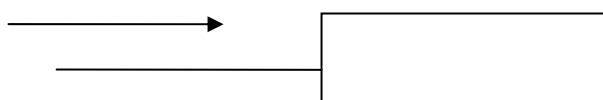
Figure 2. Define the problem – the EFFECT

Step 2: Identification of the cause

A method for identifying the cause which lead to the problems defined above is composed in:

✓ Forming the problem of all possible causes of the problem to be analyzed. It is obvious that an overview can be the result of a consequence, groups or professional teams, but at this stage recommend the results previously held Brainstormng session. When given the importance of the overview of the causes is complete, that is, goes off in advance of a cause which in subsequent analysis may result in the basic cause – and effect relationship.
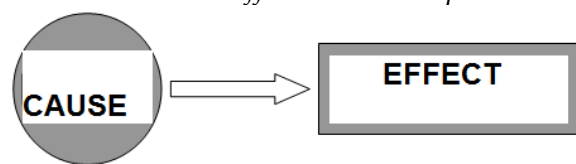
Figure 3. The basic form of cause – effect relationships

Classification by type of the cause, effection mode and related features.

Classification is the most effective use of simple forms of classification systems – coding sample: groups of causes related to the participants in the work, groups of causes related to materials, groups of causes related to the working procedures, groups of causes related to the means of work.

Step 3: Selection the basic structure

For non–production application forward given structure group **(4M)** obviously does not correspond – it takes depending on the nature of the problem, to form a new group.

If you previously added to the structure given category **Marketing**, **Money**, and **Management** structure then transferred to the structure type 7M.

The present stage of the analysis involves the selection of a certain structure **CAUSES – EFFECT** diagram. Structure type **4M** or **7M** can be a good basis for forming the basic structure of the diagram, where the adopted structure (number and nature of groups of causes) may not be final because the further development permit modification. The main groups of samples are entered by pulling the appropriate lines on the line effection causes diagram in step 1., to provide the basic structure diagram **CAUSES – EFFECT** given in Figure 4.
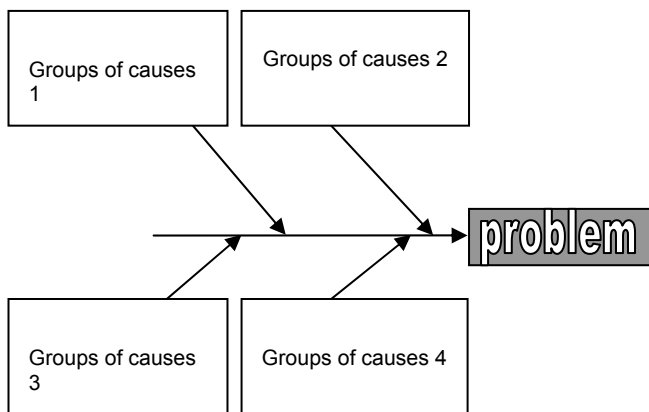
Figure 4. Basic structure of Causes – Effect diagram

Step 4: **Develop a diagram**

For selected basic structure diagram should be the main groups of causes lines to add causes of which are previously located in the group. The addition is carried out by pulling each of the sample connection line in the basic group of the cause, as shown in Figure 5.
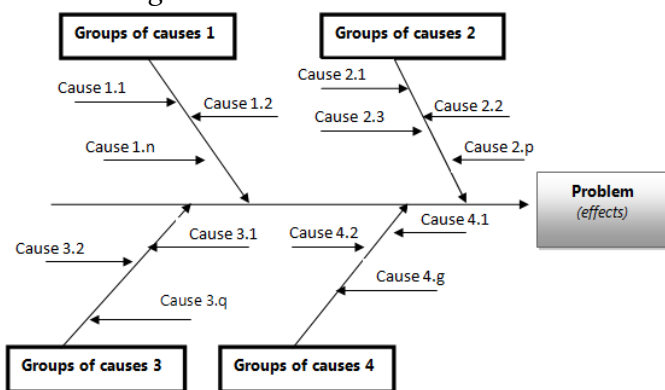
Figure 5. Development phase of
Causes – Effect diagram

In the present step, it is necessary to make adjustments of the basic structure diagram in case of occurrence of the cause the concentration of one or two basic groups of the branches the cause (unbalanced diagram). You have acquired a basic insight into the effect of certain causes, the need of their allocation or elimination in cases of unnecessary connections.

Based on the foregoing it can be concluded that the elaborate diagrams need to respect the principles ofe:

✓ Balanced structure
✓ The necessary minimum of the cause or cause – effect relationship.

Step 5: **The process of spreading (branching)**

A method of spreading is performed from the cause connected in multiple stages, without limitation, as long as it does not exhaust all the examination of identified causes.

Step 6: **Analysis**

When by entering in diagram at a certain level exhaust all identified causes and check the logic of each of the branches, the approach to the analysis that is performed is in two directions:

✓ Identification of the most likely cause–problem which is analyzed and their designation in the diagram. Probable cause should seek on the line: the bigest level causes – the highest level causes – lower levels causes,

✓ Given process, in addition to targeting the root causes of problem, allows, in certain cases, finding **the critical line cause**, which is certainly one of the most important results of this method,

✓ Diagram CAUSES – EFFECT considered separately is not sufficient to solve the problem – it only refers to its underlying causes, and the cause – effect relationships.

For these reasons it is necessary to collect data in order to check the most important (most probable) cause and troubleshooting any other suitable method (ABC or Pareto diagram).

3. EXAMPLE DIAGRAM CAUSE – EFFECT IN THE TECHNOLOGICAL PROCESS OF CUTTING LOGS

Step 1 **– Identify effects**

We **need to identify and clearly define the output or effect** that will be analyzed. The effects should be formulated as a special quality characteristics, problems resulting in the work, planned objectives, etc.

We **must use the definition.** Within the team we have to determine the definition of effects to ensure that it is clearly and unambiguously understood.

We **need to know that the effect can be positive (objective) or negative (a problem)**, depending on the issue under discussion. The use of positive effects that focuses on the desired output can create an optimistic atmosphere that encourages the participation of team members. Whenever possible recommended expression effects in a positive way. Focusing on the negative effects can turn team effort to search justify why the problem occurred and determination of guilt. However, in some situations, for it is easier to

focus on what are the causes of problem, but what are the causes of a positive output. The team needs to decide which approach is best for a particular case.

NOTE: *An example used to explain the construction of a „diagram of cause–effect" is divided into its component parts and described in detail to illustrate the construction steps. Using this example, we will show the causes that are related to getting poor quality boards when cutting logs.*
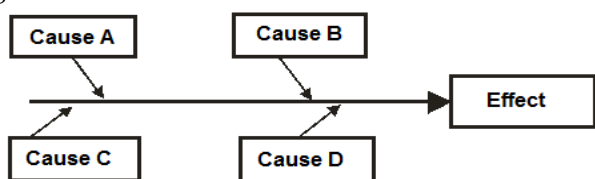
Figure 6: The basic structure of the cause–effect diagram

Step 2 – Drawing effects

Using a board or larger paper, placed so that each team member can well see, than draw the BASIC STRUCTURE and create a effects RECTANGLE. Draw a horizontal arrow to the right end. This is the basic structure.. Right from the arrow write a brief description of effects or the output that results from the process (eg: a **effect** is **poor quality of the boards**– Figure 7). Draw a rectangle around a description of the consequences.
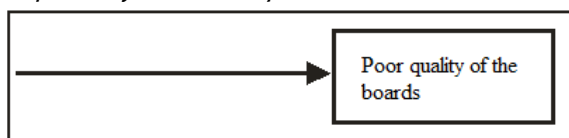
Figure 7. Step 2 – Drawing „effects"

Step 3 – Identify the causes

Identifying main CAUSES that contribute to the effects that we analyze. These are signs of the main parts of our diagram and become categories that will be given reasons related to that category.

Determine the main causes, or categories, which will be referred to other possible causes. You need to use a label for a category that makes sense to create a diagram. Here are some commonly used categories:

✓ *3M and O – methods, materials, machines and staff,*

✓ *3P and O – politics, processes, facility and staff,*

✓ *Environment – potentially significant fifth category.*

Write down the main categories that our team chose the left of the effect rectangle, above and below the «basic structure».

Draw the rectangle around the label of each category, and connect them with the «basic structure» slanted lines.

Step 4 – Identification of other factors

For each of the main group, identifying other specific factors that can be CAUSES EFFECTS:

✓ *Identify as many causes or factors and attach them as a subgroup of the main group (eg. possible causes for the poor quality of the boards are shown under the appropriate categories in Figure 9.).*

✓ *Provide details for each cause. If a cause of lower order applied to several causes higher order please include it below each of them.*
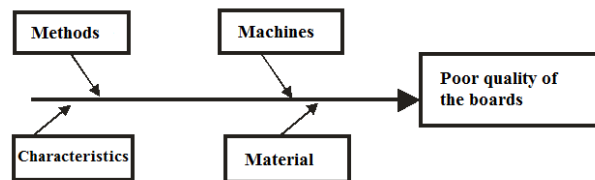
Figure 8. Step 3 – Identification of the major categories

Step 5 – Identify the causes

We need to identify the deeper causes and to continue to organize under the appropriate causes or categories. We can do a series of questions asking **why**.

Figure 9 shows how the diagram looks like when all the causes have been identified that contribute to the effect. As you can see there can be many causes that contribute to the level of effect.
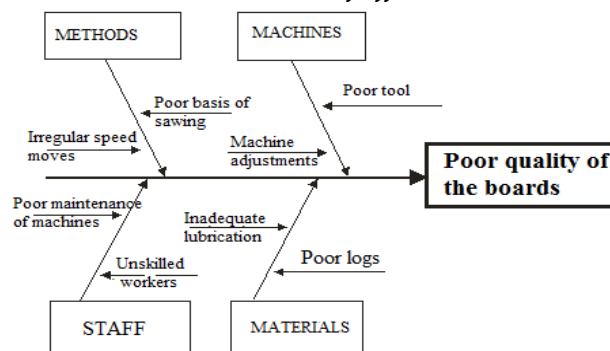
Figure 9. Step 5 – identifying the causes

Step 6 – Analysis of the diagrams

The analysis helps to identify causes that warrant further investigation. Because „diagram cause–effect" identifies a **possible cause**s of this further work we can use Pareto diagram to determine the cause of which will be the first focus. When

analyzing the diagram we need to do the following:

» Consider «balance» in our diagram by checking comparable levels of detail for most categories
  ✓ A thin block position in one area may indicate that further research is needed.
  ✓ Main category that has only a few specific causes may indicate the need for further identification of causes.
  ✓ If several major groups have just a subset of them may be combined under one category.
» We need to seek the causes that are repeated several times. They may represent the root of the problem/effects.
» We need to seek what we can measure in each cause so that we can quantify the effects of changes that may make.
» Most importantly, identify and round up the cause in which we can take action.

Analysis of diagram indicates the following:

The level of detail is almost balanced. No cause is not repeated. Invalid moving speed may be the cause of which it is possible to establish a measurement. Moreover, the wrong speed moves the cause in which we can take action. In Figure 10., is rounded to be marked for further investigation.
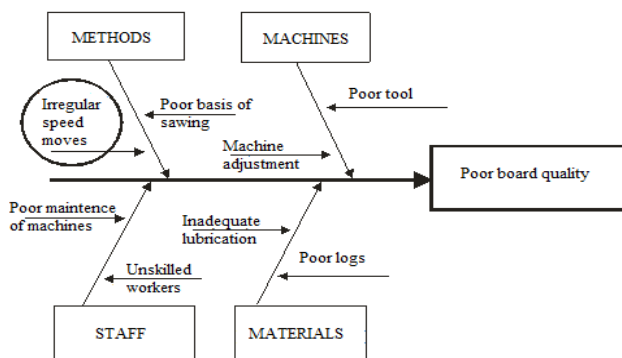
Figure 10. Step 6 – Diagram analysis

8. CONCLUSION

Strive for continuous improvement of quality, then work to meet the wishes and expectations of customers, through the reduction of variability in all processes, and improve process capability, and as a result will be an increase in the quality of products and/or services. The principle of continuous improvement can be carried out if leaders of business processes has adequate information base, which would enable them to make business decisions based on facts.

Cause–effect diagram is a tool that is suitable for identifying and organizing the known or possible causes of poor quality or problems. The structure provided by the diagram helps team members to think in a systematic way.

Cause–effect diagram is a tool that helps in identifying, sorting and displaying possible causes of a specific problem or quality characteristic. It graphically illustrates the relationship between a given output, and all the factors that affect the output. This type of diagram is sometimes called the „Ishikawa diagram" because it was invented by Kaoru Ishikawa or „fishbone diagram" because of his look.

In this paper, is a complete processed diagram causes – effect, his scope, description and method of making diagrams. It was made an example that indicates all the causes that affect the result of getting poor quality of cut

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1. Peter SIMONYI

SOME RESULTS OF A RESEARCH ON LOCAL ECONOMIC DEVELOPMENT (LED) IN COUNTRYSIDE IN HUNGARY

1. Department of Social and Economic Geography, Faculty of Science,
Eötvös Loránd University, 1117 Pázmány Péter sétány 1/C, Budapest, HUNGARY

Abstract: Local Economic Development (LED) is in focus in some ex-socialist countries of Europe. Eight different settlements were examined by different methods in 2012-2013 to study the present situation of its state of economy and employment and the local resources in a research. The aim of this paper is to show the key factor of LED, to attempt for standardization taking into account the scientific literature, to define indicator of well-being in countryside and an evaluation by a new LED model.
Keywords: local economic development, Hungary, countryside economy, rural, development model

1. INTRODUCTION

In the ex-socialist countries the transition period caused growth in difference of regional development. Although many financial resources have been spend to close development gap among regions and settlements of Hungary, however it may not be said successful really. The rural areas are usually less-favoured areas with high unemployment rate. Rapid growth in development occurs mainly in the capital, Budapest and in some cities and villages. The local government would have to take more effort to develop local economy based on own local resources.

The eight examined settlements represent different kinds of locality type both location and population. The location of settlements is on Figure 1 (Simonyi, P. et al. 2013).
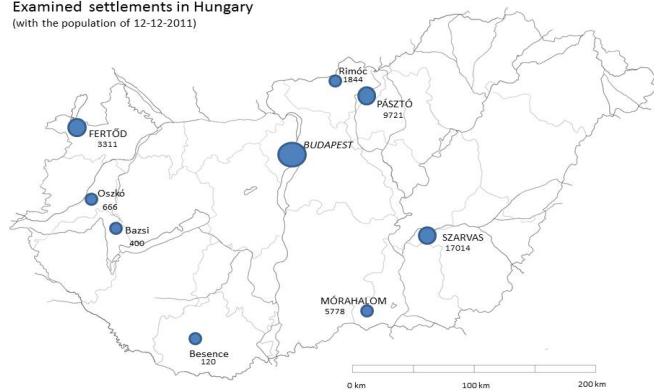
Figure 1. Location of examined settlements with population on 12-12-2011 (letters in capitals: city; in italics and capitals: capital of Hungary)

The aim is to define the key factor or factors of successful local development as this state has been recognized in some settlements in the pre-study. Furthermore we wanted examine how so-called ideal types of rural areas could be applied in Hungary? Interesting question is which indicators or indicator could be the most representative ones to show well-being of locals in countryside? Finally, a new model on local economic development how can help for evaluate the LED?

2. MATERIALS and METHODS

2.1. Materials

In this paper on LED the materials were the scientific literature and the results of the field studies, based on different methods, used in the eight different settlements as four cities (Szarvas, Pásztó, Mórahalom, Fertőd) and four villages (Rimóc, Oszkó, Bazsi, Besence).

There are different not only the number of inhabitant (Figure 1.) but their geographical position also. Rimóc and Pásztó are in Northern Hungary, in a hilly area. Szarvas and Mórahalom situated in the Great Plain (Alföld) and the other four localities can be found in Transdanubia (Dunántúl). Besence is in the south, Dráva-plain and Fertőd situates in quasi opposite in north-west at the Austrian border. Oszkó and Bazsi are more or less typical transdanubian villages in the west and in the middle sub-region.

2.2. Methods

The study method for the research in the field-work was multiple ones to come near to the holistic approach (Clark 2011). Standardized questionnaire used for open the opinion of the inhabitants up. In-depth interviews were the most important way to uncover the sight of local stakeholders. Focus group interviews were planned in every settlement with dominant persons and local stakeholders, except the major, however in Fertőd it was unsuccessfully. At the end there was only one participant but by that situation the strength of local social cohesion was represented. In the other localities it was found special useful way for our research.

It was an important condition that only those persons were asked who had some connection with the locality.

3. RESULTS and DISCUSSION

The answers to the questions of this paper can be concluded in few points on base of the results of the study.

The local hero was found the main key factor of LED. He is not the only one but local hero is a dominant person. The number of local heroes depends of the number of inhabitants. Mórahalom, Rimóc, Bazsi and Szarvas were typical settlements where the strong leather determinates local development and his successful activity provides visible development for locality. The local attachment as property of the local person transforms to local paternalism described in wide aspect in Illés (Illés, S., 2014). The best practice was found in Szarvas where the support of local government from so called business Incubator House following project database up to the tax reduction for small enterprises give chance for new entrepreneurs good start up. This effective structure gave a prosperous view of the city with high level cultural life. The key to the future of development of local economy is in attitude and activity of local inhabitants (Czene, Zs., Ricz, J., 2010).

Second question is that standardization of rural areas can be used in Hungary? Marsden et al. and Flynn and Lowe set ideal types of rural areas up (in Dünckmann, F., 2009; Flynn, A., Lowe, P. 1994). The four types of countryside have typical features. The preserved countryside is scenic region near the urban metropolitan area, where LED focus on preservation supported by high income commuter households. The contested countryside is in an outer zone where effects of urbanism idea are on lower level. Against the local authorities, landowners, farmers the incomers advocate a cautious way of development of local economy. In the paternalistic countryside the locals are able to guide the LED partly from their estates. The fourth ideal type is the clientilistic countryside which depends on state subsidies. Rapkay, B. was the first, in his not published thesis, examined these ideal types in 2012. In our study we applied it for Hungary and we found some difference in, after Rapkay. In Hungary the preserved countryside has not generally the feature to be close to the metropolitan areas, because affluent commuters prefer the modern high quality lifestyle and living conditions. However some high educated middle class citizens have interests "to preserve the countryside, and also it is the result of their particular attitude towards the rural area" which results "conservation of the traditional image of villages" can be basis of rural tourism (Simonyi, P. et al 2013 p. 43.). Villages of this ideal type of countryside situate far from the metropolitan areas in Hungary in many cases. The contested countryside is the more frequent type in Hungary. Efforts for LED are made by locals but less than more effective ones usually. The heritage of the past (unemployment, lack of jobs, traditions) are coated by new ones as land ownership after land privatisation, political conflicts, end of subsidy finishing project program and some other reasons. This type of settlement is examined by the researchers of rural areas, sociologists and it is attended by media. The paternalistic countryside has strong background come from our history out. Land and its cultivation are in centre. Widely accepted that land owner should be the person who also cultivate it (Mellár, T. 2012). But today the basis of paternalism is really rather an attitude, a mental relationship to the locality. The high level of local patriotism and paternalism are the roots of fruitful LED. Some good example was found by the project. Unfortunately the clientilistic countryside or state-dependent countryside is other frequent

ideal type in Hungary. Mainly in the Northern Hungary and in the north-east region, furthermore in south Transdanubia it is common that small villages depends on the state support. These are the least favours localities having the most problems where locals lost vision of their future the life is only to survive the actual day.

It was an clear conclusion that features of different ideal types of countryside were characteristic for a settlement so "more typical" words may be a correct answer to classify a settlement into an ideal type of countryside.

Thirdly a question was put to answer on the indicators which best shows a prosperous countryside or settlement. According to the goal of local economic development the aim is to develop a flowering countryside where it is worth to live and there is a local and individual vision of future. The well-being depends on the daily income closely linked to the employment proved to be the most serious problem (Skerratt, S. 2013). For the local inhabitants in countryside beside the risk of downward social mobility the threat of unemployment status became the major economic problem (Csaba, L. 2011). The individual and the local income and the unemployment rate define the local economic level clearly as we can sum up. However the social community life can be much more underdeveloped level.

Finally mentioned a LED model is an output of the two years research. Previously a general model of LED and a specific model of LED have published in Geographical Review last year (Rapkay, B. et al. 2013).

This concept, put by Illés, Sándor on in 2014, discussed by study-group, is an attempt for holistic approach. In this paper two aspects are outlined in extreme short way.

One of the main questions is what should be in focus of a LED-model? We can think local paternalism or local economic development. By ones local paternalism should be in because it was found the most effective factor. By others local economic development need to be in focus because of the goal is to prosper countryside in Hungary.

The other main idea of the Illés-model is the different layers, spheres from "inner local world" to the "outer world" put around the centre.

I show here only a short analysis by some inner factors in concentrated sentences. The list of possible inner factors is in Table 1.

Table 1. Inner factors of the LED model

Type\Dimension	economy	social-nature base	Others
Local	local product	local heroes	local institutions
Resource	capital	human resources	vindication of interests
Product level	local market, shop	tradition, innovation	self-employment self-forethought
Policy	on economy	on environment	on society

Source: own compilation

These factors have different values by settlements. Local product have typically found in agriculture (e.g. Szarvas, Rimóc, Besence). Local heroes were discussed before. Local paternalism is representative in those settlements where there is a local hero however it is not inevitable. Local institutions have an important role, the least in Fertőd. Local market, shop are generally weak point of LED in these localities. Regulations in many cases are against them. Traditions, as all over the world, are general commercialized. Rimóc is the "last village" of palóc population. Innovation for the future, of local products also, is rare. Self-forethought, self-employment appears in different way in the settlements. On the one hand it is necessity because of being the only way for living there and on the other hand it is a conscious activity of local leaders. Capital is a factor that is a lack in every settlement. Vindication of interests is an important factor of development both inside and outside sphere. The EU-projects and successful applications for subsidies can be realized by. Szarvas was the best example of it. In the examined localities human resources have been found similarities ones. The graduated youth and the well qualified workers are lost for the settlement because their life is planned in large cities, in the capital or abroad. Number of the local intelligentsia is decreasing. This process has a negative effect on local economic development. Local policy on economy can improve local potential much better then it is seen today because there are many tools that could be used by the local government. The

best practice was found in Szarvas where the strong mayor supports local enterprises in a pilot-way. The local tax reduction, house for start-up entrepreneurs, administrative service for EU funds, competitions is a specific structure extremely useful for start-ups and small enterprises. Policies on environment and society are in close connection with the other policy. This way of LED is the only solution for local sustainability.

Results of the project can be concluded in some sentences. The key point of the LED has found the local hero who could be more persons if the number of inhabitants of settlement is higher. The ideal types of rural areas in Hungary differ from the literature, the settlements less depend on the distance from metropolitan areas and one locality has more features of an ideal type. The local income, included the income of local inhabitant, and the unemployment rate seems to be the best indicators of well-being in countryside, however it not represents the local social state. A LED model could be a good help to analyze the different localities. All of these thesis demands further discussions.

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1. Rasul ALIZADEH, 2. Alireza DARVISH BAHAMBARI,
3. Komeil RAHMDEL

MIXED CONVECTION OF NEWTONIAN FLUID BETWEEN VERTICAL PARALLEL PLATES CHANNEL WITH MHD EFFECT AND VARIATION IN BRINKMAN NUMBER

1. Department of Mechanical Engineering, Quchan Branch Islamic Azad University, Quchan, IRAN
2,3. Department of Mechanical Engineering, Engineering Faculty, The University of Guilan, Rasht, IRAN

Abstract: The present work is devoted to study the laminar flow of thermally and hydrodynamically developing MHD mixed convection of Newtonian fluids between two vertical parallel plates channel and also, the influence of different governing parameter on wide range of flow characters was investigated. The boundaries are considered to be isothermal with equal temperatures. The governing equations are solved numerically. The graphical results are provided for dimensionless velocity, temperature, mean temperature, centre line pressure gradient and local Nusselt number.
Keywords: MHD, Mixed convection, Newtonian fluid, Parallel-plates channel

1. INTRODUCTION

Studies of MHD combined forced and free convection heat transfer (mixed convection flow) problem involving Newtonian fluids from vertical channel with constant temperature or constant heat flux boundary condition has attracted considerable attention recently. This interest is due to many important engineering applications which are relevant to this problem. One might come across a flow as such in many industrial applications, such as those in heat exchangers, chemical processing equipment, geothermal reservoirs, cooling the nuclear reactors. As expressed previously, the flow of fluid through channel has been investigated in many engineering applications. One of the earliest analyses on this subject can be found in Tao [1]. Salah El-Din [2] have studied the effect of thermal and mass buoyancy forces on the development of laminar mixed convection between two vertical parallel plates in the case of wall heat and mass fluxes. Rajagopal [3] have done an analytical investigation on free convection for non-Newtonian fluids in a parallel plates channel with different wall temperature. Zibakhsh and Domairry [4] have solved laminar viscous flow in a semi-porous channel by using of homotopy analysis method

(HAM). Barletta [5] have studied fully developed mixed convection flow in a parallel plates vertical channel by taking into account the effect of viscous dissipation. In this study the two boundaries are considered as isothermal and kept at equal or at different temperature. Barletta [6] analyzed mixed convection with viscous dissipation in a parallel plate vertical channel with uniform and equal wall temperatures. Barletta [7] have presented an analytical analysis of fully developed mixed convection in vertical channel include power-law fluid reference to unequal and uniform wall temperature boundary condition. Shoheil Mahmud et al [8] focused on analyze the first and second law of thermodynamics characteristics of fully developed mixed convection flow in a channel in the presence of heat generation/absorption and transverse hydromagnetic effect with isothermal boundary condition. Krishnan et al [9] experimentally and numerically studied the problem of steady laminar natural convection and surface radiation between three parallel vertical plates, viz., the central heated black plate and two unheated polished side plates, insulated from behind. Lorenzini and Biserni [10] carried out a numerical study based on finite difference method in which a power-law fluid with parabolic inlet

velocity profile and constant temperature is considered inside a vertical duct with linearly varying temperature along the channel axis direction. That the flow is fully developed or other simplicity assumptions like constant pressure gradient and so on are taken into account is mentioned in most of the above reviews. It is evident that one can use such assumption, in ideal case. To exemplify this, it is noteworthy that the fully developed flow can only be established if the channel is very long.

Generally, to date, according to the author's knowledge, there is a lake of information in the literature regarding the flow and heat transfer of thermally and hydrodynamically developing MHD mixed convection of Newtonian fluids through two parallel-plates vertical channel. Therefore, the present work is devoted to study the laminar flow of thermally and hydrodynamically developing MHD mixed convection of Newtonian fluids between two vertical parallel plates channel and also, the influence of different governing parameter on wide range of flow characters was investigated. The graphical results are provided for dimensionless velocity, dimensionless temperature, dimensionless mean temperature, center line pressure gradient and local Nusselt number.

2. PROBLEM FORMULATION

The MHD vertical and parallel plates channel, as depicted in Figure (1), consist of two parallel, vertical and electrically insulated plates with an infinite width, a finite distance between them, W, and a finite height, L, maintained at constant and equal temperatures.
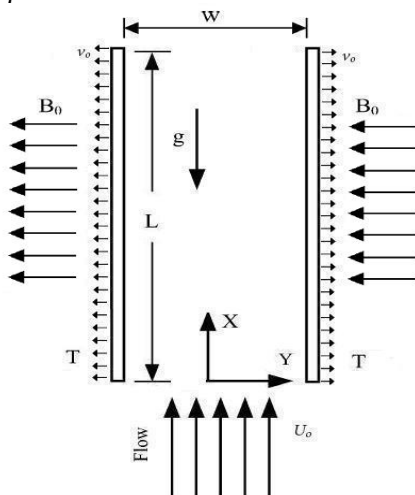
Figure 1. Geometry and boundary condition

Within this channel flows a laminar, viscous-incompressible, hydrodynamically and thermally developing and electrically conducting Newtonian fluid, which is submitted to a perpendicular, uniform and constant magnetic field.

The medium is assumed to have constant properties, outside of density, for which Boussinesq approximation is assumed to hold good. Beside this, in the energy equation, term representing viscous dissipation is neglected as it is very small and also our aim is study the pure effect of magnetic field on the flow.

Under the hypothesis above, the governing equations in dimensionless form are:

$$\frac{\partial U}{\partial X} + \frac{\partial V}{\partial Y} = 0 \tag{1}$$

$$\frac{\partial U}{\partial \Gamma} + \frac{\partial U^2}{\partial X} + \frac{\partial VU}{\partial Y} = -\frac{\partial P}{\partial X} + \frac{1}{Re}\left(\frac{\partial}{\partial X}\left(-\mu\frac{\partial U}{\partial X}\right) + \frac{\partial}{\partial Y}\left(-\mu\frac{\partial U}{\partial Y}\right)\right) + \frac{Gr}{Re^2}\theta - \frac{Ha^2}{Re}U \tag{2}$$

$$\frac{\partial V}{\partial \Gamma} + \frac{\partial UV}{\partial X} + \frac{\partial V^2}{\partial Y} = -\frac{\partial P}{\partial Y} + \frac{1}{Re}\left(\frac{\partial}{\partial X}\left(-\mu\frac{\partial V}{\partial X}\right) + \frac{\partial}{\partial Y}\left(-\mu\frac{\partial V}{\partial Y}\right)\right) \tag{3}$$

$$\frac{\partial \theta}{\partial \Gamma} + \frac{\partial U\theta}{\partial X} + \frac{\partial V\theta}{\partial Y} = \frac{1}{Pr\,Re}\left(\frac{\partial^2\theta}{\partial X^2} + \frac{\partial^2\theta}{\partial Y^2}\right) + \frac{BrHa^2}{Pr\,Re}U^2 \tag{4}$$

Subjected to boundary conditions:

$$X=0, -.5<Y<.5 \Rightarrow \begin{cases} U=1, V=0 \\ \theta=0 \end{cases} \quad Y=\pm.5, X\geq 0 \Rightarrow \begin{cases} U=0 \\ V=0 \\ \theta=1 \end{cases} \tag{5}$$

In the above formulation, the following dimensionless groups were imployed:

$$U = \frac{u}{U_{in}}, V = \frac{v}{U_{in}}, T = \frac{tU_{in}}{D_h}, D_h = 2W$$

$$P = \frac{p}{\rho_0 U_{in}^2}, X = \frac{x}{D_h}, Y = \frac{y}{D_h}$$

$$\theta = \frac{T-T_0}{T_w-T_0}, Br = \frac{\mu_r u_{in}^2}{K(T_w-T_0)}, Ha^2 = \frac{\sigma B_0^2 D_h^2}{\mu_r} \tag{6}$$

$$Re = \frac{\rho U_{in} D_h}{\mu_r}, Pr = \frac{\mu_r C_p}{K}, Gr = \frac{g\beta_T(T_w-T_0)}{U_{in}^2}$$

A local Nusselt number can be defined at each boundary, namely:

$$Nu_D = \left.\frac{d\theta}{dY}\right|_{Y=W/2} \tag{7}$$

This local Nusselt number is based on, $\theta_w - \theta_0$, on the other hand, the customary definition of the local Nusselt number is based on balk temperature as the reference fluid temperature, namely:

$$Nu_T = Nu_D \times \frac{T_w-T_0}{T_w-T_m} = \frac{Nu_D}{1-\theta_b} \tag{8}$$

Where θ_b is the dimensionless bulk temperature, which is given by:

$$\theta_b = \frac{\int_{-.5}^{.5} U\theta\,dY}{\int_{-.5}^{.5} U\,dY} \qquad (9)$$

The mean Nusselt number can be defined by:

$$Nu_m = \frac{1}{L}\int_0^L Nu_D\,dX \qquad (10)$$

3. PROBLEM SOLUTION

The governing equations are solved by using a finite volume method. The SIMPLE algorithm of Patankar [11] is employed for velocity and pressure coupling. As can be seen, the hydrodynamic flow field which is governed by Eq. (2) is strongly coupled to the thermal flow field, the energy equation, Eq. (4), through the buoyancy term in vertical momentum equation, Eq. (2). So the calculation of energy equation needs to be done sequentially. To solve the system of equations tridiagonal matrix solver is used along width of channel and subsequently the calculation is moved gradually ahead inside the duct.

To fix the grid size with a view to obtain grid independent solutions, a grid independence study was carried out for channel, by comparing velocity, temperature and pressure gradient for different grid sizes. There fore, the calculations with 100×40 will be considered sufficiently accurate in the present work.

4. RESULT AND DISCUSSION

The effect of MHD field on mixed convection of Newtonian fluid flow inside a parallel plates channel is presented in Figs. (1-10). The effect of Hartman number is examined and investigated in different value of Brinkman number. Because of similarity between results only some of them are graphically reported.
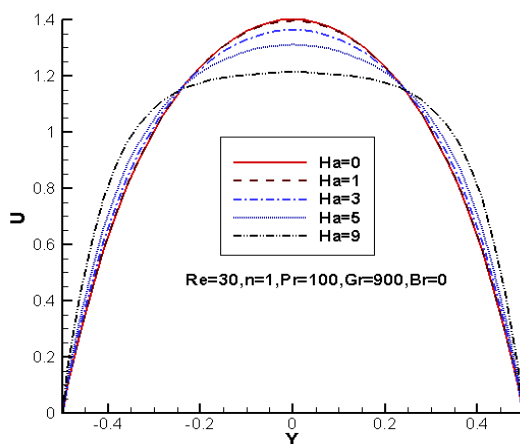
*Figure 1. Transient velocity profiles
for the different values of Hartman number*
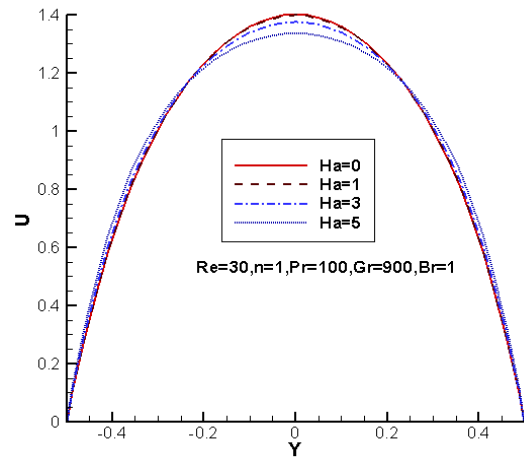
*Figure 2. Transient velocity profiles
for the different values of Hartman number*

The results show increase in the value of Ha number have tendency to slow the movement of the fluid in the centerline of channel and as a result of this, velocity increases near the walls associated with constant flow rate of each section of channel Figs. (1,2).
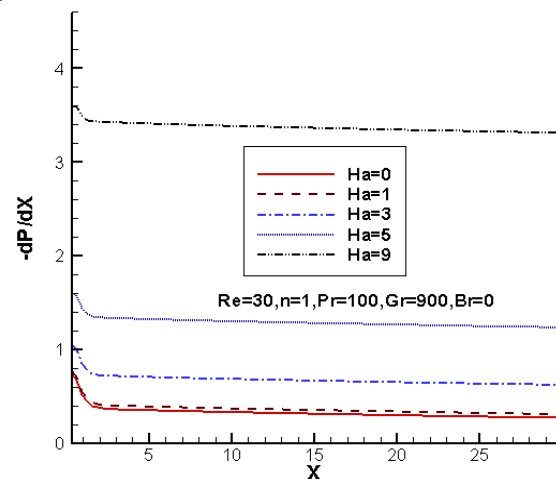
*Figure 3. Transient pressure profiles
for the different values of Hartman number*
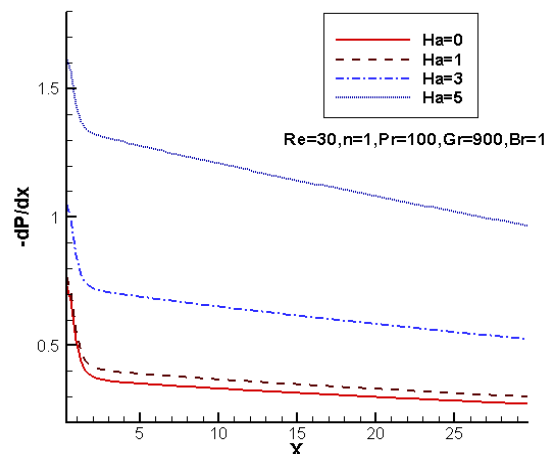
*Figure 4. Transient pressure profiles
for the different values of Hartman number*

Figs. (3,4) illustrates the variation of the pressure gradient with distance at different value of Ha number. It is observed that, while the overall value of pressure gradient increases steadily with Ha, depends on the value of Br number, it is going toward a constant value, that's mean is the flow is fully developed, in this case, or the pressure gradient is a decreasing function of X.

As said before, increases in the value of Ha have a tendency to slow the movement of the fluid in the centerline of channel. This is because of the application of magnetic field that creates a resistive force similar to the drag force that acts in the opposite direction of the fluid motion, thus casing the maximum velocity of fluid to increase.

equation (4), this is because of dependency of dissipation term, due to magnetic field to Br number.
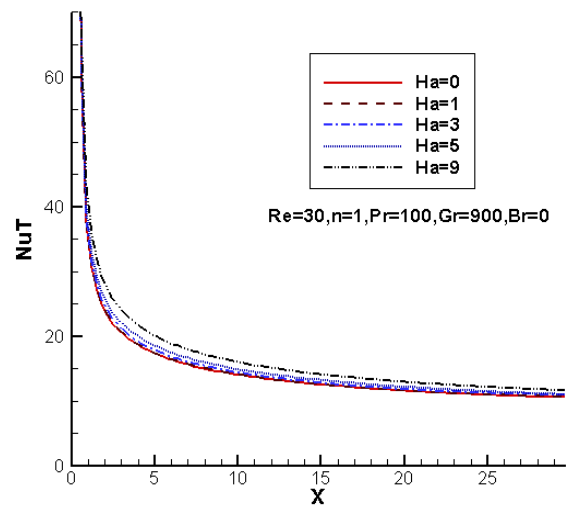
Figure 7. The effect of Hartman number on the local Nusselt number

Figure 5. Transient temperature profiles for the different values of Hartman number
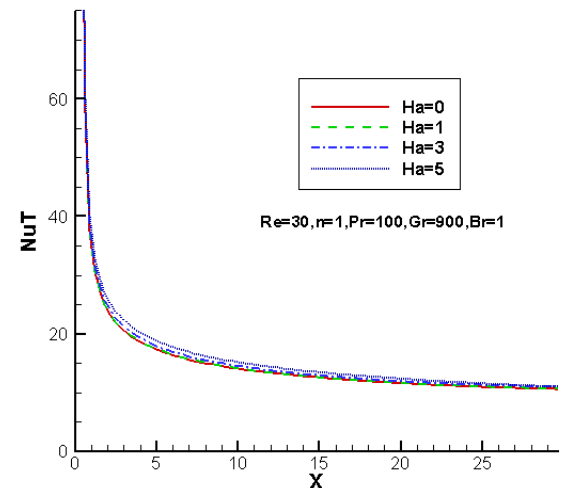
Figure 8. The effect of Hartman number on the local Nusselt number

Figure 6. Transient temperature profiles for the different values of Hartman number

Thermal behavior of flow is shown in Figs. (5-10). Overall, the effect of Ha number on thermal behavior of flow can't be explained without association with Br number. As can be seen in
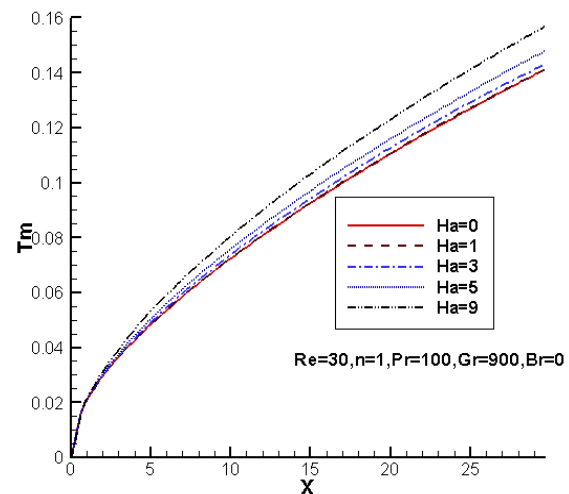
Figure 9. The effect of Hartman number on the mean temperature
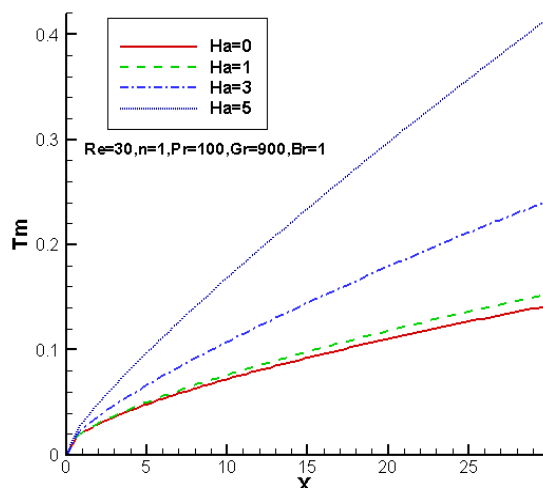
Figure 10. The effect of Hartman number on the mean temperature

Upon to what said above, at low value of Br number, magnetic field doesn't have direct and important effect on thermal behavior of flow. Then, as can be seen, there is no significant change in dimensionless temperature profile, beside this, because of changes in velocity, mean temperature and local Nusselt number slightly increase by increase in Hartman number. When Brinkman number increases, magnetic field exerts a significant influence on the flow and there for as Ha number increases, the magnitude of dimensionless temperature and mean temperature increase contrary to our expectation. While, local Nusselt number except a slight rise, doesn't show any especial changes in it's trend.

5. CONCLUSION

The MHD flow with heat transfer in the laminar, thermally and hydrodynamically developing mixed convection flow of Newtonian fluid in a plane vertical channel has been investigated numerically. The boundaries are assumed to be isothermal, with equal temperatures. The governing equations have been written in dimensionless form which is appropriate for this case of boundary condition. The dimensionless velocity, the dimensionless temperature, the dimensionless pressure gradient, the local Nusselt number have been evaluated and graphically presented.

Nomenclature

Br	Brinkman number
C_p	specific heat at constant pressure $[J.Kg^{-1}.K^{-1}]$
D	hydraulic diameter
Gr	Grashof number
g	gravitational acceleration $[m.s^{-2}]$
Ha	Hartman number
k	Thermal conductivity $[W.m^{-1}.K^{-1}]$
L	Channel height $[m]$
Nu_D	Nusselt number
Nu_T	Nusselt number
P	Dimensionless pressure
p	Pressure $[Pa]$
Pr	Prandtl number
Re	Reynolds number
T	Temperature $[K]$
t	time $[s]$
U	Dimensionless axial velocity
u	Axial velocity
V	Dimensionless transverse velocity
v	Transverse velocity
W	Channel width
X	Dimensionless axial coordinate
x	Axial coordinate $[m]$
Y	Dimensionless transverse coordinate
y	Transverse coordinate $[m]$

Greak symbols

α	Thermal diffusivity $[m^2.s^{-1}]$
β	Volumetric coefficient of thermal expansion
μ	Dynamic viscosity $[Pa.s]$
θ	Dimensionless temperature
ρ	Density $[Lg.m^{-3}]$

Subscripts

in	Inlet
m	Mean value
o	Value at the entrance or reference value
w	Value at walls

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1. Alexandra GOGA BODNÁROVÁ, 2. Zuzana FARKAŠOVSKÁ,
3. Ervin LUMNITZER

EFFECT OF NOISE ON DETERMINATION OF INDEX SOUND INSULATION OF THE SEPARATING ELEMENTS IN ENGINEERING MANUFACTURE

1-3. Technical University of Košice, Park Komenského 5, 042 00 Košice, SLOVAKIA

Abstract: The aim of this paper is to give a general description and analysis of the method for measuring airborne sound insulation separating structures according to STN EN ISO 140-4, STN EN ISO 140-14 and STN EN ISO 717-1 and develop guidance on the evaluation of airborne sound insulation of these structures in the software program NorBuild 1028 and examine if the choice of excitation signal has an effect on the measurement results. This paper describes an accurate measurement procedure, including a description of the used measurement technique that was used in measuring the sound insulation of the selected partition walls at different excitation sound field.

Keywords: airborne sound insulation, NordBuild software

1. BACKGROUND

Engineering and construction practices currently convinces us that we can´t satisfactorily eliminate all negative environmental factors. One of these factors is noise, and therefore solution of noise reduction issue is nowadays an essential requirement to ensure acoustic comfort home and work environment. This requirement is also reflected in the engineering, construction and in other kind of industries, where are applied all kinds of partition elements and structures. In the design and determination of partition elements and structures in engineering and other operations are currently using a computer and special software programs. Using such software is the entire measurement and evaluation process much easier and allows you to create designs on the high standard of quality.

2. SOUND PROPAGATION IN THE BUILDING STRUCTURE AND ELEMENTS

The sound from the source, which is located in volume room spreads through sound waves and falls on the building structure and it also radiates into space the receiving room. The thickness of the building structure is smaller than the wavelength of the incident sound wave in a wide range of frequencies. This leads to wave propagation in separating elements and also to partial re-transmitting to volume room but especially to the receiving room (depending on the sound insulation of walls). [1]

3. AIR- BORNE SOUND INSULATION

Airborne sound insulation of building structures is the ability of separating construction transmit sound power airborne from the source to the protected room but much weaker. (Figure 1) [1]
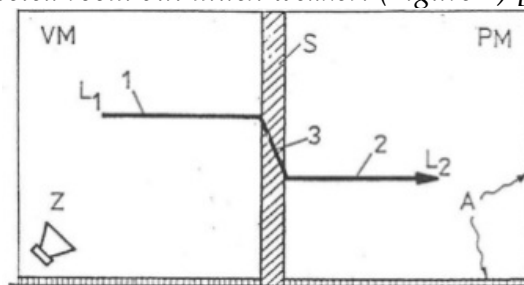
Figure 1. The principle of definition airborne sound insulation of the building construction
Figure description: L_1 – medium level of the sound pressure in volume room [dB], L_2 – medium level of the sound pressure in receiving room [dB], 3 - decrease in the level of the sound pressure influence of sound insulation of the building structure.

The main criterion for sound insulation evaluation of separating structures is the degree of the laboratory airborne sound insulation R [dB] and of the building airborne sound insulation R [dB] and laboratory index of the sound insulation Rw [dB] and building index of the sound insulation R'w [dB]. We compare the measured value of the building index sound insulation with the minimum requirements set out in the standard STN 73 0532. [1]

3.1. Laboratory level of the airborne sound insulation

Sound energy which is falling to the separating structure is transmitted to the receiving room just with its area. We talk about laboratory airborne sound insulation. In this case it doesn´t occur to the sound propagation by ancillary ways.

The levels of the sound pressure are preferentially measured in the third octave band in the receiving and volume room.
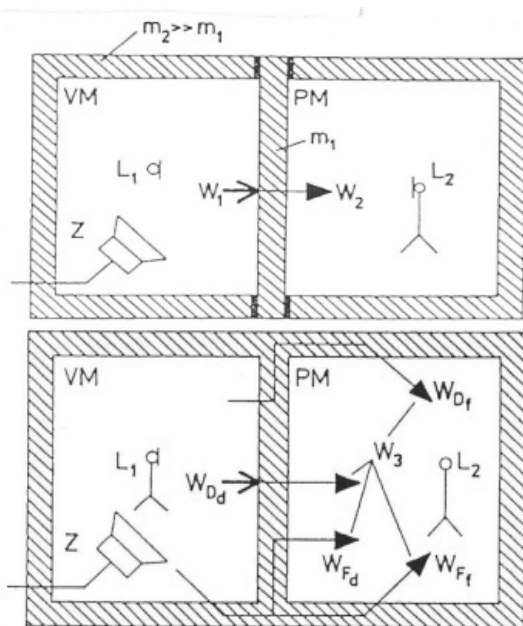
Figure 2. The principal of sound propagation the building structure with suppression of sideways (left), the principal of sound propagation the structure with designation of sideways (STN EN ISO 140-4) (right)
Figure description: W_{Dd} – sound power which enter to the wall and from the wall is again directly radiated [W]. W_{Df}- sound power which enter to the wall and is radiated with sides stuctures [W]. W_{Fd}- sound power which entersnto sides structures but is radiated directly from the wall [W]. W_{Ff}- sound power which enters to sides structures but is also radiated from sides structures [W]. W_{Otv}- sound power which is transferred

(by air) without a gap [W]. **Error! Reference source not found.**

3.2. Level of the building sound insulation

If we know spectral course of airborne sound insulation which is measured directly in building, we talk about building sound insulation R´ [dB)]. In this case the airborne sound insulation R´ has negative affect to sound propagation with sides ways or holes, leaks, joints, cracks, leap etc. The sides ways are usually defined by the radiated sound power in the individual ways of propagation according to Figure 4.

4. METHODOLOGY FOR MEASURING BUILDING SOUND INSULATION INDEX FOR CONSTRUCTION R'W AND INSTANCE OF SEEMINGLY SOUND INSULATION R' ACCORDING TO EN ISO 140-4

Sound insulation in buildings is measured in one-third - octave bands has first been agreed measurement in octaves. In the volume room must be built steady sound with a continuous spectrum in this frequency range. Most used is a broadband signal that can be adapted to the reception room to ensure the same high frequencies the signal - noise. As a source of noise we use omnidirectional speaker, which provides us with a uniform omnidirectional radiation according to the specifications. It can also be used more sound sources, but must be the same type and uncorrelated signal transmitted at the same level. When using a single sound source, this source is placed in at least two positions. If you have a different room volumes as a broadcasting room is used more of them. [2]

To evaluate the apparent sound insulation can be used the results obtained in one direction or in both directions. Speaker position must either be in the same room or the measurement must be repeated. In the opposite direction during the process of volume and receiving rooms with one or more positions of power in two rooms of buildings. Speakers are placed so as to achieve the highest sound field diffusion. Distance from the side and bulkheads must be such that doesn´t predominate directivity of such elements. [2]

4.1. The positions of microphone placement and position of the source (according to STN EN ISO 140-4)

In determining the direct sound pressure levels may be used one microphone (moved from one place to another place) or an assembly of stationary microphones, microphones moving on circular track or continuously moving microphone. If we have different positions of the microphone location and must determine the average energy. [2]

4.2. The real source location

Location source was placed at two designated sites in the volume room.

- 1.0 m distance from the side walls of the room,
- 9.5 m distance from the measured building structure,
- 4.0 m distance between resources,
- 1.7 m distance from the first microphone position.

4.3. The real location of microphones

When measuring the sound insulation according to STN EN ISO 140-14 shall designate ten measurement points in volume room and ten measurement points in the receiving room. The first measuring point shall be located closer than one meter from the source. Other data points you select in the volume and receiving room freely, and we must ensure that they are distributed evenly. The following schematic drawing (Figure 3) shows us the location of the measurement points according to STN EN ISO 140-14.
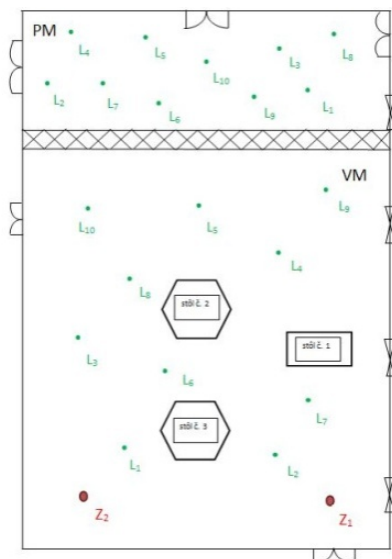
Figure 3. Positions of the microphones location in the receiving and volume room

A reverberation measurement with source location in two positions in receiving room. Location of microphone was in three positions and totally it was six positions. We used impulse method for reverberation measurement (balloon).

5. INSTRUMENT EQUIPMENT

5.1. Sound level meter NORSONIC Nor 140
(Figure 4 –a) it is the impulse integrating sound level meter of the immediate maximum and minimum equivalent sound level A and C, sound exposure and upper level. Accuracy class of the sound level meter is 1. The dynamic range is 120 dB. Instrument je equipped with a parallel measurement with filters A and C or Z. In the instrument is implemented function for measurement building acoustic magnitude.

5.2. Noise generator Nor 280 (Figure 4 – b) it is
the equipment which generate white or pink noise. These kinds of the noise bindes to piezoelectric and magneto-dynamic changers.

5.3. Omnidirectional sound source
NORSONIC 270 (Figure 4 – c) is the equipment which radiates acoustic energy evenly to the all directions. The equipment has a spherical shape from 12 loudspeakers and they are connected serial-parallel.

Figure 4 a) Sound level meter NORSONIC Nor 140. b) Noise generator Nor 280, c) Omnidirectional sound source NORSONIC 270

6. DETERMINATION OF THE SOUND INSOLUTION INDEX R'W AND INSTANCE A SEEMINGLY SOUND INSULATION R 'SELECTED WALLS IN DIFFERENT SOUND FIELD EXCITATION

6.1. Excitation of the sound field in volume room using pink noise with excitation interval 75-78 [db]

Measured building structure is situated in the area of Technical University in Košice in Environment Department. The partition is situated on the first floor among two rooms number 19 and 20. Thickness of the partition is 16 cm and is made from brick blocks and without holes.

a. Configuration of the experiment

The measurement was carried in the rooms No. 19 and 20 with sound level meter Nor 140

(manufacturer NORWAY, serial number 1403867, microphone NORSONIC, Nor1225 type, serial number 112818, accuracy class 1) at Department of the Environment. The measuring device has been verified in accordance with applicable regulations metrology.

As a first step was to calculate and mark the measuring points in the volume room (room no. 19) and also in the receiving room (room no. 20).

Before the measuring it was necessary to draw and contrain receiving and volume room. To determine the dimensions of the room was used plastic tape measure (manufacturer STRATEG and type 2 meters finder DISTO D5, serial number 390951175). It was also necessary made a volume calculation of volume and receiving room and calculation of common area measured building partition which is situated between rooms No. 19 and No. 20.

To create white noise and pink noise generator was used Nor 280 (manufacturer NORSONIC AS NORWAY, serial number 2803632), which was placed in volume room on the floor. When measuring the sound insulation of building partition is used omnidirectional sound source Nor 270 (NORSONIC manufacture, serial number 30756) which are moved from point Z_1 to point Z_2 and opposite. Hearing protection from adverse impact of pink and white noise was necessary to use a hearing protector manufacturer ČERVA type 1310.

b. Volume of both rooms

The volume of the receiving room: $V = 64.7\ m^3$

Volume of the volume room: $V = 220.2\ m^3$

c. Area used to calculation R,

The common area of partition structure: $S = 20.80\ m^2$

d. Measurement of sound pressure level of background noise L_b and the sound pressure level of background noise L_{b1} through L_{b10} in different locations receiving room as well as measuring the average reverberation time T and the receiving room reverberation T_1 to T_6 in different locations receiving room were performed only once.

e. The excitation characteristic

In the volume room we used for excitation pink noise. Equivalent sound pressure level LAeq values reached 75 to 78 [dB] and to the farthest and

closest measuring point from the source. The time course of noise excitation is shown in Figure 5 (left). From the picture it is clear that it is a continuous uniform sound. Frequency Response excited noise is shown in Figure 5 (right).
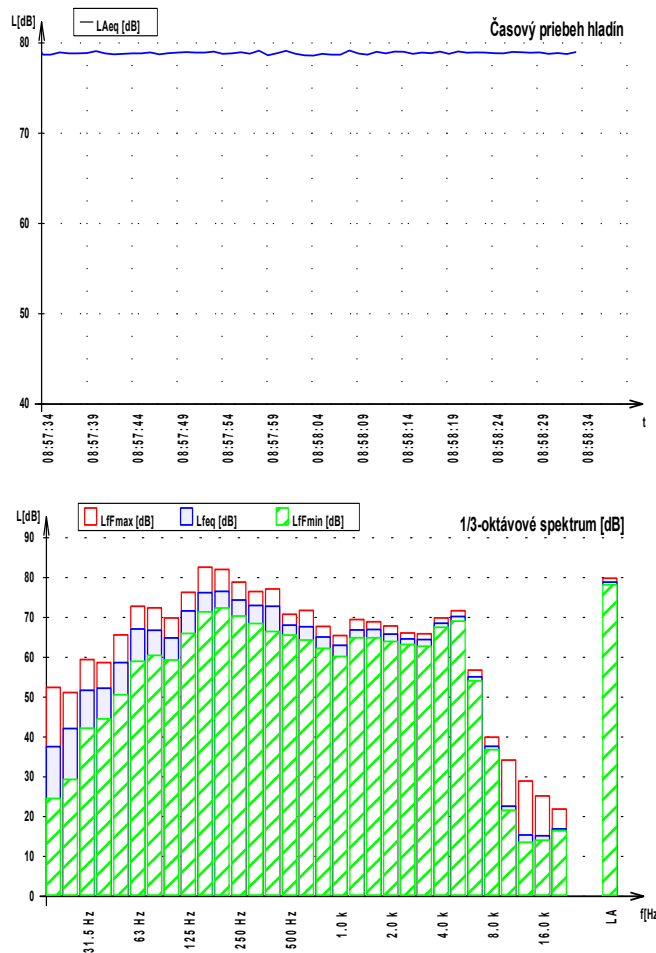
Figure 5. Time course of the levels of pink noise excitation interval 75-78 [dB] volume room (left), frequency response for pink noise excitation interval 75-78 [dB] volume room (right)

6.2. Sound field excitation in broadcast room with white noise excitation interval 75-78 [dB]

Description and identification of building structure, the test configuration, the volume of both rooms and space used to compute R is the same in terms of sound field excitation in volume room using pink noise excitation interval 75-78 [dB].

Measurement of sound pressure level of background noise L_b and the sound pressure level of background noise L_{b1} through L_{b10} in different locations receiving rooms as well as measuring the average reverberation time T and the receiving

room reverberation T_1 to T_6 in different locations receiving room were performed only once.

a. The excitation characteristic

In volume room, we used to excitation white noise. Equivalent sound pressure level LA_{eq} values reached 75-78 [dB] and to the farthest and closest measuring point from the source. The time course of the noise excitation is shown in Figure 6 (left). From the picture it is clear that it is a continuous uniform sound. Frequency characteristic of excited noise is shown in Figure 6 (right).
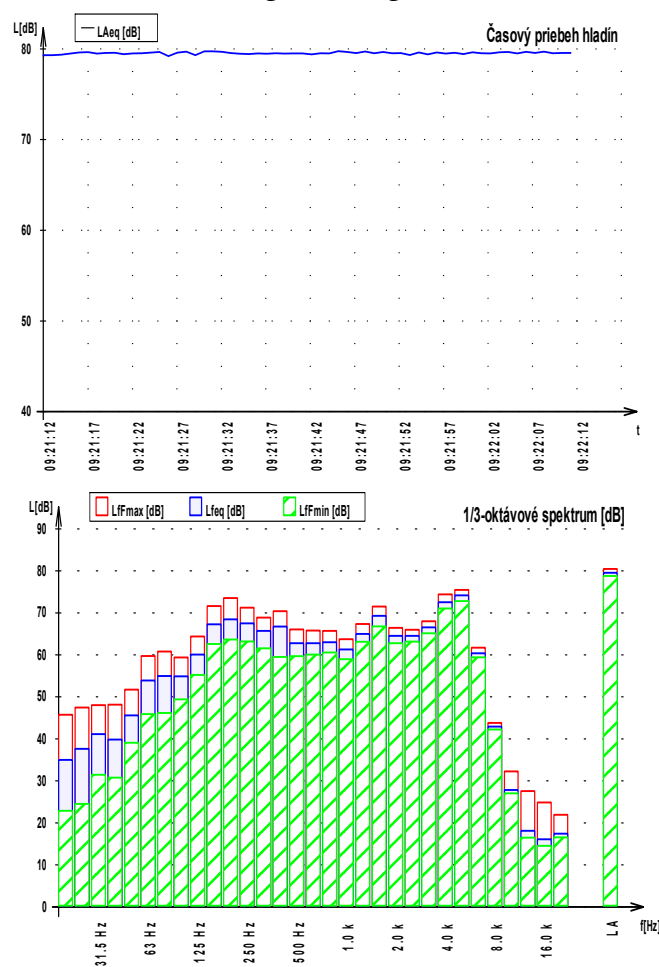
Figure 6. Time course of levels for white noise with excitation interval 75-78 [dB] of the volume room (left), frequency response for white noise with excitation interval 75-78 [dB] of the volume room (left)

7. MEASUREMENT RESULTS

Next tab. 1 shows measurement results. From these results of measurement is obviously the values in individual standards exhibit no important divergences. The values of building index sound insulation moves in level 38-39 dB in

two instances. In pursuance of finding results we can say that the choise of noise signal for generation sound field depends on an expert which realizes the measurement.

Table 1. Excitation interval of the pink and white noise and index of the building sound insulation for pink and white noise

Excitation interval pink noise [dB]	Excitation interval white noise [dB]	Index of the building sound insulation R´w pink noise [dB]	Index of the building sound insulation R´w white noise [dB]
75÷ 78	75÷ 78	38 (-1; -3)	39 (-1; -2)
80÷ 83	79÷ 83	39 (-2; -3)	39 (-1; -2)
85÷ 88	84÷ 89	38 (-1; -2)	39 (-1; -2)
90÷ 93	89÷ 94	39 (-1; -2)	39 (-1; -2)
95÷ 98	98÷ 94	38 (0; -2)	39 (-1; -2)
98÷ 102	98÷ 102	38 (-1; -2)	39 (-1; -2)
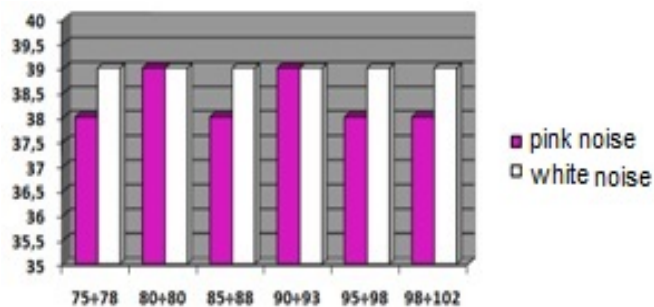
Figure 7. Graphic display of the results and their comparison

8. CONCLUSION

The objective of these measurements was to determine the effect of noise when measuring sound insulation of building walls as in the measurement process is currently using two standards. STN EN ISO 140-4 recommends the use of white noise, and the standard STN EN ISO 717-1 pink noise. Making measurements showed that the measurement standard can be used at the discretion of the expert, since significant differences were found in the results of measurements by different standards.

Acknowledgement

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[1.] Jimit R. PATEL, [2.] Gunamani DEHERI

PERFORMANCE OF A MAGNETIC FLUID BASED DOUBLE LAYERED ROUGH POROUS SLIDER BEARING CONSIDERING THE COMBINED POROUS STRUCTURES

[1,2.] Department of Mathematics, Sardar Patel University, V. V. Nagar, Anand, Gujarat, INDIA

Abstract: Efforts have been made to obtain the analytical solution for pressue, load and friction for a magnetic fluid based double layered rough porous slider bearing. The permeability of the upper layer is based on the model of Kozeny-Carman while Irmay's model governs the permeability of the lower layer. Regarding roughness, the method adopted by Christensen and Tonder finds the application here in statistical averaging of the associated Reynolds equation. The magnetic field is taken oblique to the stator. The results are illustrated by graphical representations which show that the introduction of combined porous structure of the double layered results in an enhanced performance. The friction remains considerably reduced. The magnetization tries to compensate the adverse effect of roughness for a large range of combined porous structures.
Keywords: Slider Bearing, Magnetic Fluid, Porous structure, Roughness

INTRODUCTION

The contribution of surface roughness and properties of lubricant film on the load carrying capacity and friction is an important aspect in the analysis of slider bearings. Porous sliders are important in fluid cushioned moving pads. Applications of porous bearings in mounting horsepower motors include vacuum cleaners, water pumps, record players, tape recorders and generators. Traditionally, the analyses of porous slider bearings have been based upon the Darcy's model, where Darcy's equations were applied to guide fluid motion through the porous medium (Murti (1974), Srinivasan (1977), Verma (1978), Kumar (1980), Lin (2001), Khan et al. (2011)). Cusano (1972) obtained an analytical solution for the performance characteristics of a two layered porous bearing using the short bearing approximation. Bujurke (1992) investigated the influence of couple stresses on the dynamic properties of a double layered porous slider bearing. Later on, Rao et al (2013) presented an analysis of a long journal bearing with a double layer porous lubricant film using couple stress and Newtonian fluids. In all the above studies a porous layered lubricant film configuration increased the load carrying capacity and reduced the coefficient of friction in the bearing.

In most of the studies conventional lubricants were used. Use of magnetic fluid as a lubricant modifying the performance of the bearings has been very well established. The application of magnetic fluid as a lubricant was investigated by many authors (Agrawal (1986), Bhat and Deheri (1995), Odenbach (2004), Nada and Osman (2007), Urreta et al. (2009), Huang et al. (2011)). In all these studies it has been established that the performance of bearing system could be improved by using a magnetic fluid as the lubricant.

Surface roughness evaluation is very important for many fundamental problems such as friction, load carrying capacity, contact deformation, heat and electric current conditions, tightness of contact joints and positional accuracy. For this reason surface has been the subject of experimental and theoretical investigations for many decades. In literature, many investigations such as (Tzeng and Saibel (1967), Christensen and Tonder (1969a, 1969b, 1970), Prajapati (1991), Gupta and Deheri (1996)) accounting for surface roughness effect, have been proposed in order to seek a more realistic representation of bearing surfaces. Gururajan and

Prakash (2002) examined the effect of surface roughness in hydrodynamic narrow porous journal bearings operating under steady conditions. Deheri et al. (2004) analyzed the performance of longitudinally rough slider bearings with squeeze film formed by a magnetic fluid. Deheri et al. (2005) discussed the performance of transversely rough slider bearings with squeeze film formed by a magnetic fluid. The behaviour of squeeze film between rough porous infinitely long parallel plates with porous matrix of variable film thickness was discussed by Patel et al. (2008). Patel et al (2010) dealt with the performance of a magnetic fluid based squeeze film between transversely rough triangular plates. Shimpi and Deheri (2011) analyzed the performance of a magnetic fluid based squeeze film between porous infinitely long rough rectangular plates. Patel and Deheri (2012) investigated the performance of a ferrofluid lubricated rough porous inclined slider bearing considering slip velocity. All the above investigations indicate that although magnetization introduces a positive effect on the performance, the bearing suffers owing to transverse surface roughness. It was noticed that the performance of the bearing system could be made to improve by suitably choosing the magnetization parameter in the case of negatively skewed roughness, which became sharper with the variance. Recently, Patel and Deheri (2013) launched an analysis for the comparison of various porous structures on the performance of a magnetic fluid based transversely rough short bearing. It was seen that the negatively skewed roughness induced an increase in load carrying capacity which could be canalized to compensate the adverse effect of porosity, at least in the case of Kozeny-Carman model and the effect of magnetization responding more in the case of Kozeny-Carman model as compared to Irmay's model.

The objective of this study is to investigate the performance of a magnetic fluid based double layered rough porous slider bearing considering the combined porous structures.

2. ANALYSIS

The geometry and configuration of the problem is shown in the Figure 1. All the assumptions of conventional lubrication theory are retained

(Srinivasan (1977)). The porous regions are assumed to be homogeneous and isotropic and the lubricant is an incompressible fluid. The pressure in porous regions satisfies the Laplace equation.
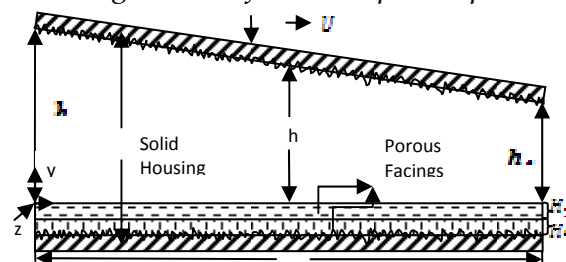
Figure 1: Configuration of the bearing system
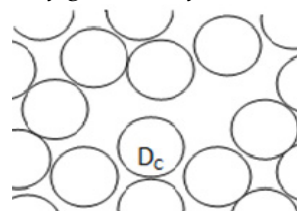
Figure 1A: Kozeny-Carman's model of porous sheets
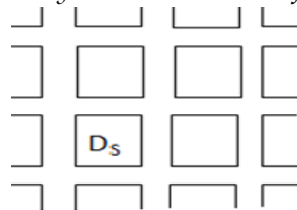
Figure 1B: Irmay's model of porous sheets.

A porous material is filled with globular particles (a mean particle size Dc), which is given in Figure 1A. The Kozeny-Carman equation is a well-known relation used in the field of fluid dynamics to calculate the pressure drop of a fluid flowing through a packed bed of solids. This formulation remains valid only for laminar flow. The Kozeny-Carman equation mimics some experimental trends and hence serves as a quality control tool for physical and digital experimental results. The Kozeny-Carman equation is very often presented as permeability versus porosity, pore size and turtuosity. Liu (2009) (Patel and Deheri (2013)), suggests that the Kozeny-Carman formulation turns in the relation

$$\phi_1 = \frac{D_c^2 e^3}{180(1-e)^2}$$

where e is the porosity.

In Figure 1B, the model consists of three sets of mutually orthogonal fissures (a mean solid size Ds) and assuming no loss of hydraulic gradient at the junctions, Irmay (1955) (Patel and Deheri (2014)) derived the permeability

$$\phi_2 = \frac{D_s^2 \left(1 - m^{\frac{1}{3}}\right)^3 \left(1 + m^{\frac{1}{3}}\right)}{12m}$$

where $m = (1 - e)$ and e is the porosity.

It is assumed that the bearing surfaces are transversely rough. According to the stochastic model of Christensen and Tonder (1969a, 1969b, 1970), the thickness $h(x)$ of the lubricant film is taken as

$$h(x) = \bar{h}(x) + h_s \qquad (1)$$

where $\bar{h}(x)$ is the mean film thickness and hs is the deviation from the mean film thickness characterizing the random roughness of the bearing surfaces. hs is governed by the probability density function

$$f(h_s) = \begin{cases} \frac{35}{32c_1}\left(1 - \frac{h_s^2}{c^2}\right)^3 & , -c_1 \le h_s \le c_1 \\ 0 & , \text{elsewhere} \end{cases}$$

wherein c is the maximum deviation from the mean film thickness. The mean a, the standard deviation σ and the parameter ε, which is the measure of symmetry of the random variable hs, are defined and discussed in Christensen and Tonder (1969a, 1969b, 1970). The details can be culled from these investigations.

Introduction of these assumptions lead to a modified Reynolds equation for the film region

$$\frac{\partial}{\partial x}\left[\left(\substack{h^3 + 12\phi_1 H_1 \\ +12\phi_2 H_2}\right)\frac{\partial}{\partial x}\left(p - \frac{\mu_0 \bar{\mu} M^2}{2}\right)\right]$$
$$+ \frac{\partial}{\partial z}\left[\left(\substack{h^3 + 12\phi_1 H_1 \\ +12\phi_2 H_2}\right)\frac{\partial}{\partial z}\left(p - \frac{\mu_0 \bar{\mu} M^2}{2}\right)\right]$$
$$= 6\mu U \frac{dh}{dx} + 12\mu V_h \qquad (2)$$

Neglecting the side leakage effect and since there is no normal velocity i.e. Vh=0, equation (1) reduces to

$$\frac{d}{dx}\left[\left(\substack{h^3 + 12\phi_1 H_1 + \\ 12\phi_2 H_2}\right)\frac{d}{dx}\left(p - \frac{\mu_0 \bar{\mu} M^2}{2}\right)\right]$$
$$= 6\mu U \frac{dh}{dx} \qquad (3)$$

The magnetic field is taken to be oblique to the stator as in Agrawal (1986). Prajapati (1995) investigated the effect of various forms of magnitude of the magnetic field. The magnitude of the magnetic field is taken as

$$M^2 = kx\left(1 - \frac{x}{L}\right)$$

where k is a suitably chosen constant from dimensionless point of view so as to produce a required magnetic field of strength over 10^{-23} (Bhat and Deheri (1995)).

Under the usual assumptions of hydro magnetic lubrication (Bhat (2003); Prajapati (1995); Deheri, et. al. (2005)) and stochastically averaging (2) by the method of Christensen and Tonder, the Reynolds equation governing the pressure distribution is obtained as

$$\frac{d}{dx}\left[\left(\substack{g(h) + 12\phi_1 H_1 \\ +12\phi_2 H_2}\right)\frac{d}{dx}\left(p - \frac{\mu_0 \mu M^2}{2}\right)\right]$$
$$= 6\mu U \frac{dh}{dx} \qquad (4)$$

where

$$g(h) = h^3 + 3h^2\alpha + 3(\sigma^2 + \alpha^2)h + 3\sigma^2\alpha + \alpha^3 + s$$

while μ_0 is the magnetic susceptibility, μ is the free space permeability, μ is the lubricant viscosity, φ_1 is permeability of inner layer, φ_1 is permeability of outer layer, H_1 is wall thickness of the inner layer, H_2 is wall thickness of the outer layer, U is tangential velocity of the slider.

The relevant boundary conditions are

$$P(0) = P(L) = 0 \qquad (5)$$

Introducing the non dimensional quantities

$$\bar{h} = \frac{h}{h_1} = \bar{h}_2 - (\bar{h}_2 - 1)X, P = \frac{h_1^2}{\mu U L}p, \bar{h}_2 = \frac{h_2}{h_1}$$
$$\mu^* = \frac{k\mu_0 \bar{\mu} h_1^2}{U\mu}, X = \frac{x}{L}, \bar{\sigma} = \frac{\sigma}{h_1}, \bar{\alpha} = \frac{\alpha}{h_1},$$
$$\bar{s} = \frac{s}{h_1^3}, \bar{\phi}_1 = \frac{D_c^3 H_1}{h_1^3}, \bar{\phi}_2 = \frac{D_s^2 H_2}{h_1^3}$$
$$\psi = \left[\frac{e^3}{180(1-e)^2}\bar{\phi}_1 + \frac{\left(1 - m^{\frac{1}{3}}\right)^3 \left(1 + m^{\frac{1}{3}}\right)}{12m}\bar{\phi}_2\right]$$

and solving equation (4) using boundary conditions (2) the dimensionless form of the pressure distribution is obtained as

$$P = \frac{\mu^*}{2}X(1 - X) + \frac{6}{(1 - \bar{h}_2)}$$
$$\left[\substack{D \ln(\bar{h} - J_1) + E \ln(\bar{h}^2 - J_2\bar{h} + J_3) \\ +F \tan^{-1}\left(\frac{2\bar{h} - J_2}{\sqrt{4J_3 - J_2^2}}\right) + c_2(1 - \bar{h}_2)}\right] \qquad (6)$$

where

$$D = A + c_1' A_1, \quad E = \frac{1}{2}\left(B + c_1' B_1\right),$$

$$F = \frac{2(C + c_1' C_1) + (B + c_1' B_1)J_2}{\sqrt{4J_3 - J_2^2}}$$

$$L_1 = \ln(\bar{h}_2 - J_1), \quad L_2 = \ln(1 - J_1),$$

$$L_3 = \ln\left(\bar{h}_2^{\,2} - J_2 \bar{h}_2 + J_3\right),$$

$$L_4 = \ln(1 - J_2 + J_3),$$

$$T_1 = \frac{1}{\sqrt{4J_3 - J_2^2}} \tan^{-1}\left(\frac{2\bar{h}_2 - J_2}{\sqrt{4J_3 - J_2^2}}\right),$$

$$T_2 = \frac{1}{\sqrt{4J_3 - J_2^2}} \tan^{-1}\left(\frac{2 - J_2}{\sqrt{4J_3 - J_2^2}}\right),$$

$$c_1' = -\frac{\left(\begin{array}{c} A(L_1 - L_2) + (B/2)(L_3 - L_4) \\ +(2C + BJ_2)(T_1 - T_2) \end{array}\right)}{\left(\begin{array}{c} A_1(L_1 - L_2) + (B_1/2)(L_3 - L_4) \\ +(2C_1 + B_1 J_2)(T_1 - T_2) \end{array}\right)},$$

$$A = \frac{J_1}{J_1^2 - J_1 J_2 + J_3},$$

$$c_2' = \frac{1}{(1 - \bar{h}_2)}\left| \begin{array}{c} DL_1 + EL_3 \\ + \left\{ \begin{array}{c} 2(C + c_1' C_1) \\ +(B + c_1' B_1)J_2 \end{array} \right\} T_1 \end{array} \right|,$$

$$B = -A, \quad C = \frac{J_3}{J_1^2 - J_1 J_2 + J_3},$$

$$a = 3\bar{a}, \quad b = 3(\bar{a}^2 + \bar{\sigma}^2),$$

$$c = \bar{a}^3 + 3\bar{\sigma}^2 \bar{a} + \bar{s} + 12\psi,$$

$$J = \sqrt[3]{-2a^3 + 3\sqrt{3}J' + 9ab - 27c},$$

$$J' = \sqrt{4a^3 c - a^2 b^2 - 18abc + 4b^3 + 27c^2},$$

$$J_1 = \frac{J}{3\sqrt[3]{2}} - \frac{\sqrt[3]{2}(3b - a^2)}{3J} - \frac{a}{3},$$

$$J_2 = -2\frac{J}{6\sqrt[3]{2}} + 2\frac{(3b - a^2)}{32^{2/3}J} - \frac{2a}{3},$$

$$A_1 = \frac{1}{J_1^2 - J_1 J_2 + J_3}, \quad B_1 = -A_1,$$

$$C_1 = \frac{J_2 - J_1}{J_1^2 - J_1 J_2 + J_3}$$

and

$$J_3 = \left[\begin{array}{c} 4\left(\dfrac{J}{6\sqrt[3]{2}}\right)^2 + 4\left(\dfrac{J}{6\sqrt[3]{2}}\right)\left(\dfrac{(3b - a^2)}{32^{2/3}J}\right) \\ +4\left(\dfrac{(3b - a^2)}{32^{2/3}J}\right)^2 + 2\left(\dfrac{J}{6\sqrt[3]{2}}\right)\dfrac{a}{3} - \\ 2\left(\dfrac{(3b - a^2)}{32^{2/3}J}\right)\dfrac{a}{3} + \dfrac{a^2}{9} \end{array} \right]$$

The expression for non dimensional load carrying capacity of the bearing system then turns out to be

$$W = \frac{h_1^2 w}{\mu U B L^2} = \frac{\mu^*}{12}$$

$$+\frac{6}{(1 - \bar{h}_2)^2}\left[\begin{array}{c} DI_1 + EI_2 + F' I_3 \\ +c_2'(1 - \bar{h}_2)^2 \end{array} \right] \tag{7}$$

where

$$I_1 = (1 - J_1)(L_2 - 1) - (\bar{h}_2 - J_1)(L_1 - 1)$$

$$I_2 = -2(1 - \bar{h}_2) + (4J_3 - J_2^2)(T_2 - T_1)$$

$$+\left(\frac{2 - J_2}{2}\right)L_4 - \left(\frac{2\bar{h}_2 - J_2}{2}\right)L_3$$

and

$$I_3 = \sqrt{4J_3 - J_2^2}\left\{ \begin{array}{c} \left(\dfrac{2 - J_2}{2}\right)T_2 - \left(\dfrac{2\bar{h}_2 - J_2}{2}\right)T_1 \\ +\dfrac{1}{4}(L_3 - L_4) \end{array} \right\}$$

Therefore, the dimensionless frictional drag exerted by the moving slider takes the form

$$F = \frac{f h_1}{\mu U B L} = \int_0^1 \left(\frac{\bar{h}}{2}\frac{\partial P}{\partial X} + \frac{1}{\bar{h}}\right) dX$$

$$= \frac{1}{(\bar{h}_2 - 1)}\left\{ \begin{array}{c} \dfrac{(\bar{h}_2 - 1)^2}{2}W \\ + \ln(\bar{h}_2) \end{array} \right\} \tag{8}$$

3. RESULTS AND DISCUSSION

One can easily see that equation (6) determines the non dimensional pressure distribution while the dimensionless load carrying capacity is obtained from equation (7). It is clearly observed that the increase in pressure is

$$\frac{\mu^*}{2}X(1 - X)$$

while the load carrying capacity gets enhanced by

$$\frac{\mu^*}{12}$$

as compared to the case of conventional lubricants. In comparison with the conventional porous slider bearing, the load carrying capacity increases significantly with the double layered porous, magnetic fluid based slider bearing. Further, as can be seen, the effect of double layer is to decrease the frictional force. For a conventional lubricant with smooth surfaces the present discussions reduces to the study of Srinivasan (1977).

In addition, from the equation (8) one can easily notice that the combined effect of the two different porous structures is quite significant in reducing the friction.

It is manifest that the expression occurring in equation (7) is linear with respect to the magnetization parameter; as a result, an increase in magnetization would lead to increased load carrying capacity. Probably, this may be due to the fact that the effective viscosity of the lubricant gets increased due to the magnetization.

The fact that $\bar{h}_2$ reduces the load carrying capacity is exhibited in figures 2-6.
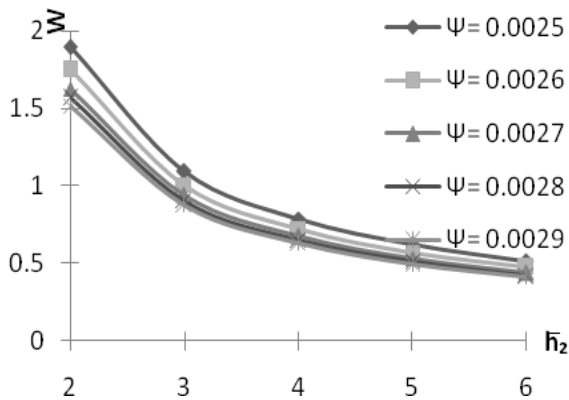
Figure 2: Variation of load carrying capacity with respect to $\bar{h}_2$ and ψ.
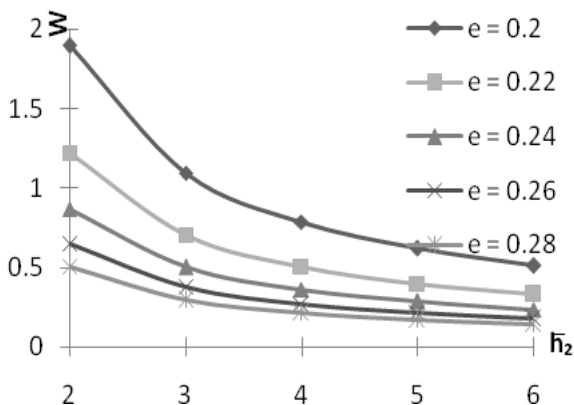
Figure 3: Variation of load carrying capacity with respect to $\bar{h}_2$ and e.
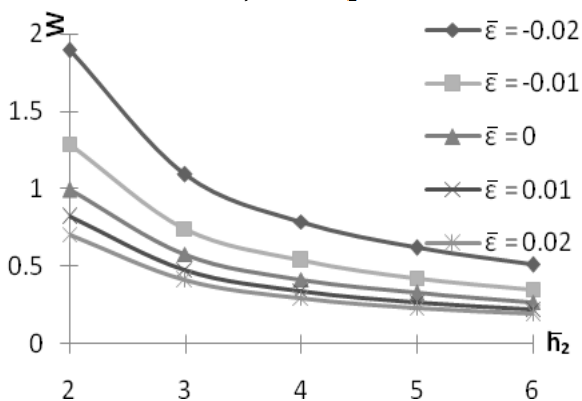
Figure 4: Variation of load carrying capacity with respect to $\bar{h}_2$ and $\bar{\varepsilon}$.
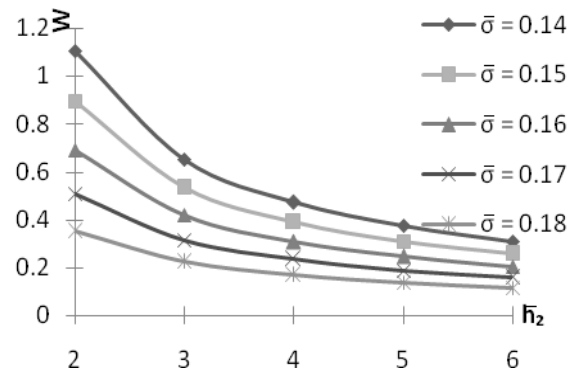
Figure 5: Variation of load carrying capacity with respect to $\bar{h}_2$ and $\bar{\sigma}$.
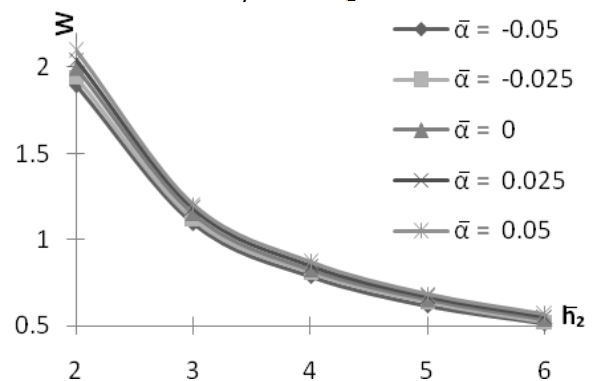
Figure 6: Variation of load carrying capacity with respect to $\bar{h}_2$ and $\bar{\alpha}$.
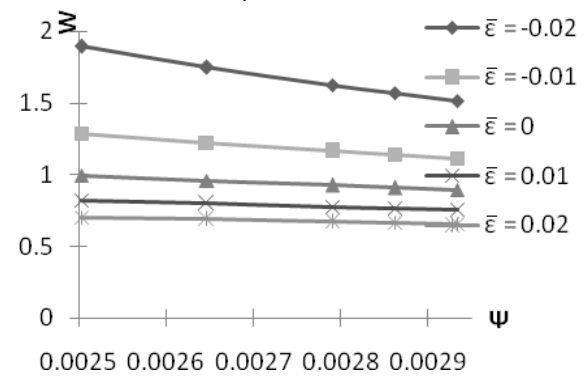
Figure 7: Variation of load carrying capacity with respect to ψ and $\bar{\varepsilon}$.
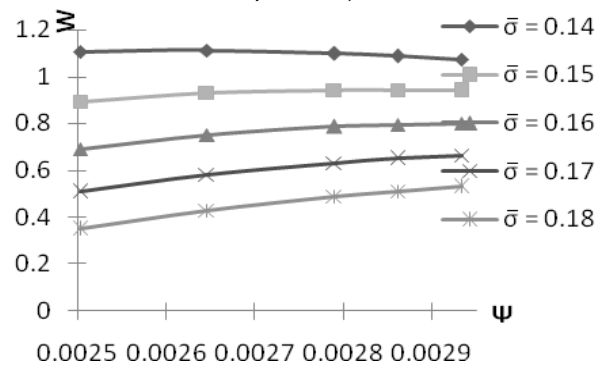
Figure 8: Variation of load carrying capacity with respect to ψ and $\bar{\sigma}$.

Figures 7-9 present the variation of load carrying capacity with respect to the combined porous structures parameter. In figure 8, it is appealing to note that even the porous structure increases the load carrying capacity in a limited way.
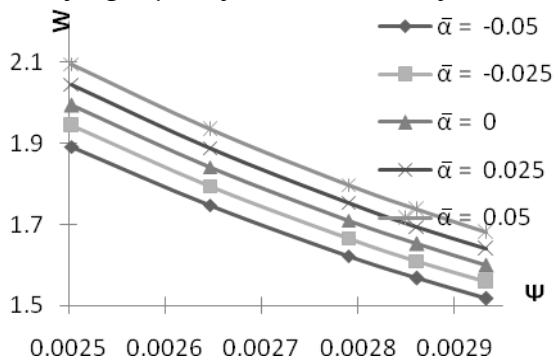
Figure 9: Variation of load carrying capacity with respect to ψ and $\bar{\alpha}$.
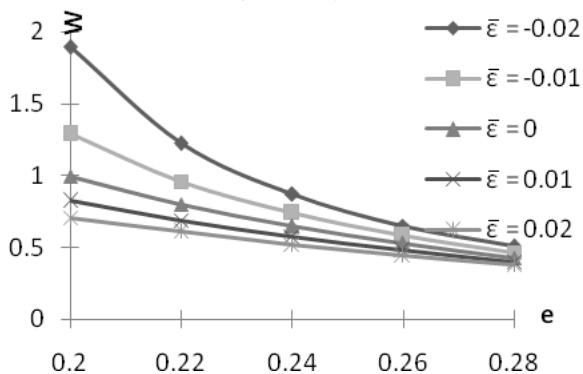
Figure 10: Variation of load carrying capacity with respect to e and $\bar{\varepsilon}$.
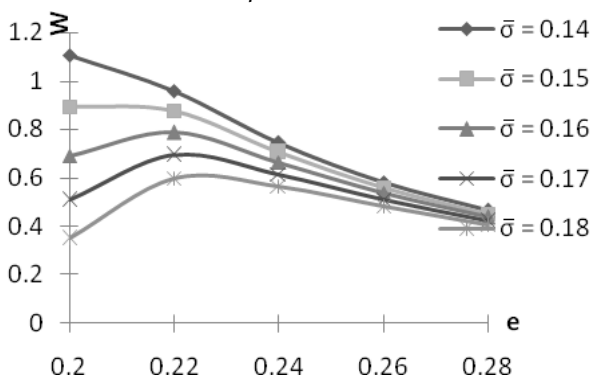
Figure 11: Variation of load carrying capacity with respect to e and $\bar{\sigma}$.

The effect of porosity given in figures 10-12 indicates that the porosity follows the path of porous structure parameter in reducing the load carrying capacity. From figure 11, it is observed that to a limited extent the smaller values of standard deviation fail to prevent the increase in load carrying capacity due to small values of

porosity parameter. In other words the combined effect of porosity and standard deviation is quite significant for small values of these two parameters as it can improve the performance.
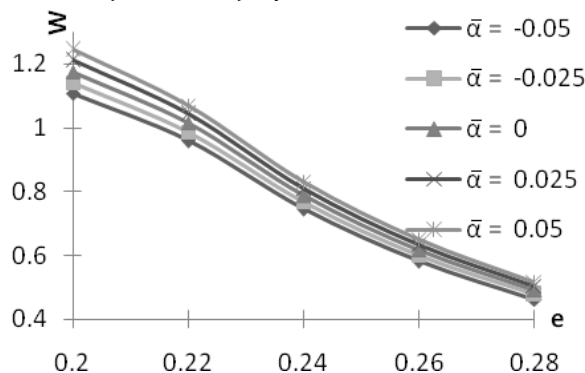
Figure 12: Variation of load carrying capacity with respect to e and $\bar{\alpha}$.
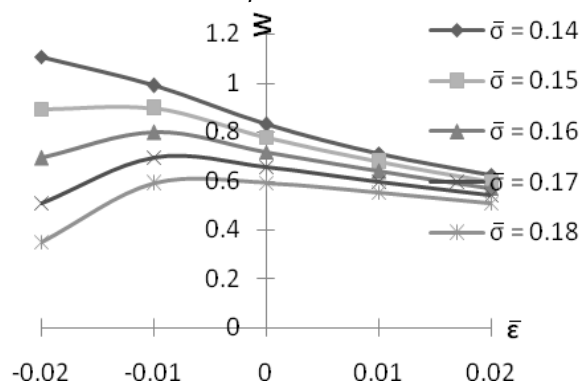
Figure 13: Variation of load carrying capacity with respect to $\bar{\varepsilon}$ and $\bar{\sigma}$.
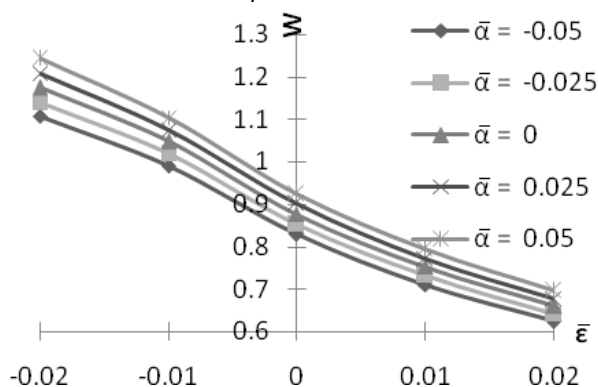
Figure 14: Variation of load carrying capacity with respect to $\bar{\varepsilon}$ and $\bar{\alpha}$.

The effect of skewness presented in figures 13-14 suggests that positively skewed roughness decreases the load carrying capacity while the load carrying capacity increases due to negatively skewed roughness. Similar is the trends of variance as far as load carrying capacity is concerned (Figure 15). Further, the combined effect of

standard deviation and skewness introduces a positive effect for larger values of standard deviation in the case of negatively skewed roughness (Figure 13).
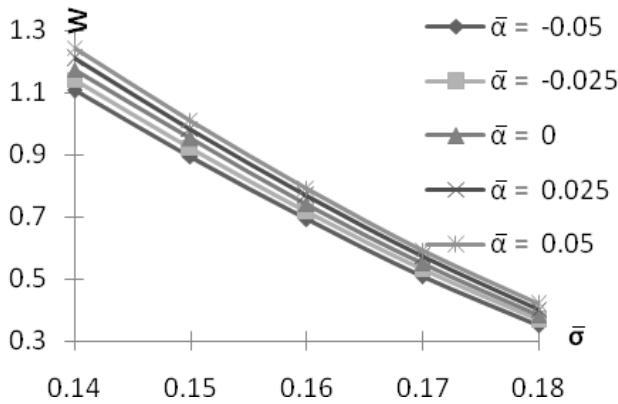
Figure 15: Variation of load carrying capacity with respect to $\bar{\sigma}$ and $\bar{\alpha}$.

The variation of friction presented in figures 16-20 makes it clear that $\bar{h}_2$ reduces the friction in a good way. In figure 20, the friction increases negligibly due to combined effect of $\bar{h}_2$ and $\bar{\alpha}$, up to 0.003.
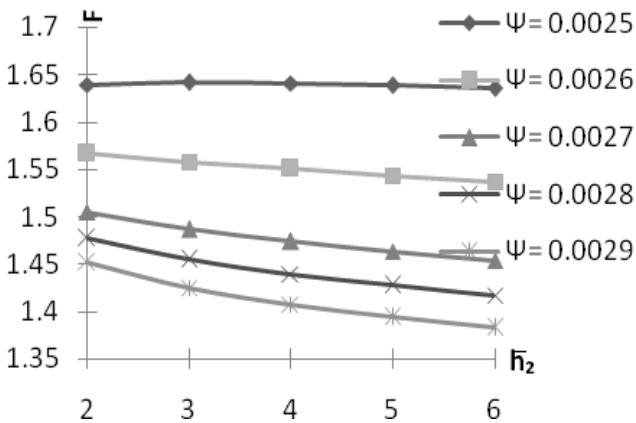
Figure 16: Variation of Friction with respect to $\bar{h}_2$ and ψ.
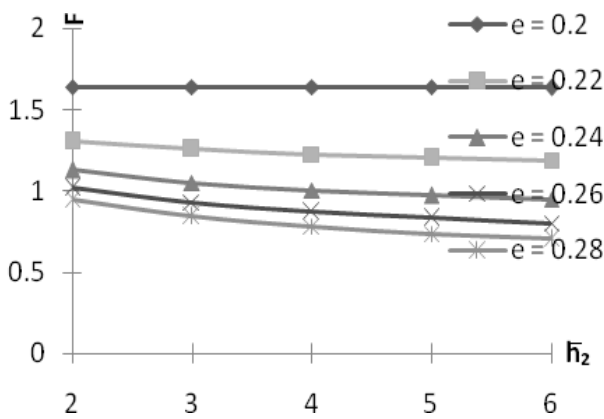
Figure 17: Variation of Friction with respect to $\bar{h}_2$ and e.
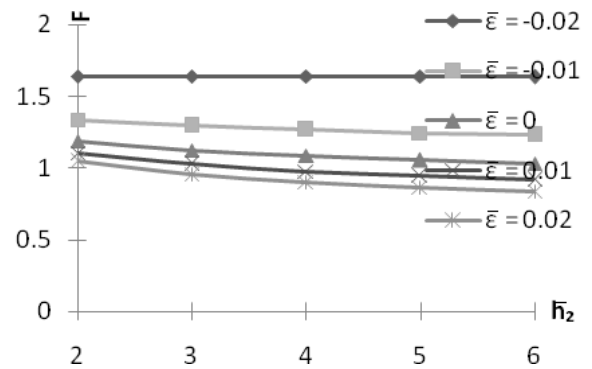
Figure 18: Variation of Friction with respect to $\bar{h}_2$ and $\bar{\varepsilon}$.
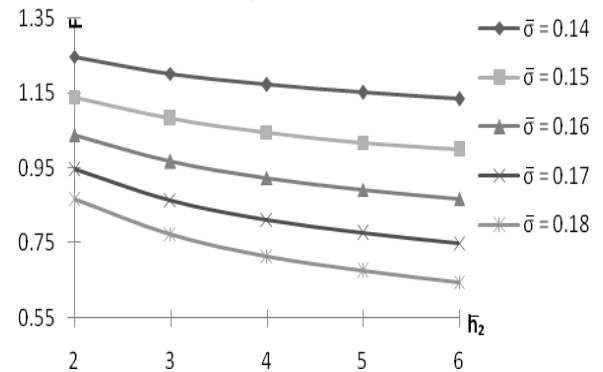
Figure 19: Variation of Friction with respect to $\bar{h}_2$ and $\bar{\sigma}$.
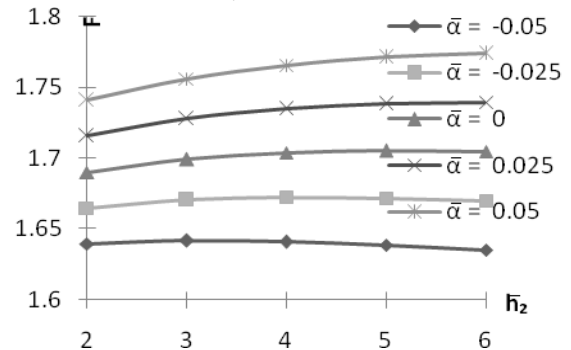
Figure 20: Variation of Friction with respect to $\bar{h}_2$ and $\bar{\alpha}$.
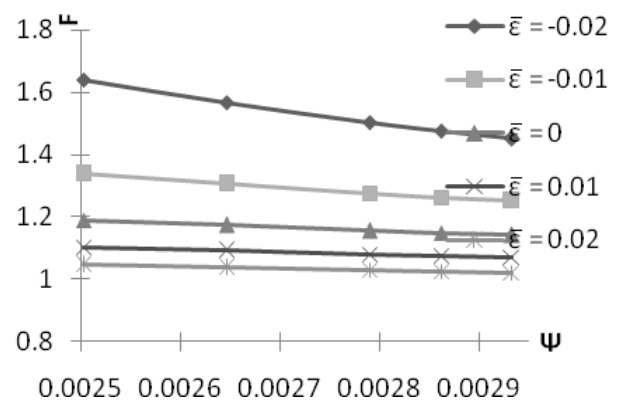
Figure 21: Variation of Friction with respect to ψ and $\bar{\varepsilon}$.
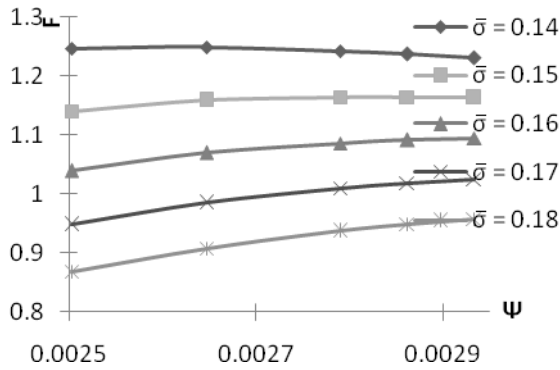
Figure 22: Variation of Friction
with respect to ψ and $\bar{\sigma}$.
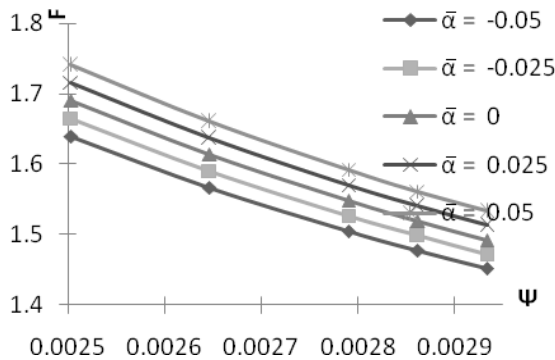
Figure 23: Variation of Friction
with respect to ψ and $\bar{\alpha}$.

Likewise, the porous structure brigs down the friction which can be seen from figures 21-23. From figure 22 it is found that porous structure introduces a small increase in the friction as well.

Analogously, the porosity parameter reduces the friction in a rapid way which is manifest in figures 24-26. For smaller values of standard deviation and porosity parameter the friction increases and it decreases significantly afterwards (Figure 25).

The effect of positive skewness is to decrease the friction which gets further decreased due to positive variance which can be seen from figures 27-28.

Figure 24: Variation of Friction
with respect to e and $\bar{\varepsilon}$.
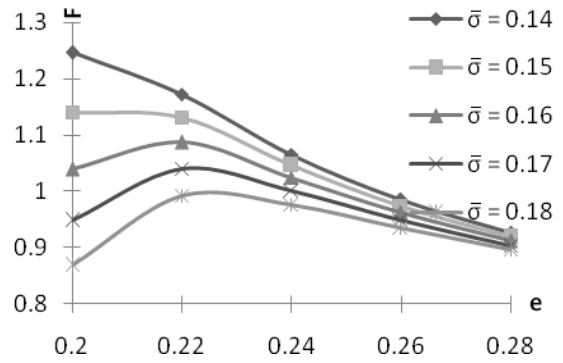
Figure 25: Variation of Friction
with respect to e and $\bar{\sigma}$.
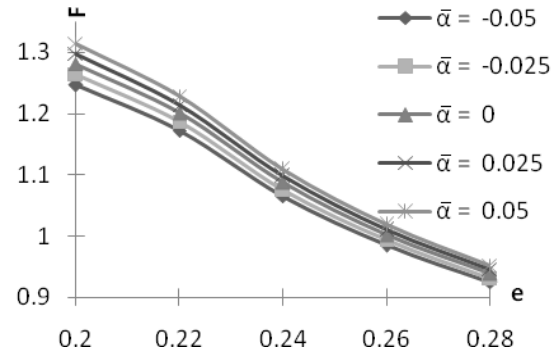
Figure 26: Variation of Friction
with respect to e and $\bar{\alpha}$.
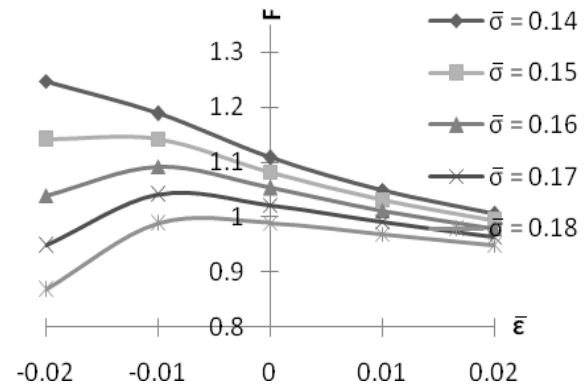
Figure 27: Variation of Friction
with respect to $\bar{\varepsilon}$ and $\bar{\sigma}$.
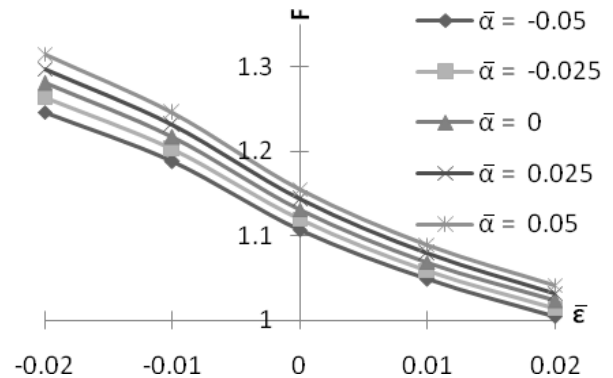
Figure 28: Variation of Friction
with respect to $\bar{\varepsilon}$ and $\bar{\alpha}$.

Figure 29 presents the variation of friction with respect to the standard deviation. Of course, magnetization increases the friction. It is found that there is a negligible increase in friction due to magnetization.
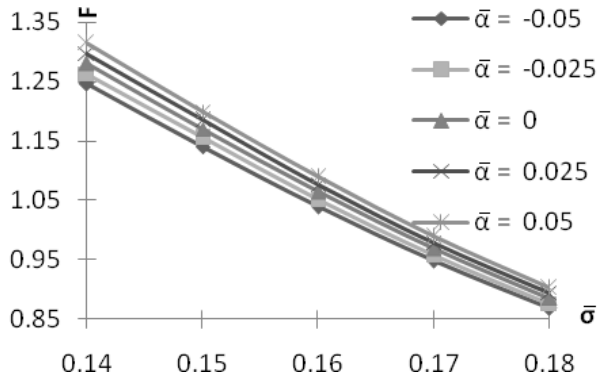
Figure 29: Variation of Friction with respect to $\bar{\sigma}$ and $\bar{\alpha}$.

A close scrutiny of some of the graphs suggest that the combined porous structure stands to increase the load carrying capacity and consequently resulting in an enhanced performance as the friction is sufficiently reduced at least in the case of negatively skewed roughness. Even the combined positive effect of variance(-ve) and negatively skewed roughness goes a long way in enhancing the performance because the standard deviation has a mild positive effect for lower to moderate values of combined porosity. The reduction in load carrying capacity owing to $\bar{h}_2$ can be minimized by the positive effect of magnetization for a large range of combined porous structures, irrespective of roughness. However, this reduction gets enhanced especially, when the negatively skewed roughness is involved. Some of the results presented here establish that the positive effect of magnetization gets enhanced when a double layered porosity is considered. This makes the situation more appealing as the layers are of different porous structures. The effect of negatively skewed roughness becomes more in the case of a double layered porous bearing as compared to that of a single layered bearing system.

4. VALIDATION

The conclusions are validated by giving a comparison of the load and friction of this investigation with some results from already published works. It is notice that load carrying capacity goes up at least by 1%. The results

presented here jell well with that of the published article. However, here the load is substantially increased to the magnetization, in spite the adverse effect of roughness. (I- the load carrying capacity of this manuscript, II- the load carrying capacity of Srinivasan (1977))

Table-1: Variation of load carrying capacity with respect to $\bar{h}_2$ and ψ.

	$\psi \rightarrow$ / $\bar{h}_2 \downarrow$	0.0025	0.0026	0.0027	0.0028	0.0029
I	2	1.89236	1.74689	1.62282	1.56764	1.51645
II		0.15695	0.15684	0.15673	0.15667	0.15662
I	3	1.09228	1.00842	0.93700	0.90526	0.87583
II		0.14668	0.14661	0.14654	0.14650	0.14647
I	4	0.78592	0.72562	0.67431	0.65151	0.63036
II		0.12337	0.12332	0.12327	0.12325	0.12322
I	5	0.61807	0.57067	0.53034	0.51242	0.49581
II		0.10295	0.10292	0.10288	0.10287	0.10285
I	6	0.51071	0.47155	0.43824	0.42345	0.40973
II		0.08673	0.08670	0.08667	0.08666	0.08665

Table -2: Variation of load carrying capacity with respect to $\bar{h}_2$ and e.

	$e \rightarrow$ / $\bar{h}_2 \downarrow$	0.2	0.22	0.24	0.26	0.28
I	2	1.89236	1.22156	0.86736	0.65057	0.50476
II		0.15695	0.15620	0.15524	0.15405	0.15259
I	3	1.09228	0.70635	0.50281	0.37809	0.29406
II		0.14668	0.14620	0.14558	0.14481	0.14387
I	4	0.78592	0.50868	0.36254	0.27294	0.21253
II		0.12337	0.12304	0.12263	0.12212	0.12148
I	5	0.61807	0.40023	0.28545	0.21505	0.16757
II		0.10295	0.10272	0.10243	0.10206	0.10161
I	6	0.51071	0.33081	0.23604	0.17791	0.13868
II		0.08673	0.08655	0.08633	0.08606	0.08572

Table -3: Variation of friction with respect to $\bar{h}_2$ and ψ.

	$\psi \rightarrow$ / $\bar{h}_2 \downarrow$	0.0025	0.0026	0.0027	0.0028	0.0029
I	2	1.63932	1.56659	1.50455	1.47696	1.45137
II		0.77162	0.77156	0.77151	0.77148	0.77145
I	3	1.64158	1.55772	1.48630	1.45456	1.42513
II		0.69598	0.69591	0.69584	0.69581	0.69577
I	4	1.64098	1.55053	1.47355	1.43935	1.40764
II		0.64715	0.64707	0.64700	0.64697	0.64693
I	5	1.63850	1.54369	1.46303	1.42722	1.39398
II		0.60825	0.60819	0.60812	0.60809	0.60805
I	6	1.63513	1.53723	1.45395	1.41697	1.38268
II		0.57516	0.57510	0.57503	0.57500	0.57497

Table -4: Variation of friction with respect to $\bar{h}_2$ and e.

	$e \rightarrow$ $\bar{h}_2 \downarrow$	0.2	0.22	0.24	0.26	0.28
I	2	1.63932	1.30392	1.12682	1.01843	0.94552
II		0.77162	0.77124	0.77076	0.77017	0.76944
I	3	1.64158	1.25566	1.05212	0.92739	0.84377
II		0.69598	0.69550	0.69488	0.69412	0.69317
I	4	1.64098	1.22511	1.00591	0.87151	0.78089
II		0.64715	0.64666	0.64604	0.64527	0.64432
I	5	1.63850	1.20282	0.97325	0.83246	0.73749
II		0.60825	0.60779	0.60721	0.60647	0.60557
I	6	1.63513	1.18538	0.94845	0.80312	0.70505
II		0.57516	0.57473	0.57418	0.57350	0.57265

5. CONCLUSION

It is established that this type of bearing system dealing with combined effect of double layered different porous structures may provide a better bearing design. However, to derive an all round improved performance of the bearing system, the roughness aspect must be given due consideration, even if suitable magnetic strength is in place. The use of different porous structures for different layer provides a better scope for minimizing the friction. At the same time the friction is considerably reduced here except in the case of magnetization, when the friction is marginally increased.

ACKNOWLEDGEMENTS

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1. *Szilárd SZÉLPÁL*, 2. *Zsuzsanna KOHÁNY*, 3. *Eszter FOGARASSY*,
4. *József CSANÁDI*, 5. *Gyula VATAI*, 6. *Cecília HODÚR*

ASSAYING OF THE FILTRATION PARAMETERS OF WHEY BY DIFFERENT FILTRATION SYSTEMS

1,4,6. *University of Szeged, Faculty of Engineering, 6725 Szeged, Moszkvai krt. 5-7, HUNGARY*
2,3,5. *Corvinus University of Budapest, Faculty of Food Science, HUNGARY*

Abstract: *The largest quantities of by-product of the dairy, namely whey comes from the cheese making. The whey proteins are used by the agriculture in animal nutrition, and by the human nutrition as well; dry soups, infant formulas and supplements. The aim of our experiments was the separation of the lipid fraction of whey. During the measurments 0.05 µm, 0.2 µm and 0.45 µm microfiltration membranes were used in vibrating membrane filtration equipment (VSEP) and in a laboratory tubular membrane module. During the microfiltration, analytical characteristics, the fouling and the retention values were examined. Using the VSEP and the tubular module made possible to compare the effect of vibration, the static mixer and/ the airflow on the separation parameters.*
Keywords: *cheese making, experiments, lipid fraction, laboratory tubular membrane module*

1. INTRODUCTION

Liquid whey contains lactose, vitamins, protein, and minerals, along with traces of fat. During the degreasing cream can be skimmed from whey. Whey cream is more salty, tangy, and "cheesy" than ("sweet") cream skimmed from milk, and can be used to make whey butter. The other reason of the degreasing is the further processing of the whey for dry powder/nutritional supplement. The membrane degreasing methods are new ones and the biggest gap of it is the low flux and high resistances. These effects could be mitigated by used membrane modes of us, i.e. static mixer, aeration and vibrating.

Newtonian fluids such as an aqueous solution, - are being turbulent flow in most industrial applications, but within a short pipe section this turbulence is not enough to equalize temperature or concentration in-homogeneities. The use of static stirrers was made better amalgamation than increase the speed or the pressure during the process. The flux is increased and the operating cost is decreased at tubular membranes with static mixer (Krstic et al. 2002). Similar result was obtained with an alternative design equipment to increase turbulence and other type of membranes as well (Bellhouse et al. 2001, Costigan et al. 2002). The fouling of the membranes was possible to decrease at the introduction of gas into the liquid (Laboire et al. 1998, Cabassud et al. 2001, Cui and Wright, 1996). The introduction of a specific gas - in this case air - directly into the fluid created a two-phase gas/liquid flow. The efficiency of the separation is influenced by the position of the membrane (vertical or horizontal) and the direction of the flow (up or down).

The aeration method is limited by the gas distribution and the management of this process (Derradji, 2000). During the vibratory shear enhanced process (VSEP), the filtering parameters (flux, retention and resistances) were investigated by the effects of the vibration. This is another solution to decrease fouling (Frappart et al. 2008, Hodúr et al. 2013). The shears strengths at the surface of the membrane can be increased by vary the frequency of the vibratory membrane module. The polarization layer, the resistance values, and the fouling were measured by the effect of vibration, and the evolution of retention values were measured by the effect of increase of

vibrational amplitude (Ahmadu et al. 2009, Hodúr et al. 2009, Kertész et al. 2010).

2. MATERIALS AND METHODS

Sweet cheese whey was used for measurement which came from Soma Budapest Ltd. Its basic analytical parameters are: fat content: 0.18 m/m%, protein content: 0.33 m/m%, milk sugar content: 2.61 m/m%, dry materials: 3.72 m/m%, total protein content: 0.47 m/m%. The degreasing process was made by membrane separation. These basic parameters were measured by Bentley milk analyzer equipment.

The air injection and/or static steering method were implemented by tubular and hollow fiber membranes with 0.45, 0.2 microns, 0.05 microns cut off value. The tubular membrane was 250 mm length, and it was included 1 tube which has an internal diameter of 7 mm.. The applied static mixer was a 250 mm lenght Helix type metal static stirrer with a pitch of 0,006 m and an inner radius of the stirrer of 0.0035 m. (KenicsTM, Helix) as illustrated in Figure 1.. The KenicsTM type static stirrer (made by plastic material) was used also with a length of 241 mm, and a thickness of 1 mm, a diameter of 6.35 mm. The flux was performed on 100 L/h recirculation flowrate, on 0.2 MPa transmembrane pressures and on 20 L/h air injection rate. In all measurments the initial amount of feed was 2 L of sweet whey. The temperature was a permanent 30°C degree during the tests. The airflow was introduced into the fluid flow before the membrane module.
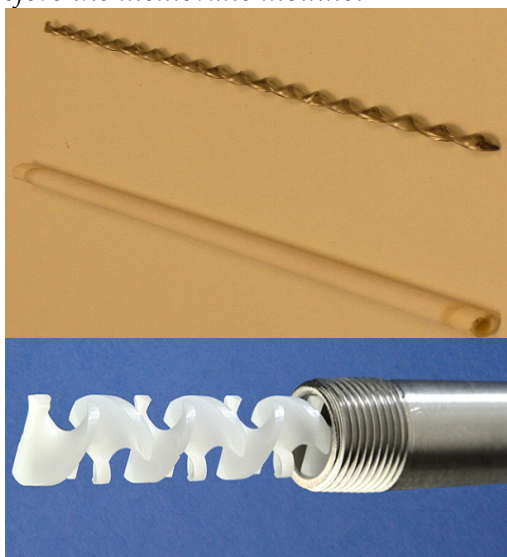
Figure 1: The Kenics TM (right) and the Helix type static stirrers

Vibratory filtration equipment set marketed by New Logic International Corp. and this equipment was used at L-mode (L: laboratory methods: the module comprises one disk-shaped membrane with an active filter surface 503cm2). The VSEP system consists of disk-shaped flat-sheet membranes. This laboratory module attached to a central shaft. The shaft was rotated a short distance at a frequency of 54 Hz. 0.2 µm cut-off values membranes (made of polyethersulfone) were used during the measurements, on a transmembrane pressure at 0.3 MPa. In this equipment the initial amount of feed was 10 L of sweet whey.

The samples were taken at different intervals during the measurement from retentate and also from permeate.

3. RESULTS AND DISCUSSION

The retention of the fat component was important in our research programme, and we were able to retain more than 50% at low pressure with using static mixer. The retention values were measured at different transmembrane pressures and recirculation flow rates by a 0.45 micron pore size membrane (Fig. 2). The main objective was to hold back the fat molecules as much as possible and to give up the other molecules.
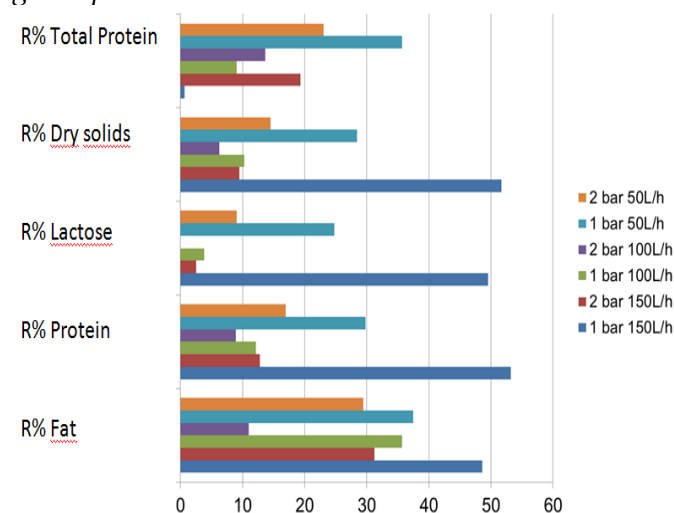
Figure 2: The retention values (R) of the different components on 0.45 µm cut off value tubular membrane

The figure shows that the fat micelles were retained the greatest amount when 0.1 MPa transmembrane pressure and 150 L/h recirculation flow rate were used. The other component was rejected at highest level at these parameters also. But these highest value itself is not enough for

degreasing aspects since it is less than 50%, so the 0,45 micrometers pore size could be said to big for this task.

Since the work was continues with 0.2 microns pore size tubular membranes. Better retention values were measured at lower transmembrane pressure (0.1 MPa) at the 0.2 micron pore size membrane than at the 0.45 micron pore size membrane. The bigger transmembrane pressure resulted worse retention values; this tendency is the same at this pore size as well. The Figure 3 presents the effect of different process arrangements on the retention. The static stirrer has a decreasing effect on the retention of protein, lactose and dry matter. Only the fat retention was increased by using the static stirrer; maximum value was measured at TMP: 0.2 MPa, q_v: 100 L/h. The tubular membrane gave better retention values than the capillary membranes, but as our goal is to minimise the fat content and to keep the other ingredients it is clearly be seemed from the measurements the 0.2 microns tubular membrane with static stirrer is the best solution among the applied arrangements.
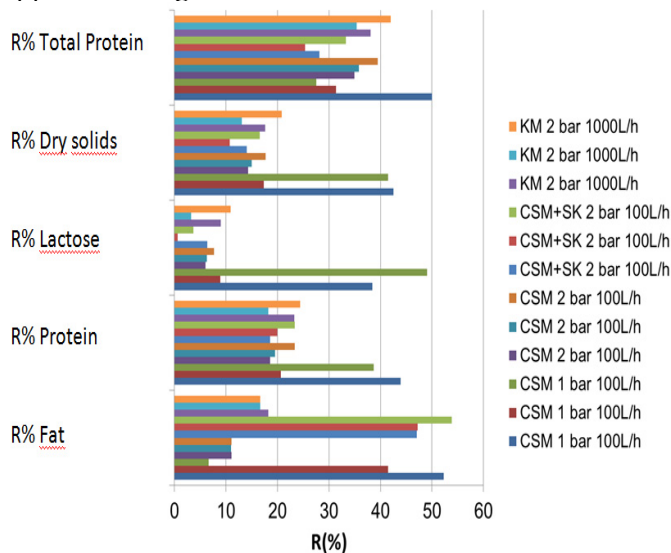
Figure 3: The retention values (R) of the different components were measured in 0.2 μm cut off value tubular membrane with (CSM+SK) and without static stirrer (KM-capillary membrane, CSM – tubular membrane)

The flux values were measured at 0.2 MPa transmembrane pressure, and at 100 L/h recirculation flow rate by a 0.45 μm tubular membrane. The flux values are started at 60 L/m²h. The flux values were showed 17-18 L/m²h values

during the normal filtration process, and with combined the air injection, the flux was decreased slight by the air flow on a 0.2 μm membrane. When the Helix static mixer element was used in the filtration process, the flux values were increased two times greater extent, from 18 L/m²h to 40 L/m²h when the Helix static mixer was used with air injection.

The increase of the flux is holding until the 0.2 MPa transmembrane pressures; because on higher pressure values this increase of the flux is started to show a strong deceleration (Figure 4). When the air injection process was used alone, the flux values remained very low; therefore the air injection method itself is not a recommended method for whey processing. When the Helix static mixer was used alone in the equipment under the same parameters, the flux values were showed higher values than the experiments with air injection, but above 0.2 MPa transmembrane pressures values, the flux was strongly decreased, therefore it was justifed to use the lower transmembrane pressure.
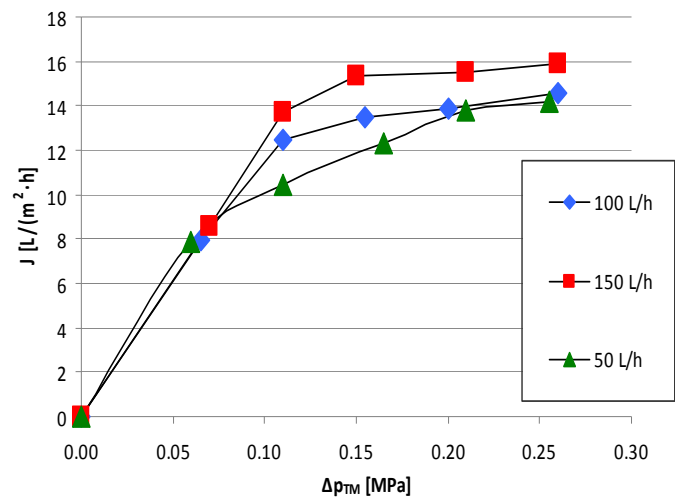
Figure 4: The changes of whey flux (J) as a function of trasnmembrane pressure at different recirculation flow rate

The 0.2 microns membrane was used with Kenics type static mixer in second period of our research programmes. The flux values (J = 45 L/m²h) were increased by the Kenics static mixer, but the increasing was not as high as using the Helix-type static mixer (J = 53 L/m²h). Our experiments were continued by a 0.05 microns pore size tubular membrane to comparing the received data with the other tubular membranes different data. The flux

was increased 50-80% during the filtration process by using a 0.05 microns pore size tubular membrane with a Kinetics static mixer. The flux was decreased strongly after 0.3 MPa transmembrane pressures. The vibratory shear enhanced membrane filtration was examined by a 0.2 μm pore size microfiltration membrane, on 0.3 MPa transmembrane pressures with using vibration at 54 Hz vibrational frequency and without using vibration (Figure 5).
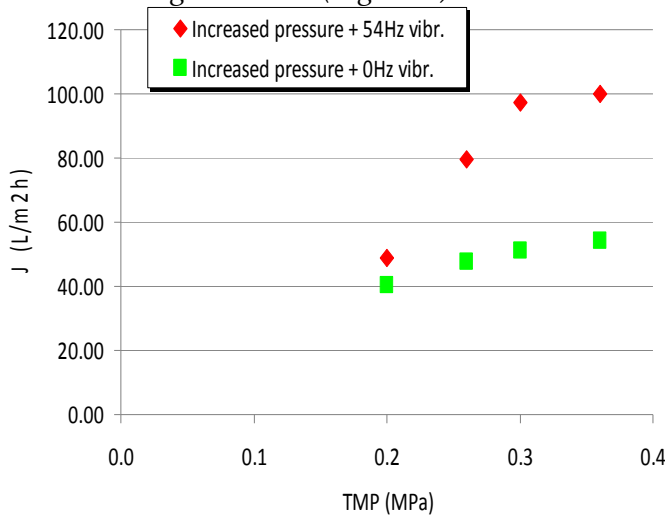
Figure 5: The changes of whey flux (J)
as a function of trasnmembrane pressure at vibrated (54 Hz) and non vibrated methods

The retention values were measured only from the fat molecules. The examination of the resistance values was showed that the gel layer and the membrane resistance values showed the same magnitude values. The fouling resistance was showed an order of magnitude lower value than the two other determinative resistance values before.

In non-vibrating mode, not only the total resistance value was showed differences, but its structure and distribution as well. Without using vibration during the separation process, the flux values were showed four times lower; the total resistance value was showed one order of magnitude higher; and the fouling resistance values were showed two orders of magnitude higher values.

The drag resistance values were decreased by the vibration, therefore this change was allowed the fat molecules to move and accumulate on the membrane surface (Figure 6) The flexible fat molecules were moved into the capillaries of the membrane under pressure and without vibration,

where due to their sizes (3.5 microns), these molecules were fouled inside the membrane capillaries. The increased retention values and their absolute magnitude were been significant by fat content. The retention values of the small components were increased by the fouled pores.
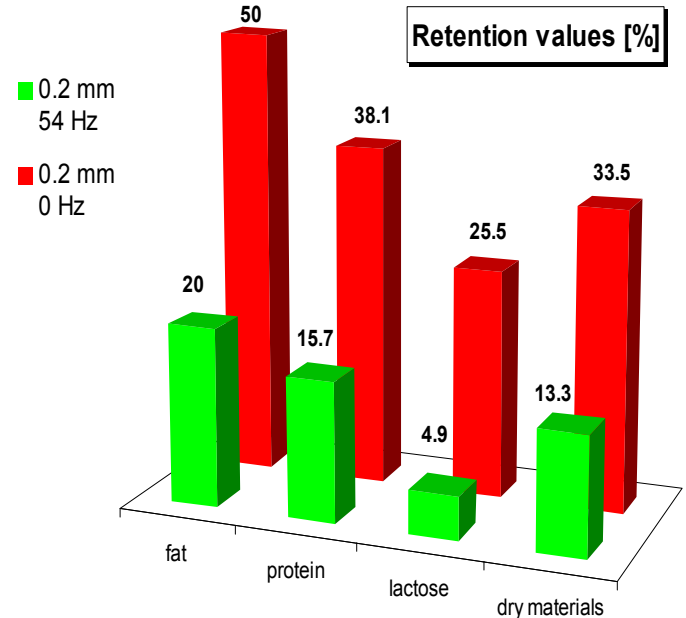
Figure 6: The retention value of most important components of whey

4. CONCLUSION

The experiences showed that the 0.45 microns pore size membrane could slightly hold back the fat molecules, due to their larger pore size. The desired filtration results were achieved by the measurements of 0.2 MPa and 100 L/h.

The 45 % higher flux values were measured by Helix static stirrer against the normal filtration process, but the combination of the static stirrer and the air injection were made the highest flux values (30 % higher than the filtration process by the Helix static stirrer) under the same conditions. Comparing the two different static stirrers, it was found, that the 15 % higher flux values were measured by Helix static stirrer than the Kenics stirrer. This means that the separation of the fat content was easier and more effective by using the combination of static stirrer and air injection.

The vibratory shear enhanced process was showed that not only the retention values of the fat content were increased without vibration, but the other elements retention values too. 300 % higher flux values were measured by 54 Hz vibration than without vibration.

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1. F. O. ARAMIDE, 2. S. R. OKE

PRODUCTION AND CHARACTERIZATION OF CLAY BONDED CARBON REFRACTORY FROM CARBONIZED PALM KERNEL SHELL

1-2. Department of Metallurgical and Materials Engineering,
Federal University of Technology, Akure, NIGERIA

Abstract: The effects of varied contents of clay on the mechanical properties of clay bonded carbon refractory samples produced from Ifon clay and carbonized palm kernel shell was investigated. The physical, mechanical and morphological characterizations of the samples were carried out following American Society for Testing and Materials (ASTM) stipulated standards. The clay bonded carbon refractory samples were produced by mixing respectively 40, 50 and 60 weight percents processed clay obtained from Ifon, Ondo State, Nigeria and carbonized palm kernel shell. Each mixture was uniaxially compressed into standard samples dimension and then fired in the furnace at 950°C. The characterized/investigated properties were bulk density, cold crushing strength, porosity, water adsorption, young's modulus and absorbed energy. Scanning Electron Microscopy and Energy Dispersive X-ray Spectroscopy using back scattered secondary imaging were used to determine the chemical compositions, size, and morphology of the produced clay bonded carbon refractory. The result shows that the compositions of Ifon clay are of kaolinite, microcline, muscovite, plagioclase and quartz. The result also reveal that the apparent porosity and water adsorption increases with increase in carbonized palm kernel shell content while other properties such as bulk density, cold crushing strength, young's modulus and absorbed energy decreases with increase in the carbonized palm kernel shell content. It was however concluded that the composite grade containing 40 wt % carbonized palm kernel shell and 60% ifon clay, had the best combination of mechanical properties of all the composites produced.

Keywords: clay bonded carbon refractory, composite, palm kernel shell

1. INTRODUCTION

Refractory materials are non-metallic materials that provide linings for high-temperature furnaces and other processing units. Refractories unusual withstand physical wear, corrosion by chemical, high melting temperatures and maintain their structural properties at very high temperatures [1-3]. Refractories are employed in great quantities in the metallurgical, glassmaking, and ceramics industries, where they are formed into a variety of shapes to line the interiors of furnaces, kilns, and other devices that process materials at very high temperatures [4, 5]. Refractory materials are very useful and play very crucial roles in the industrial development of any nation. The Nigerian metallurgical industries are struggling today because of many factors which include short supply of refractory materials. It was however reported that Ajaokuta Steel Complex requires about 43,503 tonnes per year of fireclay refractories for its operations; and these refractories are sourced abroad [6,7]. Despite having extensive clay mineral deposits in Nigeria, Nigeria continues to depend on external sources of refractory materials for many of its industries [8].

The characteristic properties of a refractory are a function of both raw material base and the method of production used for the refractory product. Refractory manufacturing involves four processes: raw material processing, forming, firing and final processing [9]. In this research, clay bonded carbon refractory is considered and produced by adding processed clay with carbonized palm kernel shell and firing to a sufficient temperature to vitrify the clay and to produce a bond with the carbonized palm kernel shell.

Carbon and graphite in refractories produces extraordinary properties for special applications. Carbon is desirable element for refractory use because it is not wetted by most molten metals and slags; it has excellent thermal shock resistance; good strength and susceptibility to oxidation [10]. However, its use is limited to applications which are either strongly reducing or where the oxygen content of the atmosphere at a given operating temperature is low enough to prevent appreciable combustion of the carbon.

Many researchers have reported on their various successes in the production of activated carbon using agro-waste materials and by products such as Fluted Pumpkin Stem Waste (Telfairia occidentalis Hook F) [11], macadamia nutshell [12], coconut shell [13] and rice husk [14], Palm kernel shell and coconut shell [15]. Activated carbon is an organic material that has an essentially graphitic structure. The main features common to all activated carbon are; graphite like planes which show varying degrees of disorientation

But there have been little information on the use of these carbonaceous materials gotten from the conversion of these agro-waste materials in the production of refractory materials for industrial use. The current work is aimed at this the possibility of utilizing these vast available material (palm kernel shell) in the fabrication of refractory materials. In view of all these facts, there is therefore every need to produce, characterize, evaluate and improve the refractory properties of the Ifon clay deposit in Ondo State Nigeria with the addition of carbonized palm kernel shell.

2. MATERIALS AND METHODS
2.1. Materials
The materials utilized in this research work are Ifon clay and Carbonized palm kernel shell. The Ifon clay was collected from Ifon (an area fond to be rich in fireclay), Ose Local Government Area of Ondo State (latitude 7° 52` N and longititude $7^O$ 28` 60 E). The clay lumps were crushed, grounded and sieved.

2.2. Clay Processing Procedure
This clay samples as obtained was soaked in water for three days to dissolve the clay and at the same time to form slurry. The resulting slurries were then sieved to remove dirt and other foreign substances using a sieve. These were then allowed to settle down for seven days after which the floating clear liquids were decanted. The settled fine clays is then poured into Plaster of Paris (P.O.P) moulds and left undisturbed for three days in other to allow the liquid present to drain out completely. The resulting plastic clay mass were sun dried and subsequently dried in a laboratory oven at 110°C for 24 hours to remove moisture content completely.

The resulting dried clay samples were milled at 300 rev/ min for 4 hour to an average particle size of about 300µm. The carbonized palm kernel shell was produced as described by Ekpete and Horsfall [11], with the exception that the carbonization took place at 700°C. A mixture of clay and carbonized palm kernel shell was made using ball-mill for six hours using respectively 40, 50 and 60 weight percents of Ifon clay in each mix. Each mixture was made thoroughly with a little addition of water to induce some plasticity. The samples were then compressed uniaxially inside a standard stainless steel die. The compressed samples were placed in a ceramic crucible, properly sealed to limit the amount of air that will be in contact with the samples during firing. The crucibles containing the samples were placed in a muffle furnace and then fired (sintered) at 950°C, held at the temperature for 1hr. The percentage weights ratio of the mix is presented in Table 1:

Table 1. Percentage mass of representative samples

Composition	Carbonized palm kernel shell (%)	Ifon clay (%)
A	40	60
B	50	50
C	60	40

2.3. Apparent Porosity
Produced clay bonded carbon refractory samples were dried for 12 hours at 110°C. The weight of the dried samples were taken and recorded as D. The samples were immersed in water for 6 hours to soak and weighed while been suspended in air. The weight will be recorded as W. Finally, the specimen will be weighed when immerse in water. This will be recorded as S. The apparent porosity will then be calculated from the expression:

$$p = \frac{(W - D)}{(W - S)} \times 100\%$$

2.4. Cold Compression Strength

Cold compression strength test was used to determine the compression strength to failure of each sample, an indication of its probable performance under load. The standard samples were dried in an oven at a temperature of 110°C, and then allowed to cool. The cold compression strength test was performed on INSTRON 1195 at a fixed crosshead speed of 10mm min^{-1}. Samples were prepared according to ASTM D412 (ASTM D412 1983) and tensile strength of standard and conditioned samples can be calculated from the equation:

$$CCS = \frac{Load\ to\ Fracture}{Surface\ Area\ of\ Sample}$$

2.5. Water Absorption Test

Water absorption tests were carried out following standard procedures. Samples of each composite grade were oven dried before weighing and the weights recorded were reported as the initial weight of the composites. The samples were then placed in distilled water maintained at room temperature (25^{0}C) and at time intervals of 24h, the samples were removed from the water, cleaned using a dry cloth and weighed. The weight measurements were taken periodically at time intervals of 24h. The amount of water absorbed by the composites (in percentage) was calculated using the equation:

$$W = W_T – W_0/W_0$$

2.6. Bulk Density

The test specimens were dried at 110°C for 12 hours to ensure total water loss. The dried weights were measured and recorded. Samples were allowed to cool and immersed in a beaker of water. Bubbles were observed as the pores in the specimens were filled with water. Their soak weights were measured and recorded. Bulk densities of the samples were calculated using the formula:

$$bulk\ density = \frac{D}{(W - S)}$$

Where : D = Weight of dried specimen, S = Weight of dry specimen suspended in water, and W = Weight of soaked specimen suspended in air

2.7. Qualitative and Quantitative (XRD)

The samples were prepared for XRD analysis using a back loading preparation method. The samples were analyzed using a PANalyticalX'Pert Pro powder diffractometer with X'Celerator detector and variable divergence- and receiving slits with Fe filtered Co-Ka radiation. The phases obtained were identified using X'PertHighscore plus software. Graphical representations of the qualitative result will then follow. The relative phase amounts in weight % were estimated using the Rietveld method (Autoquan Program). Amorphous phases, present were not taken into consideration in the quantification.

2.8. Scanning Electron Microscopy

Morphology and microanalysis of the clay and composite samples were determined using ultra-high resolution field emission scanning electron microscope (UHR-FEGSEM) equipped with energy dispersive spectroscopy (EDS). The pulverize clay samples were graphite coated. The sintered samples were studied using ultra-high resolution field emission scanning electron microscope (UHR-FEGSEM) equipped with energy dispersive spectroscopy (EDX). Particle images which are obtained with a secondary electron detector.

2.9. Chemical Analysis

The major elements were determined by X-ray fluorescence with an ARL® 9800 XP spectrometer. The pulverized   samples were mixed with lithium tetra borate for chemical analysis. The ignition loss was measured by calcinations at 1000 °C.

3. RESULTS AND DISCUSSIONS

Figures 1 and 2 respectively shows the XRD result and SEM/EDX analysis of the raw clay sample. Table 2 also shows the XRD analysis results of the raw clay sample. These show the various phases present in the raw clay sample. It can be seen from Table 1 that the overall feldspar contents of the raw clay samples are high (30.90% microcline and 18.22% Plagioclase Albite).

Table 2: XRD result of the Ifon clay sample showing the quantity of phases

Phases identified	Weight%
Kaolinite	5.63
Microcline	30.90
Muscovite/illite	3.81
Plagioclase albite	18.22
Quartz	41.42

It has been noted that feldspars favour liquid phase formation and densification at low temperature; this will disqualify the utilization of the clay in

refractory (high temperature) applications except if subjected to serious purification process to reduce or eliminate the feldspar content and the fusion point of the fireclay increases [16, 17].
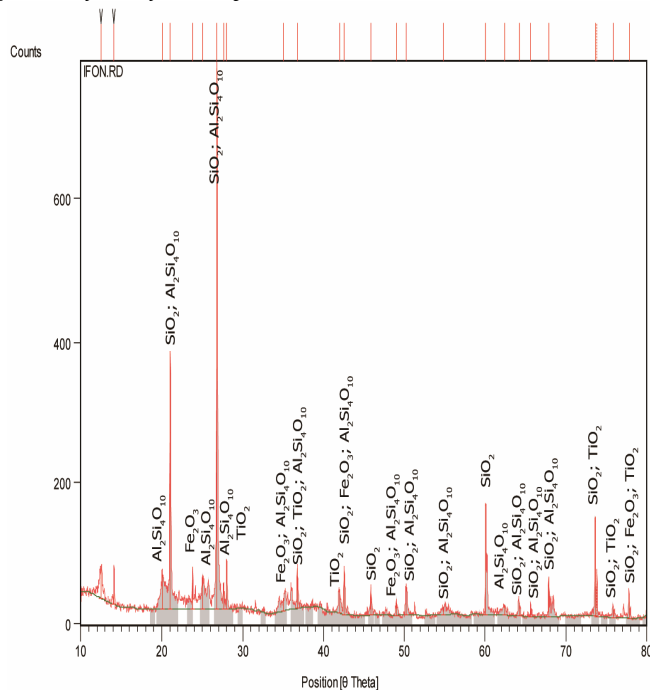
Figure 1: X-ray diffraction pattern (phase analysis) of the Ifon clay sample.
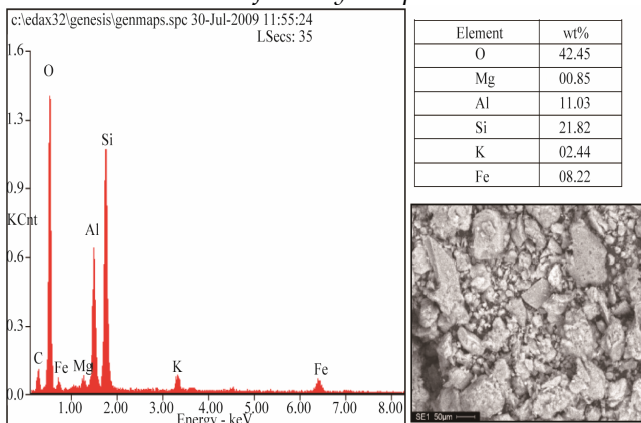
Figure 2: Typical SEM/EDS of Ifon clay sample; showing the morphology of the minerals and its chemical composition.

3.2. Effects on the mechanical properties

The apparent porosity of the clay bonded carbon ceramic samples are presented in Figure 3. It is observed that the porosity of the sample increases with the increase in carbonized palm kernel shell content from 5.15 % at 40 % carbon to a maximum of 18.78 at 60 % carbon addition. It has been observed that as the graphitic content of carbon based refractory increases, the density of the refractory decreases. This result is primarily due to the fact that the morphology of the graphite as

compared to the other refractory materials. The graphite materials, which are used in refractories, are commonly of a flaky structure; therefore, these flakes do not lend themselves to the same particle packing phenomena as do granular particles. The flaky morphology gives rise to high porosity; some of these pores are filled up by the clay particles. As the percentage content of the carbonized palm kernel shell increased, the percentage content of clay in the sample reduced, which means less clay particles are available to fill the pores between the flakes of carbon, hence the increased porosity with increased percentage content of the carbonized palm kernel shell.
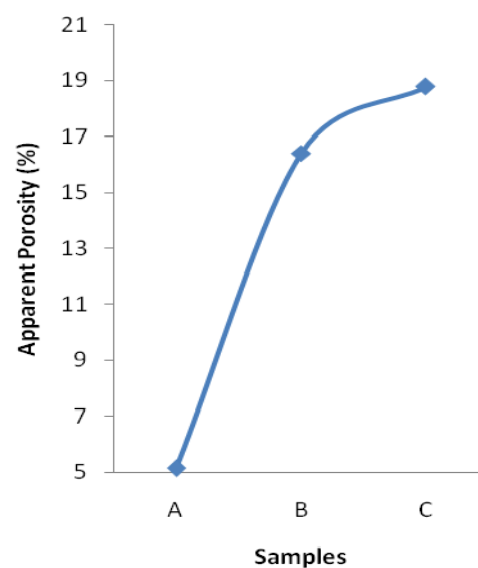
Figure 3: Effect of carbonized palm kernel shell on the apparent porosity of the samples

Moreover, one of the authors has earlier reported that the clay deposit used as binder in this work contains feldspar as it is observed in Table 2. These feldspar content is known to favour low temperature liquid phase sintering [18]. As the clay content increase (reduced content of carbonized palm kernel shell), more feldspathic clay particles are available to form more liquid phase during sintering at the sintering temperature. This liquid phase then flows into the pores filling up some of the pores.

From Figure 4, show the effects increase in the amount of carbonized palm kernel shell on the bulk density of the test samples. It is observed that there is a general decrease in the density of the samples with increase in the weight percent of the carbonized palm kernel shell from 40 to 60 wt% in the composites. The decrease in density with

increase in carbonized palm kernel shell content is obviously due to the lower density of the carbonized palm kernel shell in comparison with the raw clay samples.
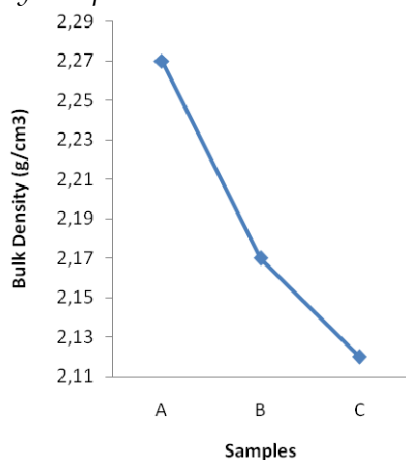
Figure 4: Effect of carbonized palm kernel shell on the Bulk density of the sample

From Figure 5, it is also observed that the cold crushing strength of the samples reduced with increased percentage carbonized palm kernel shell. This is because the increased percentage carbonized palm kernel shell leads to reduced matter content of the sample; less matter are available to bear the applied load. A brick of high porosity will have lower load bearing capacity than one of the same material with lower porosity, since there is less material in the brick to carry the load in the former case. Porous bricks are lighter and therefore unlikely to carry heavy load [18, 19].
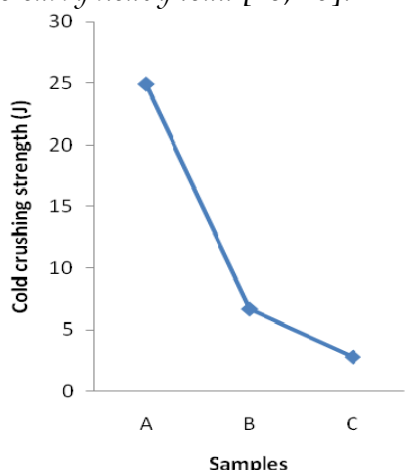
Figure 5: Effect of carbonized palm kernel shell on the cold crushing strength of the samples

Young's modulus which is a measure of a material's rigidity is presented in Figure 6. It is observed that the young's modulus decreases linearly with increase in weight percent of carbonized palm kernel shell. The curve shows that at 40 wt% carbonized palm kernel shell, young's modulus was at an initial value of 19103 N/mm^2, and thus decreases linearly at 50 wt% clay and 60 wt% carbonized palm kernel shell to a value of 3321.3 N/mm^2 and 2875.1 N/mm^2 respectively. This could be attributed to increase in the amount of open porosity in the sample which acts as 'notch' which is a stress (both mechanical and thermal) concentrator [20]
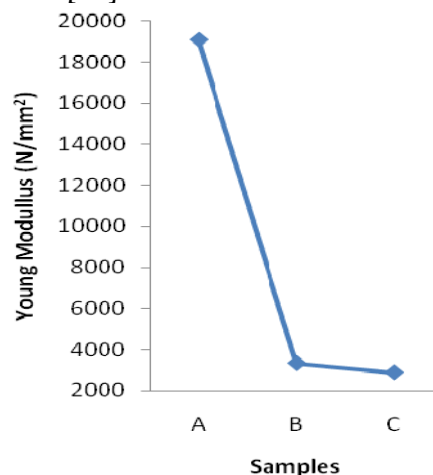
Figure 6: Effect of carbonized palm kernel shell on the young's modulus of the sample
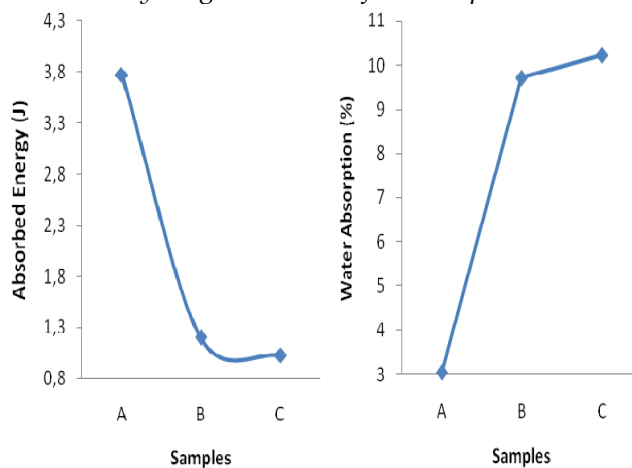
Figure 7: Effect of carbonized palm kernel shell on the (a) absorbed energy and (b) Water adsorption of the samples of the samples

From Figure 7a, it can be observed that the absorbed energy of the test sample decreases with increase in weight percent of carbonized palm kernel shell from 3.772 J at 40 wt% carbonized palm kernel shell to a minimum of 1.0294 J at 60 wt% carbonized palm kernel shell addition. The decrease observed in absorbed energy can be allotted to the increase in porosity in the samples. Thus, according to [21], the capacity of a porous

material in energy absorption can largely be characterized by its plateau strength and porosity. Fig. 7b shows clearly that the amount of water absorbed by the composites increases with the increase in the carbonized palm kernel shell content of the samples. This suggests that the carbonized palm kernel shell is more hydrophilic in comparison with the raw clay sample. In adsorption, molecular attractions known as van der Waals forces play an active part as well as carbon being a porous adsorbent. The primary factors influencing adsorption are adsorbent characteristics, such as the size of interior surface area, pore structure, chemical properties.

3.3. SEM/EDS of the Carbon Bonded Refractory

The SEM/EDS microstructures of the carbon bonded clay composites are shown in Figures 8-10. Morphological analysis using SEM clearly show difference in the morphology of the raw clay sample (Figures 2 & 3) and its composites (Figures 8-10) created by the use of activated carbon.
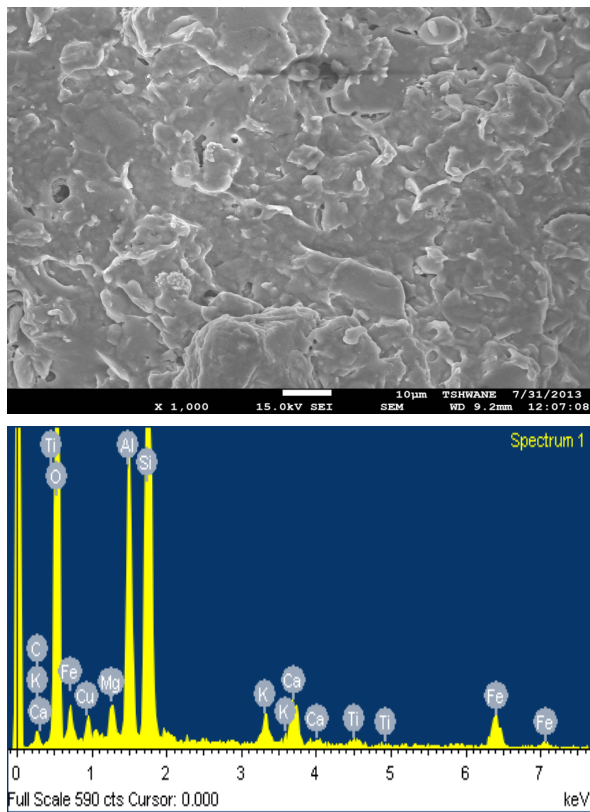
Figure 8: SEM/EDS Microstructure of the 40 % carbonized palm kernel shell addition

The microstructure clearly shows that when the carbonized palm kernel shell particle was added to the raw clay samples, morphological changes in the

structure took place. The microstructure also reveals that the size and shape of the particles vary; however, they consist of porous irregular shape particles.
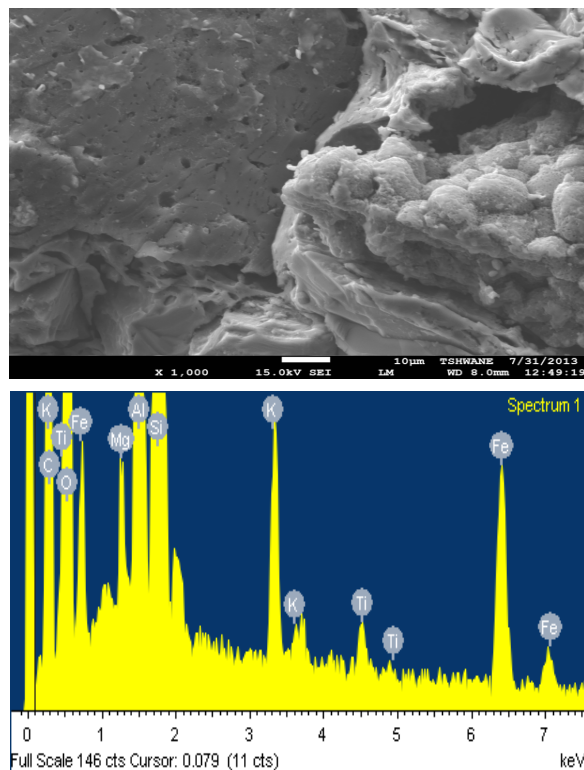
Figure 9: SEM/EDS Microstructure of the 50 % carbonized palm kernel shell addition
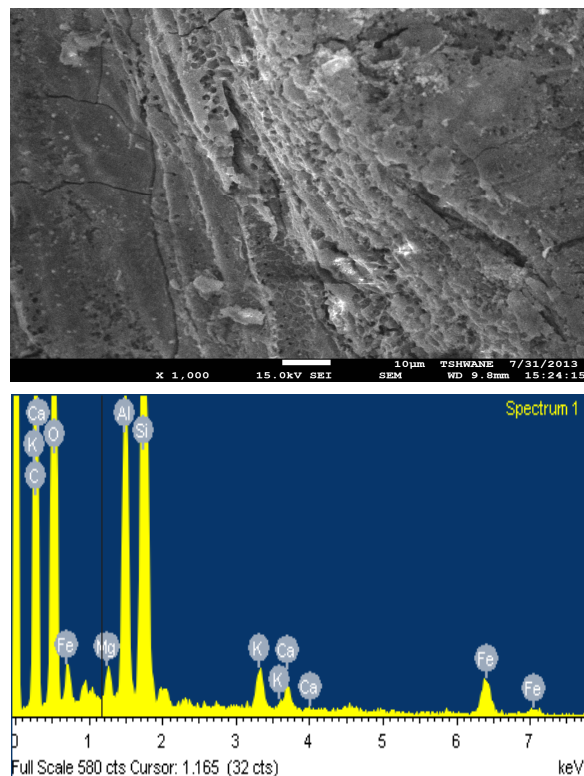
Figure 10: SEM/EDX Microstructure of the 60 % carbonized palm kernel shell addition

The EDS of the composite particles reveals that the particles contain Ca, Si, O, Mg, Al, Fe, P with the presence of C. The carbon presence is due to the carbonization process. These elements confirm that, carbonized palm kernel shell particles consists of calcium carbonate in the form of calcite ($CaCO_3$), the carbonized palm kernel shell have carbon in graphite form. It is therefore observed from the SEM micrographs that Figure 8 reveals little formation of pores. Figure 10 shows that the samples contains many pores than samples A and B. it could be seen that it comparatively contains more element of carbon.

4. CONCLUSION

Clay bonded carbon refractory have been produced and properties investigated. From the results obtained, the following conclusions are drawn:

- ✓ *The major phases in the raw Ifon clay sample are Kaolinite, Microcline, Muscovite/Illite, Quartz and Plagioclase Albite.*
- ✓ *The porosity of the sintered composite samples as well water adsorption reduces with increase in clay content.*
- ✓ *The cold crushing strength, young's modulus and absorbed energy of the samples increases with increase in clay content.*
- ✓ *The optimum combination of mechanical properties is achieved in a sample with composition of 40 wt% carbonized palm kernel and 60% clay.*

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1. Slobodan STEFANOVIC, 2. Imre KISS,
3. Gordana BOGDANOVIC, 4. Damjan STANOJEVIC

ANALYSIS OF FACTORS OF OCCURRENCE OF TOXIC COMPONENTS IN OTTO ENGINE

1. Department of Mechanical Engineering, Higher School of Applied Professional Studies,Vranje, SERBIA
2. Department of Engineering & Management, Faculty of Engineering – Hunedoara, University POLITEHNICA Timisoara, ROMANIA
3. Department of Food technology, Higher School of Applied Professional Studies,Vranje, SERBIA
4. Department of Wood Technology,Higher School of Applied Professional Studies,Vranje, SERBIA

Abstract: *A significant portion of the pollution of the atmosphere, and increasing with the increase of their number, a internal combustion engine. In addition to the requirements for the lower emissions of toxic substances in the exhaust of internal combustion engines, we must not neglect the imperative of saving fuel. The combustion of fossil fuels in internal combustion engines consumed more oxygen than the entire human population. Since there is a direct correlation between the consumption of fossil fuels and oxygen consumption, it is expected that fuel consumption will grow by 2.5 to 5% per year.*
Keywords: *toxic - gas components, combustion products, air, otto engine*

1. INTRODUCTION

A significant portion of the pollution of the atmosphere, and increasing with the increase of their number, a internal combustion engine, which is particularly evident in urban areas, areas of developed industry, heavy traffic and communication. One tone fuel combustion in the engine, depending on the type of engine, control, operating mode, the exhaust gases can occur 150-800 kg CO, 7.5-40 kg NOx and 30-100 kg CH.

In addition to the requirements for the lower emissions of toxic substances in the exhaust of internal combustion engines, we must not neglect the imperative of saving fuel.

Combustion products are composed of:

a) N**on-toxic** gas components, and

b) **Toxic** gas components.

2. MAIN NON-TOXIC GAS COMPONENTS OF PRODUCTS OF COMBUSTION

Nitrogen (N_2) in the motor comes as a component of air, and makes up about 70% of the content of the combustion products. While in the gaseous phase under normal conditions, it is non-toxic and neutral.

Carbon dioxide (CO_2) occurs after the complex mechanism of combustion, and originates from the carbon in the fuel. Its share in the combustion products is 1-16%. During the combustion process resulting water vapor (H_2O) and its share in the combustion products is 2-15%.

In the case when the engine is running with a rich mixture (less air than theoretically necessary) in the combustion products can be found hydrogen (H_2). In case that the engine is running with the lower quality in the the combustion products can be found oxygen (O_2).

In addition to H_2 all these ingredients are complete combustion products, and they can no longer ignite and combusted, so that they do not represent a threat to the external environment and emissions.

The physical and chemical terms, mechanism of formation for these components is very complicated, but it can be simplified display the following formulas:

$$C + O_2 \longleftrightarrow CO_2 + Q \qquad (1)$$

$$2H_2 + O2 \longleftrightarrow 2 H_2O + Q \qquad (2)$$
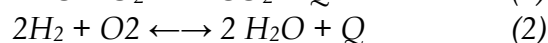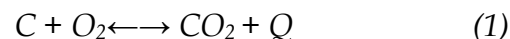
where: Q-heat liberated.

Carbon dioxide (CO_2) is a gas that is not toxic, but with 50% it participates in the occurrence of the greenhouse effect. CO_2 emissions is directly proportional to fuel consumption, because in many countries there is a need for the introduction of legislation in terms of CO_2 emissions coming from the exhaust.

3. MAJOR TOXIC COMPONENT OF COMBUSTION PRODUCTS

Combustion in Otto engines feature undesirable toxic ingredients:

✓ carbon monoxide (CO),
✓ nitrogen oxides (NOx),
✓ unburned hydrocarbons (CH),
✓ odoriferous substances,
✓ lead (in case of use of fuels with ethyl),
✓ a compound of sulfur (if the fuel contains sulfur).

3.1. Carbon monoxide (CO)

Carbon monoxide is the result of incomplete combustion of hydrocarbon in fuel due to a lack of oxygen in the combustion chamber. Theoretically, in the case that the excess air ratio ($λ>1$) in combustion products does not have carbon monoxide because it's combustion in the carbon dioxide (CO_2). Significant amounts of CO occur in a rich mixture of the ($λ<1$). The cause of the presence of CO during combustion in exhaust gas (stoichiometric and lean mixture) is a consequence of the dissociation of carbon dioxide with a maximum temperature of the work cycle. As for the lean mixture the maximal temperature of duty cycle is lower than the maximum temperature of carbon monoxide (CO) is lower.

One of the lowest reaction formation and combustion of CO is:

$$CO + OH \longleftrightarrow CO_2 + H \qquad (3)$$
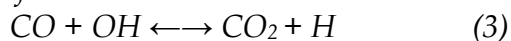
Chemical reactions depends on the temperature. Most likely reason for the appearance of the entire exhaust gases at $λ> 1$ is a relatively slow process of transformation of CO into CO_2, so that a sudden drop in temperature during the expansion causing freezing reaction started established at higher temperatures. The presence of CO in the atmosphere leads to its binding to the hemoglobin in blood decreases, and its antioxidant properties.

This can be explained by the fact that the binding affinity of the hemoglobin with carbon monoxide is greater than to oxygen for about 240 times. CO concentration of 60-120 ppm blocks 10-20% of erythrocytes. With increasing concentrations of CO, directly influences to the traffic safety because it reduces the rate of reaction, affects drivers' attention, decreasing the work ability of drivers.

Carbon monoxide can be oxidized to carbon dioxide, which is why it requires a large activation energy, so he usually stays in the atmosphere as CO. On the other hand, the carbon dioxide is under very high temperatures decomposes to carbon monoxide and oxygen. In humans and animals, carbon monoxide, block oxygen transport, by binding to hemoglobin to form carboxyhemoglobin. In the normal course of breathing oxygen binds to hemoglobin, building oxyhemoglobin.

However, the carbon monoxide has a higher affinity to hemoglobin than oxygen. Lack of oxygen has detrimental effects on the functioning of all organs, especially the brain. Carbon monoxide is a gas asphyxia, who quickly blocked hemoglobin, which results in rapid suffocation. It is a dangerous gas in enclosed spaces due to accumulation.

The concentration of carbon monoxide by 50-60% in the surrounding air is lethal, whereas 80% of the current causing death. If the organism is exposed to a longer period of low concentrations of carbon monoxide produced chronic poisoning, the symptoms of which are increased pulse, disorders of respiration, blood pressure and reflexes.

In plants which are exposed for a long time to higher concentrations of carbon monoxide is negative effects occur.The adverse effects of carbon monoxide on the plants to amplifyin the presence of sulfur oxides and nitrogen oxides.

3.2. Nitrogen oxides (NO$_x$)

Resulting from the reaction of nitrogen and oxygen at high temperatures in the combustion process in the engine cylinder. For the concentration of NO_x, in addition to high temperature the oxygen has an important role. The process of oxidation of nitrogen is carried out according to the following reactions:

1. Entering the nitrogen molecules react with oxygen atoms.

$$N_2 + O \longleftrightarrow NO + N – Q \qquad (4)$$

   (endothermic reaction)
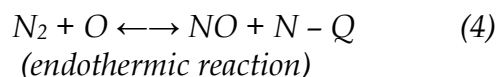
2. Entry of the nitrogen atom in the reaction with oxygen molecules.

$$N + O \longleftrightarrow NO + O + Q \qquad (5)$$
(endothermic reaction)
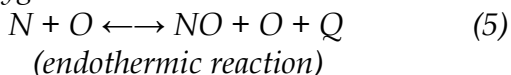
The second chemical reaction equilibrium constant is small and the nitrogen oxides formed in this reaction are insignificant. During the expansion, and in extraction operation the resulting atmosphere of nitrogen monoxide reacts with oxygen giving the nitrogen dioxide:

$$2NO + O_2 \longleftrightarrow 2NO_2 \qquad (6)$$

Nitrogen dioxide is an odorless gas, red brown color, soluble in water and as such gives a ''acid rain''. Nitrogen oxides in contact with moisture irritant effect on mucous membranes of eyes, nose and respiratory tract.

Nitrogen oxide concentration in the area of the rich mixture ($\lambda> 1$), due to the increase in the concentration of molecules and atoms, despite a slight decrease in the maximum temperature of the concentration of nitric oxide cycle and reaches a maximum with impoverishment of the mixture ($\lambda>1$, 1) decreases the concentration of nitrogen oxides occurs even excess oxygen due to a decrease of maximum temperature cycles.

Nitrogen belongs to the essential elements, and is one of four biogenic elements. Biogenic elements (C, H, O and N) make up 95% of living matter, and play a key role in the initiation and maintenance of biological systems.

It is involved in the structure and the amino-acid proteins, nitrogen bases, and nucleic acids.

Anthropogenic activity leads to the transformation of nitrogen to oxides thereof that pollute the air. The most important oxides of nitrogen are nitric monooxide and nitrogen dioxide.

In the soil nitrogen is oxidized in the form of inorganic nitrites and nitrous compounds and the reduced form and in the form of organic compounds, some of which are intermediarius in the way of mineralization.

3.3. Nitrogen -suboxide (N_2O)

Nitrogen - suboxideoccurs in soil by microbial activity through denitrification, whereby they can go into the atmosphere or the activity of other microorganisms converted to nitrate. Its concentration in the atmosphere is very small, only a few ppm.

Due to the physico-chemical properties and durability of 20 years, reaches to multiple layers of the atmosphere (the stratosphere). In the lower layers of the atmosphere are in small concentrations, so there is a risk from the standpoint of pollution, but can easily converts into nitrogen monooxide, which contributes to the pollution of the atmosphere.

Table 1. The composition of the exhaust gases

The composition of the exhaust gases		Approximate value	Remark
	Mark	(%)	
Non-toxic gas components	N_2	70-85	Nitrogen from the air
	CO_2	1-16	Ideal product of the combustion of liquid and gaseous fuels
	H_2O	2-15	
	O_2	0-20	The acid from the air at $\lambda<1$
	H_3	0-6	Product of combustion
The main gas components	CO	0-15	Combustion at $\lambda<1$
	CH	0-2	Unburt hydrocarbons and formaldehyde
	NO	0-0.5	Nitrogen oxides are formed at high temperatures
	$NO3$	0-0.05	
	$CO2$	0-0.5	It comes from sulfur in the fuel
	$NH3$	0-0.2	It occurs in the catalyst

Table 1(continuing). The composition of the exhaust gases

The composition of the exhaust gases		Transparency	Performance	
	Mark		Stimulatory	Toxic
Non-toxic gas components	N_2	Colorless		
	CO_2	Colorless	Low acidic	
	H_2O	Condensing steam		
	O_2	Colorless		
	H_3	Colorless		
The main gas components	CO	Colorless	Odorless	Inhalation poison
	CH	White smoke, blue smoke or colorless	The main causative smell	
	NO	Colorless		Heavy blood poison
	NO_3	The yellow-brown to reddish-brown color	Coughing and irritate the mucous membranes	It damages the lungs
	CO_2	Colourless encourages the formation of aerosols	Irritating odors	
	NH_3	Colorless	Irritating to mucous membranes	

3.4. Nitrogen-monooxide (NO)

By biological path nitrogen monooxide is formed as the oxidative product of metabolism of certain bacteria.

Regarding the sources of anthropogenic pollution of nitrogen monoxide distinguish:
- ✓ *fossil fuels,*
- ✓ *then combustion in industry,*
- ✓ *production of electricity,*
- ✓ *operation of the internal combustion engine (where the high temperature and pressure of elements nitrogen oxidized to NO).*

The concentration of nitrogen monoxide in the exhaust emissions of cars depends on the type of fuel, and driving mode (at higher speeds on the open road, is higher emissions of NO).

Participation of total emissions of nitrogen monoxide percentages like this:
- ✓ *transport (30%),*
- ✓ *power plants (45%),*
- ✓ *industry and domestic furnaces (25%).*

Nitrogen monoxide could be oxidized to nitrogen dioxide, nitrate aerosol, and by photolysisto the gaseous nitrogen.

3.5. Nitrogen-dioxide (NO_2)

Nitrogen monoxide in the air maintains a short time, because of the unstable and quickly subject to oxidation by nitrogen dioxide in the presence of ozone.

Nitrogen dioxide under the influence of sun rays easily decomposed into nitrogen monoxide and atomic oxygen, which by reacting with oxygen produces ozone. If concentrations are not high, these reactions are maintained at an optimum level value of nitrogen monoxide, nitrogen dioxide and ozone.

From the air nitrogen dioxide can be removed by absorption into the soil through the diffusion, by photolytic reactions, or in the form of the compound produced in the secondary air. Of the total annual emissions of nitrogen dioxide 50% comes from transport, 44% of thermal power plants and industry, 6% frees agriculture and combustion of solid waste.

Nitrogen dioxide is a gas of a reddish brown color, pungent odor (sensible already at a concentration of 15 ppm), and is retained for about 3 days in the air. Toxic to the live nature but more toxic than it

is his secondary compounds, nitric acid and nitrate peroxy acyl (RAN). Although the half-life of peroxy acyl nitrate for about 1 hour, he is highly toxic to the plants.

Felling of nitrogen dioxide in the air is conducted by the dry and wet deposition (nitric acid). Nitric acid is stable in the gaseous state, and quickly precipitate out of the sulfuric acid.

Since the nitrogen oxides emitted mostly by transportation equipment, they are retained in the surface layer of the urban environment.

4. UNBURNED HYDROCARBONS

Occur as a result of incomplete combustion at rich mixture, and the unfinished combustion (fire extinguisher) for stoichiometric and lean mixture in Otto engines.

The largest portion of unburned hydrocarbons in the Otto engines comes from the boundary layer temperature, the gap between the piston cylinder liner over the first compression ring from a narrow zone displacement between the piston and cylinder head. In a narrow zone near the walls, is large heat losses, which leads to flame extinction.

Of all the hydrocarbon compounds in the creation of aerosols allogeneic elements have major role. They reacted with oxides of nitrogen, and under the influence of sunlight form ozone and other oxidants, all of them have adverse effects on the body.

4.1. The smell of exhaust gases

The smell of exhaust gases derived from aromatic components contained in the fuel and of the individual components of incomplete combustion. Compounds containing an intense smell are both very poisonous, and the occurrence of smell is a warning of danger, per intense scent stand out:
- ✓ *Nitrogen dioxide,*
- ✓ *Partially oxidized hydrocarbons,*
- ✓ *The compounds of sulfur.*

4.2. Lead (Pb)

In the exhaust gases lead comes from tetraethyl and tetramethyl lead, which is added to gasoline as an antioxidant agent. 75% of the lead products of combustion amounts into the atmosphere, of which one quantity deposited on the ground, and about 40% goes as fine airborne particles in the environment, which in conditions of intense traffic poses a risk to human health.

About 25% of lead contained in the fuel is deposited on the walls of the exhaust system, on the walls of the space for combustion and oil for greasing.

Lead found in the exhaust gases occurs in the compounds of phosphorus, bromine, chrome. When lead gets into the body disrupts the function of the digestive system, neuromuscular system and brain. Lead from the body is very difficult to remove and can reach a dangerous concentration.

In the atmosphere reaches the combustion of liquid fuels (additives), from refineries, production processes of steel, lead, zinc, copper and combustion of coal and wood.

Natural sources of lead dust, volcanic eruptions, fires, vegetation, irrigation and flushing of sea mining.

Lead particles are retained for about 10 hours in the air of industrial and urban regions. It can not be transported long distances, and thus is in Greenland measured concentrations of up to 500 times greater than the natural level.

Lead found used in paint industry, installation, batteries and defense industries. Half of the lead produced is obtained by recycling.

The largest source of lead contamination is the primary combustion of gasoline, because it is still used as an additive.

4.3. Sulfur (S)

If in the fuel is sulfur (S), in the exhaust gas can be found sulfur dioxide (SO_2). It is a colorless, encourages the creation of aerosols, and acid rain, which has an impact on deforestation in the country.

Sulfur in the fuel occurs in the form of combustible and non-combustible. Combustible sulfur in the form of sulphate, iron, calcium, in the course of combustion turns into ashes. Combustion sulfur occurs as the organic (within complex organic compounds).

The presence of sulfur in the fuel is highly undesirable because the sulfur is corrosive, and their combustion products is harmful to living world and create acid rain.

Large amounts of sulfur are used in the vulcanization process in which the rubber is transformed into a tire. Natural rubber by treating sulfur loses its stickiness and becomes more elastic.

This process takes place at a temperature between 100-150˚C. Depending on the percentage of sulfur is obtained soft or totally hard rubber.

A certain amount of sulfur is in the oil in the soil gas (unprocessed oil and natural gas that is obtained in certain regions contain large amounts of sulfur. By their burning occurs sulfur dioxide and refineries are required to remove the sulfur from it). Sulfur contained in the pure form below soil is dissolving in hot water steam and extracted to the earth's surface it with compressed air. An important source of sulfur is well as its compounds that are found in industrial gases.

4.4. Ammonia (NH_3)

Ammonia is a chemical compound of oxides and nitrogen with molecular formula NH_3. Under normal conditions, ammonia is gas. It is poisonous, corrosive to some materials, is characteristic odor.

Ammonia is used in the production of fertilizers, explosives and polymers. Also ammonia is an ingredient of some detergents for glass.

Liquid ammonia is also used as the solvent. Also ammonia is used in cooling devices. Ingredient with high toxicity resulting from the reduction of NO in the catalyst. In the exhaust gases are present in small amounts to 0.2%. Irritating to eyes and mucous membranes of the respiratory tract.

4.5. Soot

Particles of soot in the air badly affect to the health of people who have problems with the respiratory organs in asthmatics, patients with chronic bronchitis or other. Carbon black is a collection of various compounds that are found in the air. The composition of the soot and varies depending on the composition, carbon black may be a carcinogen and irritating. The composition of the soot is nowhere examined and it is mostly hydrocarbons.

During the combustion of different types of fuel in the engines, in addition to release of the energy is discharged and a large quantity of harmful substances such as carbon monoxide, carbon dioxide, sulfur dioxide, nitrogen oxide, soot and ash.

In Otto engine, the appearance of soot is linked to work with a rich mixture (little oxygen), whereas under normal conditions of engine running soot occurs in negligible quantities.

Soot particles can absorb various organic and inorganic compounds that are products of incomplete oxidation of fuel and lubricant, where can be very toxic.

5. SOLUTION THAT REDUCES THE AMOUNT OF ALREADY FORMED TOXIC COMPONENTS

Neutralization of the content of toxic components in the exhaust system of Otto engines can be realized by installing thermal, catalytic and combined reactor.

Depending on the application of appropriate fuels these solutions can be divided into two basic groups:

✓ Systems which permits the use of fuels with ethyl,

✓ Systems that require the application of unleaded gasoline.

The principles of operation of both of these groups are shown in the following figure I.

6. INSERTION OF AIR INTO THE EXHAUST SYSTEM

Insertion of air into the exhaust system proved to be effective in reducing the content of carbon monoxide (CO) and hydrocarbons (CH). The amount of air depends on the temperature of the exhaust gas. If the temperature can be advantageous to perform post-combustion of these two components in the exhaust system.

The air in the exhaust inserts by a special mechanical pump. The air is inserted as close to the exhaust valve. Insertion of air is combined with thermal insulation channels in the cylinder head and exhaust system. Inserting the inserts in the the special channel, create an insulating air layer, which gives good results.

7. PROTECTION OF AIR POLLUTION

The overall objective is to prevent, reduce or remove any pollution that degrades the environment. Protection of air pollution in residential areas can be achieved by zoning measures, technical and technological processes, as well as maintaining cleanliness of roads and public spaces in neighborhoods proper clearing up of solid and liquid waste.

Zoning measures to protect settlements from air pollution include proper planning and zoning settlements. Zoning protection measures goes back

to when the general planning of the entire region selection of the winning features of the relief and the wind rose for the location of settlements, in the location in general and detailed urban plans are extremely important in terms of zoning settlements and provide sufficient surface vegetation. Particular attention should be paid to the choice of location for a residential area as the cleanest part of the settlements and industrial zones as part of the settlement burdened with pollutants. Proper planning of roads is very important, both in relation to the wind rose, and in relation to the frequency of traffic.
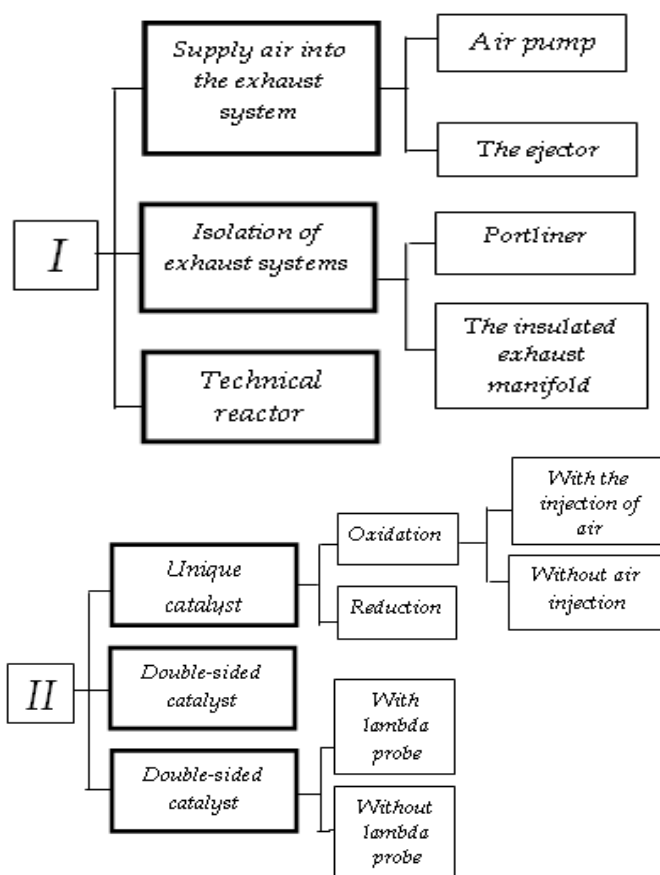
Figure I. Overview of the system to reduce the content of toxic components
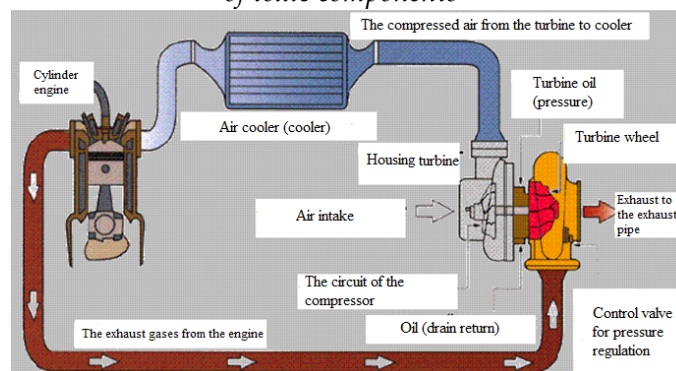
Figure II. Insertion of air into the exhaust system

Technical and technological measures aimed at improving combustion in furnaces, improvement of technological processes of production, with the lowest percentage of waste and emissions of air pollutants. There are a number of technological processes that may be used to protect the air.

Reducing carbon dioxide emissions can be achieved:

- ✓ *selecting an oil which contains less of sulfur;*
- ✓ *desulfurization of fuel and exhaust gases;*
- ✓ *control the amount of air in the combustion;*
- ✓ *reducing hydrocarbon emissions in the transport and processing of fuels (petroleum and its derivatives);*
- ✓ *reducing carbon dioxide emissions by switching to closed production systems;*
- ✓ *removing particles cyclones;*
- ✓ *removing particulate filtration;*
- ✓ *removing electrostatic sedimentation;*
- ✓ *treatment of waste gas absorption;*
- ✓ *catalysts to control emissions from cars; and*
- ✓ *catalytic removal of NO_x and SO_2 from gaseous combustion products*

8. CONCLUSION

The negative impact of traffic on people and the environment, in the work is expressed through the negative external effects of transport (accidents, congestion, capture area, noise, exhaust fumes). These negative effects caused occurrence of certain costs which are defined as the external costs of transport, that man has always avoided factored into the budgets of other costs.

The presence of polluting substances in the air has a number of direct and indirect impacts on the health of all living beings in the biosphere and even the material time. The overall objective is to prevent, reduce or remove any pollution that degrades the environment. Environment for a long time been considered a natural treasure inexhaustible resource that all claimants.

Atmospheric pollution by sulfur dioxide to the fullest extent, is derived from artificial sources of contamination (85% of total emissions), and that:

- ➢ *combustion of fossil fuels,*
- ➢ *operation of thermal power plants,*
- ➢ *oil refineries, and other.*

Once the clean air of the lower atmosphere, which was one of the primary factors in the origin of life and in the human evolution, still has a tendency of significant changes and begins to threaten human. All combustion processes are accompanied by oxygen consumption.

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1. Sadiki LAMARI ABDELMAJID, 2. Salah Eddine EL QOUATLI,
3. Abdelilah CHTAINI

ELECTROCATALYTIC ACTIVITY OF Ni MODIFIED CARBON PASTE ELECTRODE IN DIRECT ETHANOL FUEL CELLS

1-3. Equipe d'Electrochimie Moléculaire et Matériaux Inorganiques, Université Sultan Moulay Slimane, Faculté des Sciences et Techniques de Béni Mellal, Maroc

Abstract: Fuel cells have been identified as a promising power source for transportation and portable electronic devices, since they convert the chemical energy of a fuel derectly into electrical energy. The performance of direct ethanol fuel cells (DEFCs) is still limited by the electrocatalysts available for ethanol oxidation, which are mostly based on expensive noble metals such as platinum or its alloys. Investigations on systems using Ni modified carbon paste electrode (Ni-CPE) electrocatalysts for ethanol oxidation in alkaline solution. The relative activities of the Ni-CPE catalyst were assessed. The results show that this electrode is active for the ethanol oxidation. The prepared electrode shows a considerable performance in direct ethanol fuel cell.
Keywords: Fuel cell, ethanol, electrocatalyst, modified electrode, power density

1. INTRODUCTION

The performance of direct ethanol fuel cell is still limited by the electrocatalysts available for ethanol oxidation.

Fuel cells have been identified as a promising power source for transportation and portable electronic devices, since they convert the chemical energy of a fuel derectly into electrical energy; have low emissions and absence of moving parts. The Direct Ethanol Fuel Cell is an electrochemical device which converts the energy through chemical reactions: electrooxidation of ethanol, into electrical energy. The demand for energy, coupled with concerns about environmental pollution and growing fossil fuel costs have created a great need for clean and efficient power sources [1]. Both direct methanol fuel cells and direct ethanol fuel cells have been projected to be strong candidates to complete with advanced batteries for powering mobile and portable electronic devices owing to their uniquely high specific energy [2]. However methanol is toxic for human beings is easily volatile and inflammable as well as non- renewable [3-5]. Among the other alcohols available, ethanol appears as an attractive and promising fuel due to it's:

i-   Non-toxicity,

ii-   Natural availability,

iii-   Renewability

iv-   Higher power density

Based on that, direct ethanol fuel cells (DEFCs) appear as more attractive technologies than direct methanol fuel cells (DMFCs) [6-8].

The performance of direct ethanol fuel cells (DEFCs) is still limited by the electrocatalysts available for ethanol oxidation, which are mostly based on expensive noble metals such as platinum or its alloys [9-12].

Past research on the development of DEFCs has focused mainly on the so-called PEM DEFCs that use PEM as the electrolyte, a Pt-based catalyst on the anode, and a pure Pt catalyst on the cathode [13-14].

In this work, Ni-CPE anode is prepared by electrodeposition nickel catalyst layer onto carbon paste surface. The morphology and structure of the relative activities of the Ni-CPE anode were assessed by TEM. The relative activities of the prepared electrode were tested for ethanol oxidation reaction.

2. Experimental section

2.1. Apparatus

Electrochemical experiments were performed using a voltalab potentiostat (model PGSTAT 100, Eco

Chemie B. V., Utrecht, The Netherlands) driven by the general purpose electrochemical systems data processing software (voltalab master 4 software).

All the electrochemical experiments were performed in a standard one-compartment three-electrode cell. The reference electrode was SCE and the counter electrode was platinum. All electrode potentials were referred to this reference electrode. The working electrode was copper modified carbon paste electrode (Ni-CPE).

2.2. Reagents and solutions

All chemicals were of the highest quality. Graphite powder (spectroscopic grade RWB, Ringsdorff-Werke GmbH, Bonn-Bad Godesberg, Germany) was obtained from Aldrich and was used without further purification. $NiSO_4$ was obtained from Merck chemicals. Deionised water was used to prepare all solution. Electrolytic solution is 0.1 M KOH.

2.3. Preparation of the modified electrode

The carbon paste unmodified was prepared by adding paraffin oil to carbon powder and thoroughly hand –mixing in a mortar and pestle. The resulting paste was packed into the electrode and the surface was smoothed. The electrocatalyst electrode (Ni-CPE) was developed by depositing the nickel at fixed potential (0.1 V for 1 hour) onto the carbon paste electrode surface.

3. RESULTS AND DISCUSSION

3.1. Characterization of prepared electrode

The cyclic voltammograms (CVs) of the unmodified carbon paste electrode (CPE), and Ni-CPE were recorded in the supporting electrolyte (0.1M KOH solution).
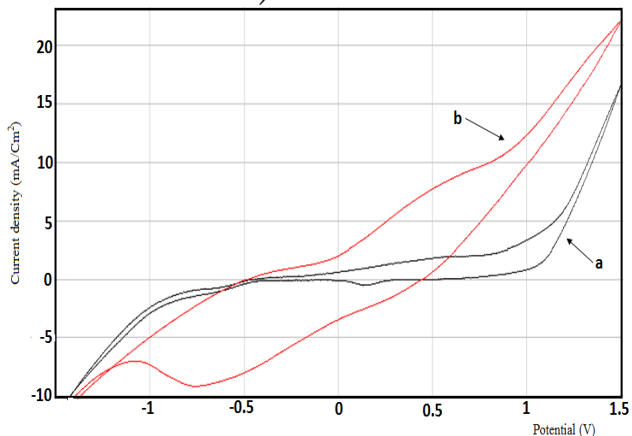
Figure 1. Cyclic voltammograms recorded in electrolytic solution at 100 mV/s, at a- carbon paste electrode, b- nickel modified carbon paste electrode

The change of the CVs shapes (Figure. 1), before and after modification, is a major sign that the carbon paste electrode was, effectively, modified with Ni.

A typical EDX spectrum is shown in Figure 2 the atomic ration of Ni (electrodeposited onto carbon paste electrode) is about (40%). The characteristic peak of Ni can not be found in Figure 2. It indicates that CPE is almost fully covered by the Ni catalyst layer.
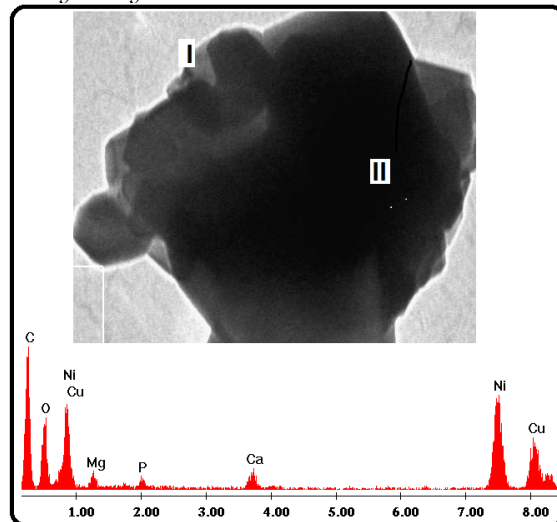
Figure 2. EDX spectra analysis of the Ni-CPE scanning electron micrographs of the cross-section of Ni-CPE anode: II: Ni and I: CPE catalyst

The Nyquist plots for the tested electrode Ni-CPE, in alkaline solution is presented in Figure 3. The locus of Nyquist plots is regarded as one part semi circle in CNi-CPE electrode (curve b), but in carbon paste electrode (curve a), the plot was not perfect semi circle. This feature had been attributed to frequency dispersion of interfacial impedance, and corrosion resistance of carbon paste electrode better than Ni-CPE.
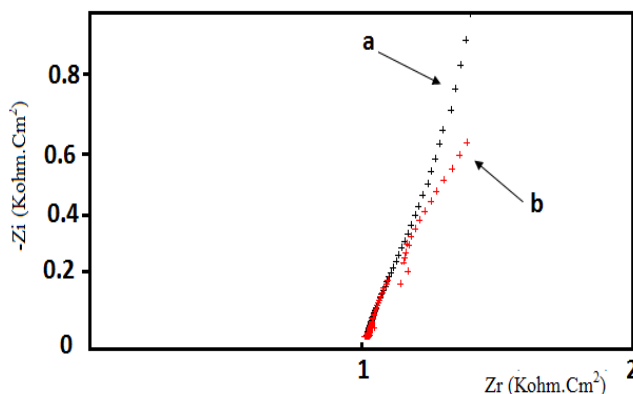
Figure 3. Electrochemical impedance spectroscopy recorded for CPE (curve a) and Ni-CPE (curve b), in 1M KOH solution

3.2. Ethanol oxidation

Figure 4 compares the transient curves recorded, successively, at carbon paste electrode (curve a) and at nickel modified carbon paste electrode (curve b), in 0.1M KOH containing 0.24 mol/L ethanol. It is clearly seen that carbon paste electrode has little activity of ethanol oxidation. The onset potential of ethanol oxidation is observed at around 500 mV for Ni-CPE (Figure 5). The Ni-CPE showed much better electrochemical activity and stability than carbon paste electrode.
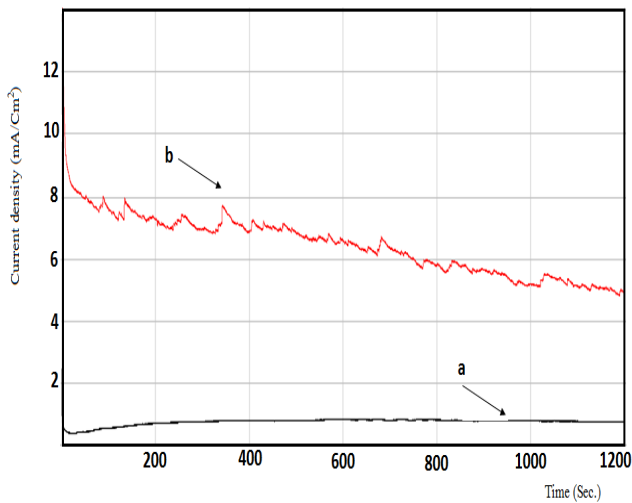
Figure 4. Chronoamperometry curves of a-Carbon paste electrode and b- Ni-CPE for ethanol oxidation, in 0.1M KOH.
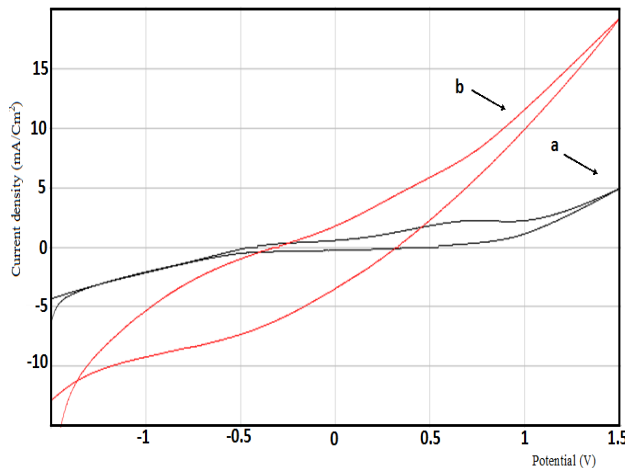
Figure 5. Steady state cyclic voltammograms of a- carbon paste electrode and b- Ni-CPE in 0.1 M KOH + 0.24 M ethanol, scan rate 100 mV.s^{-1}, room temperature.

The ethanol concentration on fuel cell performance has a positive effect. An increase on ethanol concentration will lead to an increase on the coverage of the electrocatalyst, increasing the ethanol oxidation reaction, and to an increase of current density (Figure 6).
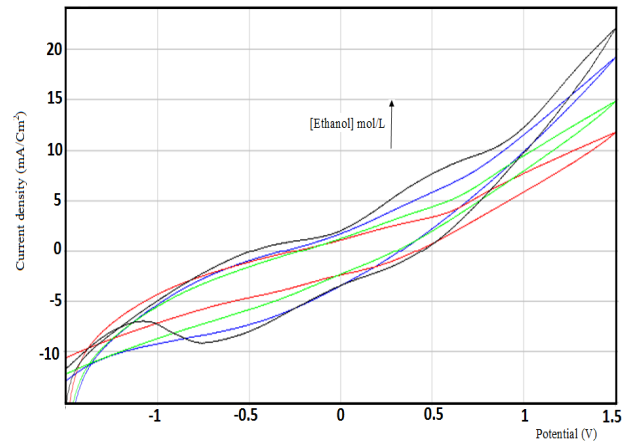
Figure 6. Influence of ethanol concentration on oxidation current density

The results presented in Figure 7, show that increase of ethanol concentration leads to increase in cell performance.

The effect of ethanol concentration on fuel cell performance usually, have two different effects, a positive and a negative one:

i- *An increase on ethanol concentration will lead to an increase on the coverage of the electrocatalyst, increasing the ethanol oxidation reaction, and to increase of the oxidation current density;*

ii- *From a certain concentration of ethanol, the total active sites were occupied by the ethanol molecule, which leads to the deterioration in performance of the fuel cell.*
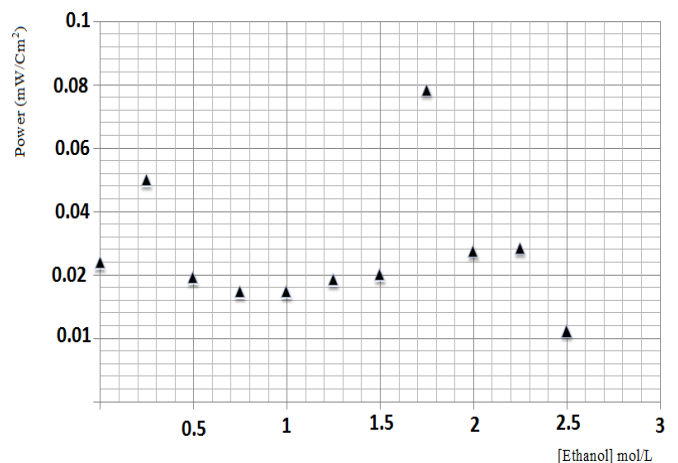
Figure 7. Influence of ethanol concentration on power density

4. CONCLUSION

Based on the obtained results and discussion, it is concluded that Ni-CPE based catalyst shows good promises to improve the activity of oxidation reaction of ethanol in alkaline media, and the effect of ethanol concentration was studied.

High ethanol concentrations achieve lower fuel cell performance.

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1. *Alina LĂSCUȚONI*

STEEL THERMAL STRATIFICATION DURING STATIONARY PERIOD IN LADLE

1. *Politechnica University Timişoara,*
Faculty of Engineering of Hunedoara, ROMANIA

Abstract: *The paper presents the issue of the thermal stratification of the metal bath in the ladle during its stationary period. Due to the suggested research and experiments we aim primarily at knowing this phenomenon in detail and at investigating its influence upon the control of the temperature during the continual pouring of the steel. As a consequence of the natural convection, a vertical temperature gradient appears in the metal bath, because the metal bath, is formed of layers of steel, colder towards the bottom and the top of the ladle, and hotter in its middle section. The phenomenon of thermal stratification of the metal bath from the ladle and its influence upon the temperature control during the steel continuous casting has a major importance in steel plants.*
Keywords: *steel, thermal stratification, ladle, temperature*

1. INTRODUCTION

Because of the inevitable heat losses of the ladle, the natural convection is a phenomenon which takes place in the ladles during the stationary period, prior to its emptying. A consequence of this phenomenon is the thermal stratification of the metal bath contained by the ladle. Because of the heat loss in the liquid alloy which comes to direct contact with the refractary masonry of the ladle's walls, this cools and becomes denser than the rest of the steel. The liquid steel, colder and heavier, descends towards the bottom of the ladle, from where it pushes up the hotter and lighter steel. As a consequence of this phenomenon, a vertical temperature gradient appears in the metal bath, because the metal bath, contained by the ladle, is formed of layers of steel, colder towards the bottom and the top of the ladle, and hotter in its middle section. This phenomenon has been name „thermal stratification" in the literature.

2. SCIENTIFICAL RESEARCH

The phenomenon of thermal stratification of the metal bath from the ladle and its influence upon the temperature control during the steel continuous casting has a major importance in steel plants. This is due to the fact that the temperature of the liquid steel flowing from the furnace inside the ladle where a thermal stratification is produced will have a direct impact on the temperature of the liquid steel from the distributor of the continuous casting machine. As a consequence of this phenomenon, a temperature variation will also take place in the distributor during the pouring, as well as in the crystallizer of the continuous casting machine. The temperature variation of the steel in the crystallizer has an influence upon the structure of the pouring of blanks and upon the quality of their surface. It is obvious that the easiest technological measure for the thermal homogenization, as well as for the diminishing of the thermal stratification is sparging the liquid steel with inert gases. Due to this cause the investigation of this impact is absolutely necessary, but this firstly demands a good understanding of the phenomenon of thermal stratification inside the ladle.

According to the professional studies, we have noticed that there are only a few works related to these aspects, and the current studies have mainly focused on laboratory and industrial measurements, mathematical simulation and physical simulation.

Hlinka and Miller [1] made the first attempts in measuring the thermal stratification of the metal bath contained by a ladle, with the capacity of 7.5 to. For this, they used a bar made from refractary materials, on which they fixed three thermodevices, at different levels.

Petegnief and others [2], measured the thermal stratification from a ladle with a 7 to capacity in a similar way.

Wester [3] and Jonsson [4], in order to emphasise thermal stratification, installed three thermodevices, at different levels, in the refractary masonry of a ladle with a 7 to capacity, thermodevices which infiltrated the metal bath on a distance of 50 mm.

Rieche and others [5] and Grip [6,7], succeeded in emphasizing the thermal stratification existent in the industrial ladles, by introducing, in the metal bath of the ladle, a tool made by refractary materials equipped with thermodevices fixed at different heights.

These measurements have proven the existence of temperature gradients on the height of the metal bath and have confirmed the existence of the thermal stratification in the metal bath contained by ladles. Even more, Grip [6] has also shown that this thermal stratification can be easily prevented through the temporary shacking of the metal bath (less than 5 min), through the blasting of argon. Still, the thermal stratification appears almost immediately after the argon blasting stops, because of the fact that the ladle continually loses heat, so the natural convection takes place permanently. These results have attested that, if the metal bath contained by the ladle is „calm" (for example when the ladle is about to be emptied), the thermal stratification is inevitable as long as no other measures are taken in order to shake the metal bath.

The methods of direct measurement of the metal bath stratification contained by the ladles, previously presented, require a high discharge of effort and time, as well as high costs. Because of this, they are not recommended as strategies for the studying of thermal stratification in the ladles, however, they can still be used for checking the mathematical patterns developed with the purpose of simulating these phenomena.

Focusing on the CFD theory (Computational Fluid Dynamics), a few mathematical patterns have been developed in order to simulate the natural convection in ladles. These patterns somehow give a computational answer to the equations with partial Navier-Stokes derivatives of the turbulent pouring, equations which describe the phenomena of thermal transfer and pouring which take place during the natural convection, through the solving of whom the speed field and the temperature distribution inside the ladles result.

Ilegbbusi and Szekely [8] have developed a bidimensional pattern for the simulation of the thermal stratification phenomenon of the metal bath in a ladle equipped with an electromagnetic shaker. Their studies have emphasized the existence of the phenomenon of thermal stratification and have also shown that the thermal heterogeneity of a metal bath from a ladle can be diminished by an electromagnetic shaking of the bath.

Koo, and others [9] have also produced a CFD bidimensional pattern, used for the same purpose, with the sole difference that the shaking of the metal bath is done through the blasting of argon. Their results have shown that, for a 20 min. stationary period of the ladle, the difference in temperature between the superior and the inferior part of the metal bath can go up to even 24^0C, and the shaking of the metal bath by blasting argon can reduce this difference to 3^0C.

Austin, and others [10], has established a CFD bidimensional pattern that computes the thermal stratification of the metal bath in ladles with different capacities (125, 200 and 275 to). Focusing on the results of the research, the authors of the studies managed to correlate the speed of developing the thermal stratification with the speed of cooling the ladle on the basis of a simple linear relation, common to all the studied ladles, no matter their size.

Chakrabotry and Y.Sahai [11] have also established a CFD bidimensioanl pattern for the simulation of thermal stratification of the metal bath in the ladles, focusing on the effect that the thickness of the cinder layer from the surface of the metal bath has on this phenomenon.

3. EXPERIMENTS AND RESULTS

In order to develop these studies and to obtain some precise patterns for the stratification of the metal bath through simulation I have traced, from a thermic point of view, the process of the steel casting from the intermediate ladle with a capacity of 110 to during a period of 30-35 min/ 10 charges at ArcelorMittal Hunedoara, the O.E.2. section.

The data obtained after performing the measurements are presented in Table 1.

Table 1. *The temperature of the steel during its casting from the intermediate ladle*

Charge no.	Time	Temperature [°C]
1	23:40	1554
	00:00	1555
	00:15	1548
2	22:25	1546
	22:35	1548
	22:55	1547
3	11:20	1544
	11:35	1548
	11:50	1545
4	8:05	1552
	8:20	1554
	8:40	1553
5	9:10	1552
	9:25	1555
	9:40	1553
6	2:40	1545
	2:55	1546
	3:10	1544
7	0:35	1550
	0:50	1552
	1:05	1549
8	12:15	1523
	12:30	1525
	12:45	1522
9	16:40	1537
	16:55	1540
	17:10	1536
10	3:05	1545
	3:25	1547
	3:45	1542

The thermal stratification of liquid steel can be one of the causes of the flaws in terms of material that appear during the continual pouring of the steel.

In order to avoid them one must also avoid thermal stratification, which exists in the metal bath of the ladle during its stationary period, the temperature of the liquid steel having to be as constant as possible.

The flaws in terms of material during the continual pouring of steel appear during the solidifying of the blank poured continually and its cooling, often leading to important metallic losses. [13] In order to prevent these losses, the purpose of metallurgical technologies and of the constructive purposes is to track down their causes of appearance, of prevention and of removal.

According to the professional literature, the fault can be defined as any deviation from the exterior aspect, form, dimension and macrostructure, chemical features, prescribed in standards or other active technical regulatory documents. The faults are detected at the blank reception through a visual control of the surface quality on the inspection bases or during the control of the sample macrostructures in the laboratory.

A fault is not always the consequence of a unique cause. Many times the fault is the result of the interaction between more than one cause, depending on a fluctuant number of parameters.

Similar faults, as far as the exterior aspect is concerned, can have one or more different causes, as well as apparently different faults can have, in between causes, one or more common causes. That is why, we can often observe the existence of more faults on the same blank. The faults that appear during the continual pouring of the steel can be classified as follows: surface faults, internal faults, shape faults, mechanical faults and deviations from the chemical composition of steel.

Let us now remember some of the faults in terms of material that appear during the continual pouring of the steel caused by defying the pouring temperature according to the limits estimated by technology.

4. SURFACE FAULTS

a) Fissures

Longitudinal fissures (figure 1) – are formed in the direction of extraction of the wire in the crystallizer, the bar that displays this fault usually being discarded totally.

The causes that lead to the appearance of the longitudinal fissures are:

✓ the irregular removal of the heat in the crystallizer and, consequently, the irregular growth of crust on the wire, thus causing transversal fissures which lead to the breaking of the wire, if the crust is not strong enough (primary irregular cooling);

✓ the turbulent fault of metal and a variation in the level of the meniscus in the crystallizer;

✓ the too intense or irregular secondary cooling;

✓ the unequal and advanced wearing of the crystallizer which results in a different coefficient of thermic conductibility;
✓ a high casting temperature (defying ΔT);
✓ the high speed of wire extraction;
✓ the abnormal behavior of the pouring dust.

Figure 1. Longitudinal fissures

Stellar fissures (Figure 2) and the ones determined by the fragility to heat – are very smooth and visible only on the surface without dross. They are polished locally in order to remove the fault (in case it is not deep).
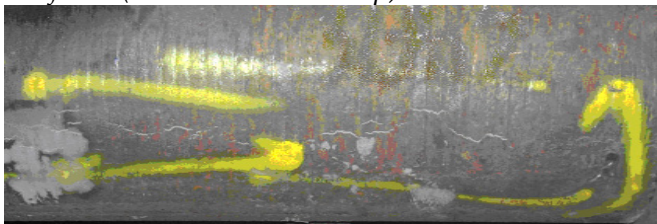
Figure 2. Stellar cracks

The causes that lead to the appearance of stellar fissures are:
✓ the intense local cooling that induces local tensions;
✓ the presence of copper at the limit of the austenitic grain.

b) Depressions

Longitudinal depressions (Figure 3) – appear because of:
✓ the uneven thermal transfer in the crystallizer tank which determines the unequal expansion of the marginal peel;
✓ the oscillation of the steel level in the crystallizer tank as well as a way larger quantity of melted flux between the wall of the crystallizer tank and the wire;
✓ the turbulent flow of the steel in the sub-meniscus;
✓ the unequal and advanced depreciation of the crystallizer tank which has as consequence a different coefficient of thermal conductibility.

c) Casting disruption

Casting disruption (Figure 4) – is determined by a short disruption of the casting process, and the fault is scavenged through shaking the bar that contains it. This fault appears because of the sudden variation of the casting speed which is due either to the temperature variation of the steel from the distributor, either to the level variation from the crystallizer tank, either to the casting method (manually).

The main way of remedying the problem is maintaining a constant casting speed by assuring a low level of thermal variation in the distributor, by maintaining the level from the crystallizer tank within the given limits and by using an automatic method of casting.

Figure 3. Longitudinal depressions

Figure 4. Pouring disruption

d) Cavity

Cavities (Figure 5) – represent an empty space in the material, visible in the transversal section, at the end of a bar and it is scavenged by cutting off the end of the bar, and the flawed portion is discarded. This fault may be caused by:
✓ a high casting temperature;
✓ a high extraction speed;
✓ intense after cooling.

Figure 5. Cavity

5. INTERNAL FAULTS

a) Fissures

Are openings in the interior of a slab billet, identified by macroscopic analysis and can be:

Internal marginal fissure (Figure 6) – is short and very close to the surface tears, under the dingle and can be caused by:

- ✓ a high casting temperature;
- ✓ a high casting speed;
- ✓ intense after cooling and jet cooling;
- ✓ uneven distribution of the lubrication powder between the crystallizer tank and the rack.
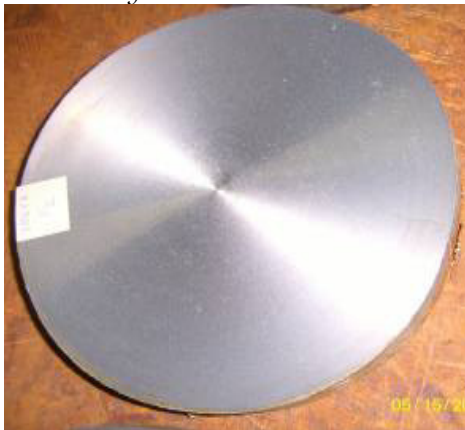
Figure 6. Internal marginal fissures

Central fissure (Figure 7) – internal fissures that extent to the core and which appear due to the following:

- ✓ a high casting temperature;
- ✓ a high pressure of the pulling cylinders on the incompletely solidified wire.

Figure 7. Central fissures

b) Micro cavity

Micro cavity (Figure 8) – is a lack of material in the central part of a transversal section (sample), taken from a steel bar. It appears after a contraction of the material in the process of turning from a liquid state in a solid state.

This fault appears because of:

- ✓ a high casting temperature;
- ✓ a high extraction speed;
- ✓ an intense after cooling;
- ✓ the maintain of the ΔT in the given limits;
- ✓ the correlation of the casting speed, ΔT and a cooling system;
- ✓ reducing the casting speed;
- ✓ reducing the cooling intensity by maintaining the water debit at the given minimum level.

Figure 8. Micro cavity

c) Central pinches

Central pinches (Figure 9) – are a lack of interior homogeneity of the continuous casting wire and can be sometimes accompanied by a cavity, having the same causes for the apparition. During the ulterior heating it is soldered together and the continuous casting material should not be discarded.

Figure 9. Central pinches

Causes for the apparition of central pinches are:

- ✓ a high casting temperature;
- ✓ a high extracting speed;
- ✓ intense after cooling.

6. CONCLUSIONS

Because the thermal stratification, existent in the metal bath of the ladle in its stationary period, (before its descent), must be as low as possible and have a somehow constant temperature, the following **technological measures** must be applied:

✓ The stationary period should be as small as possible;

✓ The initial thermal content of the ladle, (valued by the temperature of the interior surface of the clay work, before filling it up with liquid alloy) must be as high as possible;

✓ The clay work of the ladle must be made from materials with a very low thermal conductibility;

✓ The layer of slag, from the surface of the metal bath, must have a thickness of 60-70 mm;

✓ The descent debit of the ladle must have the highest value, dependent on the casting speed;

✓ Before casting in the distributor, argon splashing is obligatory;

✓ Establishing some precise correlations between the technological parameters of casting (the casting speed, the pulling speed and the cooling speed) and the temperature of the steel from the distributor / crystallizer tank;

✓ The smallest possible amount of response time to the modification of the parameters.

We consider the simulation program Autodesk Algor Simulation Professional 2010 for the study of heating transfer can offer relevant information about the phenomena that take place during the steel continuous casting, without high costs and a low degree of time and effort.

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1. Rohit BHADAURIA, 2. Rituparna CHAKI,
3. Nabendu CHAKI, 4. Sugata SANYAL

A SURVEY ON SECURITY ISSUES IN CLOUD COMPUTING

1. School of Electronics and Communications Engineering, Vellore Institute of Technology, Vellore, INDIA
2. West Bengal University of Technology, BF-142, Sector III, Salt Lake, Kolkata, INDIA
3. Department of Computer Science & Engineering, University of Calcutta, Kolkata, INDIA
4. Corporate Technology Office, Tata Consultancy Services Mumbai, INDIA

Abstract: Cloud Computing holds the potential to eliminate the requirements for setting up of high-cost computing infrastructure for the IT-based solutions and services that the industry uses. It promises to provide a flexible IT architecture, accessible through internet for lightweight portable devices. This would allow multi-fold increase in the capacity or capabilities of the existing and new software. In a cloud computing environment, the entire data reside over a set of networked resources, enabling the data to be accessed through virtual machines. Since these data-centres may lie in any corner of the world beyond the reach and control of users, there are multifarious security and privacy challenges that need to be understood and taken care of. Also, one can never deny the possibility of a server breakdown that has been witnessed, rather quite often in the recent times. There are various issues that need to be dealt with respect to security and privacy in a cloud computing scenario. This extensive survey paper aims to elaborate and analyze the numerous unresolved issues threatening the Cloud computing adoption and diffusion affecting the various stake-holders linked to it.

Keywords: Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS), Interoperability, Denial of Service (DoS), Distributed Denial of Service (DDoS), Mobile Cloud Computing (MCC)

1. INTRODUCTION

Internet has been a driving force towards the various technologies that have been developed. Arguably, one of the most discussed among all of these is Cloud Computing. Cloud computing is seen as a trend in the present day scenario with almost all the organizations trying to make an entry into it. The advantages of using cloud computing are: i) reduced hardware and maintenance cost, ii) accessibility around the globe, and iii) flexibility and the highly automated process wherein the customer need not worry about software up-gradation which tends to be a daily matter [23, 32].

A plethora of definitions have been given explaining the cloud computing. Cloud Computing has been defined as the new state of the art technique that is capable of providing a flexible IT infrastructure, such that users need not own the infrastructure supporting these services. This integrates features supporting high scalability and multi-tenancy. Moreover, cloud computing minimizes the capital expenditure. This approach is device and user-location independent. According to the different types of services offered, cloud computing can be considered to consist of three layers. IaaS or Infrastructure as a Service (IaaS) is the lowest layer that provides basic infrastructure support service. PaaS – the Platform as a Service (PaaS) layer is the middle layer, which offers platform oriented services, besides providing the environment for hosting user's applications. SaaS - Software as a Service (SaaS) is the topmost layer which features a complete application offered as service on demand [5]. **SaaS** ensures that the complete applications are hosted on the internet and users use them. The payment is being made on a pay-per-use model. It eliminates the need to install and run the application on the customer's local computer, thus alleviating the customer's burden for software maintenance. In SaaS, there is the Divided Cloud and Convergence coherence mechanism whereby every data item has either the "Read Lock" or "Write Lock" [3]. Two types of servers are used by SaaS: the Main Consistence Server (MCS) and Domain Consistence Server (DCS). Cache coherence is achieved by the cooperation between MCS and DCS. In SaaS, if the MCS is damaged, or compromised, the control over the cloud environment is lost. Hence securing the MCS is of great importance.

In the **Platform as a service approach (PaaS)**, the offering also includes a software execution environment. As for example, there could be a PaaS application server that enables the lone developers to deploy web-based applications without buying actual servers and setting them up. PaaS model aims to protect data, which is especially important in case of storage as a service. In case of congestion, there is the problem of outage from a cloud environment. Thus the need for security against outage is important to ensure load balanced service. The data needs to be encrypted when hosted on a platform for security reasons [34].

Infrastructure as a service (IaaS) refers to the sharing of hardware resources for executing services, typically using Virtualization technology. With IaaS approach, potentially multiple users use available resources. The resources can easily be scaled up depending on the demand from user and they are typically charged for on a pay-per-use basis. The resources are all virtual machines, which has to be managed. Thus a governance framework is required to control the creation and usage of virtual machines.   This also helps to avoid uncontrolled access to user's sensitive information.
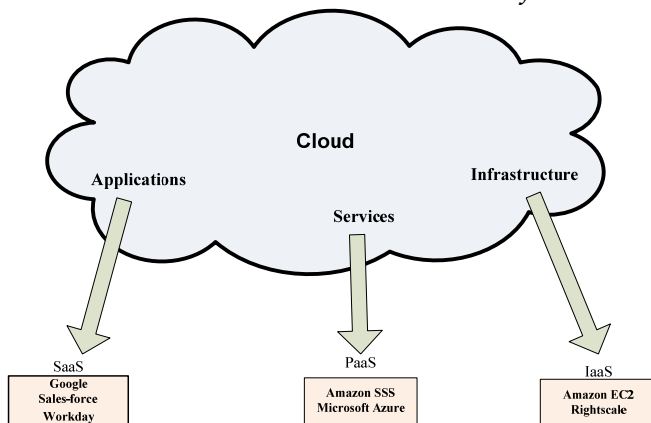
Fig.1. A simple cloud computing model with the three basic cloud services involved

Fig.1 shows the basic cloud architecture depicting the various service providers associated with different elements of cloud. Irrespective of the above mentioned service models, cloud services can be deployed in four ways depending upon the customers' requirements:

a. Public Cloud: A cloud infrastructure is provided to many customers and is managed by a third party [70]. Multiple enterprises can work on the infrastructure provided, at the same time. Users can dynamically provision resources through the internet from an off-site service provider. Wastage of resources is checked as the user pays for whatever they use.

b. Private Cloud: Cloud infrastructure, made available only to a specific customer and managed either by the organization itself or third party service provider [70]. This uses the concept of virtualization of machines, and is a proprietary network

c. Community cloud: Infrastructure shared by several organizations for a shared cause and may be managed by them or a third party service provider.

d. Hybrid Cloud: A composition of two or more cloud deployment models, linked in a way that data transfer takes place between them without affecting each other.

Moreover, with the technological advancements, we can see derivative cloud deployment models emerging out of the various demands and the requirements of users. A similar example being a virtual-private cloud wherein a public cloud is used in a private manner, connected to the internal resources of the customer's data-centre [55]. With the emergence of high-end network access technologies like 2G, 3G, Wi-Fi, Wi-Max etc and feature phones, a new derivative of cloud computing has emerged. This is popularly referred as "Mobile Cloud Computing (MCC)". It can be defined as a composition of mobile technology and cloud computing infrastructure where data and the related processing will happen in the cloud only with an exception that they can be accessed through a mobile device and hence termed as mobile cloud computing [43]. It's becoming a trend now-a-days and many organizations are keen to provide accessibility to their employees to access office network through a mobile device from anywhere.

Recent technical advancements including the emergence of HTML5 and various other browser development tools have only increased the market for mobile cloud-computing. An increasing trend towards the feature-phone adoption [43] has also ramped up the MCC market.

Cloud Computing distinguishes itself from other computing paradigms like grid computing, global computing, internet computing in the various aspects of On Demand Service Provision, User Centric Interfaces, guaranteed QoS, Autonomous system [25], etc. A few state of the art techniques that contribute to the cloud computing are:

✓ *Virtualization: It has been the underlying concept towards such a huge rise of cloud computing in the modern era. The term refers to providing an environment able to render all the services, being supported by a hardware that can be observed on a personal computer, to the end users. The three existing forms of virtualization categorized as: Server virtualization, Storage virtualization and Network virtualization have inexorably lead to the evolution of Cloud computing. As for example, a number of underutilized physical servers may be consolidated within a smaller number of better utilized severs [8].*

✓ *Web Service and SOA: Web services provided services over the web using technologies like XML, Web Services Description Language (WSDL), Simple Object Access Protocol (SOAP), and Universal Description, Discovery, and Integration (UDDI). The service organisation inside a cloud is managed in the form of Service Oriented Architecture (SOA) and hence we can define SOA as something that makes use of multiple services to perform a specific task.*

✓ *Application Programming Interface (API): Without API's it's hard to believe the existence of cloud computing. The whole bunches of cloud services depend on API's and allow deployment and configuration through them. Based on the API category used viz. Control, Data and Application API's different functions are being controlled and services rendered to the users.*

Web 2.0 and mash-up: Web 2.0 has been defined as a technology, enabling us to create web pages that don't limit a user to viewing only; in fact it allows the users to make dynamic updates as well. It enables the usage of World Wide Web technology towards a more creative and a collaborative platform. Mash-up is a web application that combines data from more than one source into a single integrated storage tool.
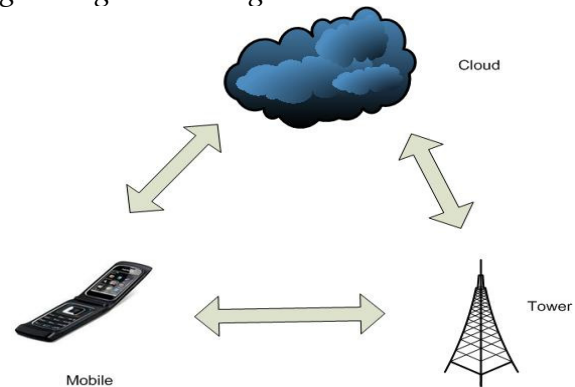
Fig. 2. A Mobile Cloud Computing Scenario

These were the few technological advances that led to the emergence of Cloud Computing and enabled a lot of service providers to provide the customers a hassle free world of virtualization fulfilling all their demands. The prominent ones are: Amazon-EC2 [19] (Elastic Compute Cloud), S3 (Simple Storage Service), SQS (Simple Queue Service), CF (Cloud Front), SimpleDB, Google, Microsoft, ProofPoint, RightScale, Salesforce.com, Workday, Sun Microsystems etc and each of them are categorised either as one of the three main classifications based on the cloud structure they provide: private, public and hybrid cloud. Each of the above mentioned cloud structure has its own limitations and benefits.

The enormous growth in this field has changed the way computing world was looked at. The IT sector has witnessed the change in the way situations were handled. However, there are issues that are same as forever and yet more compelling now. The amount of significant resources available at very low price is acting as a catalyst to distributed attacks on confidential information.

With an avalanche rise towards the deployment of Cloud Computing, the ever consistent security and privacy issues have become more sophisticated, more distributed in the sense that the user section for such services is growing by leaps and bounds [11, 39]. With the increase of on-demand application usage, the potential of cyber attacks also increases. Individual users have to frequently provide online information about their identification, and these could be used by attackers for identity theft. In order to maintain various security and privacy issues like: confidentiality,

operational integrity, disaster recovery and identity management, following schemes should be deployed at least to ensure data security [27] to some extent like:

- ✓ An encryption scheme to ensure data security in a highly interfering environment maintaining security standards against popular threats and data storage security.
- ✓ The Service Providers should be given limited access to the data, just to manage it without being able to see what exactly the data is.
- ✓ Stringent access controls to prevent unauthorized and illegal access to the servers controlling the network.
- ✓ Data backup and redundant data storage to make data retrieval easy due to any type of loss unlike the recent breakdown issues with the Amazon cloud.
- ✓ Distributed identity management and user security is to be maintained by using either Lightweight Directory Access Protocol (LDAP), or published APIs (Application Programming Interfaces) to connect into identity systems.
- ✓ An important aspect of cloud computing is that it does give rise to a number of security threats from the perspective of data security for a couple of reasons. Firstly, the traditional techniques cannot be adopted as these have become quite obsolete with respect to the ever evolving security threats and also to avoid data loss in a cloud computing environment. The second issue is that the data stored in the cloud is accessed a large number of times and is often subject to different types of changes. This may comprise of bank accounts, passwords and highly confidential files not to be read by someone else apart from the owner. Hence, even a small slip may result in loss of data security.

This paper is aimed at developing an understanding of the manifold security threats that do hamper the security and privacy of a user. Characteristics of a secure cloud infrastructure (public or private) will be discussed as also the challenges waiting and ways to solve them.

2. BARRIERS TO CLOUD COMPUTING

In spite of being a hot topic, there are certain aspects behind the fact that many organizations are yet not confident of moving into the cloud. Certain loopholes in its architecture have made cloud computing vulnerable to various security and privacy threats [62]. A few issues limiting the boundaries of this transformational concept are:

2.1. Privacy and Security

The fundamental factor defining the success of any new computing technology resides on the term how much secure it is [24, 65, 54]. Whether the data residing in the cloud is secure to a level so as to avoid any sort of security breach or it is more secure to store the data away from cloud in our own personal computers or hard drives? At-least we can access our hard drives and systems whenever we wish to, but cloud servers could potentially reside anywhere in the world and any sort of internet breakdown can deny us access to the data lying in the cloud. The cloud service providers insist that their servers and the data stored in them is sufficiently protected from any sort of invasion and theft. Such companies argue that the data on their servers is inherently more secure than data residing on a myriad of personal computers and laptops. However, it is also a part of cloud architecture, that the client data will be distributed over these individual computers regardless of where the base repository of data is ultimately stored. There have been instances when their security has been invaded and the whole system had been down for hours. At-least half a dozen of security breaches occurred last year bringing out the fundamental lapses in the security model of major CSPs. With respect to cloud computing environment, is defined as "the ability of an entity to control what information it reveals about itself to the cloud/cloud SP, and the ability to control who can access that information".[11] discusses the standards for collection, maintenance and disclosure of personality identifiable information. Information requiring privacy and the various privacy challenges need the specific steps to be taken in order to ensure privacy in the cloud as discussed in [4 , 40].

In case of a public-cloud computing scenario, we have multiple security issues that need to be addressed in comparison to a private cloud computing scenario. A public cloud acts as a host of a number of virtual machines, virtual machine

monitors, supporting middleware [13] etc. The security of the cloud depends on the behaviour of these objects as well as on the interactions between them. Moreover, in a public cloud enabling a shared multi-tenant environment, as the number of users is increasing, security risks are getting more intensified and diverse. It is necessary to identify the attack surfaces which are prone to security attacks and mechanisms ensuring successful client-side and server-side protection [61]. Because of the multifarious security issues in a public cloud, adopting a private cloud solution is more secure with an option to move to public cloud in future if needed [63].

Emergence of cloud computing owes significantly to mashup. A mashup is an application that combines data, or functionality from multiple web sources and creates new services using these. As these involve usage of multiple sub-applications or elements towards a specific application, the security challenges are diverse and intense. Based on this idea, a secure component model addressing the problem of securing mash-up applications has been proposed in [71]. Also, privacy needs to be maintained as there are high chances of an eavesdropper to be able to sneak in.

2.2. Performance, Latency and Reliability

Latency [28, 60] has always been an issue in cloud computing with data expected to flow around different clouds. The other factors that add to the latency are encryption and decryption of the data when it moves around unreliable and public networks, congestion, packet loss and windowing. Congestion adds to the latency when the traffic flow through the network is high and there are many requests (may be of same priority) that need to be executed at the same time. Windowing is another message passing technique whereby the receiver has to send a message to the sender that it has received the earlier sent packet and hence adds to the network latency. Moreover, the performance of the system is also a factor that should be taken into account. Sometimes the cloud service providers' run short of capacity either by allowing access to too many virtual machines or reaching upper throughput thresholds on their Internet links because of high demand arising from the customer

section. This hurts the system performance and adds to latency of the system.

2.3. Portability and Interoperability

Organizations may need to change the cloud providers and there have been cases when companies can't move their data and applications if they find another cloud platform they like better than the one they are using. Also, some companies use different cloud platforms for different applications based on their requirements and the services provided by the cloud service providers (CSPs). In some cases, different cloud platforms are used for a particular application or different cloud platforms have to interact with each other for completing a particular task. The internal infrastructure of the organization is needed to maintain a balance to handle the interoperability between different cloud platforms [22]. The risk of outsourced services going out of control is too much in a hybrid public and private cloud environment. All data has to be encrypted for proper security, and key management becomes a difficult task in such situations [6]. The users have actually no idea of where their information is stored [9]. Normally, a user's data is stored in a shared environment, along-with other user's data. The issue of inter-security handling becomes important in such cases. A cloud security management model is discussed in [6] to serve as a standard for designing cloud security management tools. The model uses four interoperating layers for managing the cloud security.

Thus we see that although the buzz of cloud computing prevails everywhere because of the multi-fold features and facilities provided by it, still there are issues that are needed to be solved in order to reach the landmarks set by it as to gain access to the hardware and application resources for a better functioning IT world.

2.4. Data-Breach through Fibre Optic Networks

It has been noticed that the security risks for the data in transit has increased over the last few years. Data transitioning is quite normal now-a-days and it may include multiple data-centres and other cloud deployment models such as public or private cloud. Security of the data leaving a data-centre to another data-centre is a major concern as

it has been breached quite a number of times in the recent times.

This data transfer is done over a network of fibre-optic cables which were considered to be a safe mode of data-transfer, until recently an illegal fibre eavesdropping device in Telco Verizon's optical network placed at a mutual fund company was discovered by US Security forces [44]. There are devices that can tap the data flow without even disturbing it and accessing fibre, through which data is being transferred. They generally are laid underground and hence it should not be a tough job accessing these fibre-optic cables. And hence it becomes quite important a factor to ensure data security over the transitioning networks.

2.5. Data Storage over IP Networks

Online data storage is becoming quite popular now-a-days and it has been observed that majority of enterprise storage will be networked in the coming years, as it allows enterprises to maintain huge chunks of data without setting up the required architecture. Although there are many advantages of having online data storage, there are security threats that could cause data leakage or data unavailability at crucial hour. Such issues are observed more frequently in the case of dynamic data that keeps flowing within the cloud in comparison to static data. Depending upon the various levels of operations and storage provided, these networked devices are categorized into SAN (Storage area network) and NAS (network-attached storage) and since these storage networks reside on various servers, there are multiple threats or risks attached to them. The three threat zones that may affect and cause the vulnerability of a storage network have been discussed in [62, 66].

Besides these, from them a mobile cloud computing scenario, we may see that unlike cloud computing there are several additional challenges that need to be addressed to enable MCC reach its maximum potential:

✓ Network accessibility: Internet has been the major factor towards the cloud computing evolution and without having the network access it won't be possible to access the internet and hence the inability to access the mobile cloud limiting the available applications that can be used.

✓ Data Latency: Data transfer in a wireless network is not as continuous and consistent as it is in case of a dedicated wired LAN. And this inconsistency is largely responsible for longer time intervals for data transfer at times. Also, the distance from the source adds up to the longer time intervals observed in case of data transfer and other network related activities because of an increase in the number of intermediate network components.

✓ Dynamic Network monitoring and Scalability: Applications running on mobiles in a mobile cloud computing platform should be intelligent enough to adapt to the varying network capacities and also they should be accessible through different platforms without having suffered any loss in the data. Sometimes, a user while working on a smart phone may need to move on to a feature phone and when (s)he accesses the application which (s)he was working on through her/his smart phone, (s)he should not face any data loss.

✓ Confidentiality of mobile cloud-based data sharing: The confidential data on mobile phones using cloud-based mobile device support might become public due to a hacked cloud provider. The root-level access to cloud services and information can be easily accessed from a stolen mobile device. If the stolen device belongs to a system administrator, they may even provide direct and automated access to highly confidential information.

✓ Better access control and identity management: As cloud computing involves virtualization, the need of user authentication and control across the clouds is high. The existing solutions are not able to handle the case of multiple clouds. As multiple users' data are stored by a single hypervisor, specific segmentation measures are needed to overcome the potential weakness and flaws in hypervisor platform.

Apart from the above mentioned network related challenges there are somewhat different security challenges in a mobile cloud computing environment. With applications lying in a cloud, it is possible for the hackers to corrupt an application and gain access to a mobile device while accessing

that application. In order to avoid these, strong virus-scanning and malware protection software need to be installed to avoid any type of virus/malware check into the mobile system. Besides, by embedding device identity protection, like allowing access to the authorized user based on some form of identity check feature and this will allow blocking unauthorized access.

Two types of services, have been defined in [1], namely (i) critical security service, and (ii) normal security service. The resource in a cloud has to be properly partitioned according to different user's requests. The maximal system rewards and system service overheads are considered for the security service. Hence, we see that although mobile cloud computing is still in its nascent state, there are various security issues, that haunt cloud computing and its derivatives.

3. THREATS TO SECURITY IN CLOUD COMPUTING

The chief concern in cloud environments is to provide security around multi-tenancy and isolation, giving customers more comfort besides "trust us" idea of clouds [45]. There has been survey works reported that classifies security threats in cloud based on the nature of the service delivery models of a cloud computing system [69]. However, security requires a holistic approach. Service delivery model is one of many aspects that need to be considered for a comprehensive survey on cloud security. Security at different levels such as Network level, Host level and Application level is necessary to keep the cloud up and running continuously. In accordance with these different levels, various types of security breaches may occur. These have been classified in rest of this section.

3.1. Basic Security

Web 2.0, a key technology towards enabling the use of Software as a Service (SaaS) relieves the users from tasks like maintenance and installation of software. It has been used widely all around. As the user community using Web 2.0 is increasing by leaps and bounds, the security has become more important than ever for such environment [67, 58, 48].

SQL injection attacks, are the one in which a malicious code is inserted into a standard SQL code and thus the attackers gain unauthorized access to a database and become able to access sensitive information. Sometimes the hacker's input data is misunderstood by the web-site as the user data and allows it to be accessed by the SQL server and this lets the attacker to have know-how of the functioning of the website and make changes into that. Various techniques like: avoiding the usage of dynamically generated SQL in the code, using filtering techniques to sanitize the user input etc to check the SQL injection attacks.

Cross Site Scripting (XSS) attacks, which inject malicious scripts into Web contents have become quite popular since the inception of Web 2.0. Based on the type of services provided, a website can be classified as static or dynamic. Static websites don't suffer from the security threats which the dynamic websites do because of their dynamism in providing multi-fold services to the users.

As a result, these dynamic websites get victimized by XSS attacks. It has been observed quite often that amidst working on net or surfing, some web-pages or pop-ups get opened up with the request of being clicked away to view the content contained in them. More often either unknowingly (about the possible hazards) or out of curiosity users click on these hazardous links and thus the intruding third party gets control over the user's private information or hack their accounts after having known the information available to them. Various techniques like: Active Content Filtering, Content Based Data Leakage Prevention Technology, Web Application Vulnerability Detection Technology has already been proposed [30]. These technologies adopt various methodologies to detect security flaws and try to fix them.

Another class of attacks quite popular to SaaS are termed as Man in the Middle attacks (MITM). In such an attack, an intruder tries to intrude in an ongoing conversation between a sender and a client to inject false information and to have knowledge of the important data transferred between them. Various tools implementing strong encryption technologies like: Dsniff, Cain, Ettercap, Wsniff, Airjack etc have been developed in order to provide safeguard against them. A detailed study towards preventing man in the middle attacks has been presented in [29].

A few of the important points like: evaluating software as a service security, separate endpoint and server security processes, evaluating virtualization at the end-point have been mentioned by Eric Ogren, recently in an article at Security.com to tackle traditional security flaws [31].

Hence, security at different levels is necessary in order to ensure proper implementation of cloud computing such as: server access security, internet access security, database access security, data privacy security and program access security. In addition, we need to ensure data security at network layer, and data security at physical and application layer to maintain a secure cloud.

3.2. Network Level Security

Networks are classified into many types like: shared and non-shared, public or private, small area or large area networks and each of them have a number of security threats to deal with. To ensure network security following points such as: confidentiality and integrity in the network, proper access control and maintaining security against the external third party threats should be considered while providing network level security. Problems associated with the network level security comprise of: DNS attacks, Sniffer attacks, issue of reused IP address, Denial of Service (DoS) and Distributed Denial of Service attacks (DDoS) etc.

DNS attacks

A Domain Name Server (DNS) server performs the translation of a domain name to an IP address. Since the domain names are much easier to remember. Hence, the DNS servers are needed. But there are cases when having called the server by name, the user has been routed to some other evil cloud instead of the one he asked for and hence using IP address is not always feasible. Although using DNS security measures like: Domain Name System Security Extensions (DNSSEC) reduces the effects of DNS threats but still there are cases when these security measures prove to be inadequate when the path between a sender and a receiver gets rerouted through some evil connection. It may happen that even after all the DNS security measures are taken, still the route selected between the sender and receiver cause security problems [26].

SNIFFER attacks

These types of attacks are launched by applications that can capture packets flowing in a network and if the data that is being transferred through these packets is not encrypted, it can be read and there are chances that vital information flowing across the network can be traced or captured. A sniffer program, through the NIC (Network Interface Card) ensures that the data/traffic linked to other systems on the network also gets recorded. It can be achieved by placing the NIC in promiscuous mode and in promiscuous mode it can track all data, flowing on the same network. A malicious sniffing detection platform based on ARP (address resolution protocol) and RTT (round trip time) can be used to detect a sniffing system running on a network [59].

Issue of Reused Ip Addresses

Each node of a network is provided an IP address and hence an IP address is basically a finite quantity. A large number of cases related to re-used IP-address issue have been observed lately. When a particular user moves out of a network then the IP-address associated with him (earlier) is assigned to a new user. This sometimes risks the security of the new user as there is a certain time lag between the change of an IP address in DNS and the clearing of that address in DNS caches. And hence, we can say that sometimes though the old IP address is being assigned to a new user still the chances of accessing the data by some other user is not negligible as the address still exists in the DNS cache and the data belonging to a particular user may become accessible to some other user violating the privacy of the original user.

BGP prefix hijacking

Prefix hijacking is a type of network attack in which a wrong announcement related to the IP addresses associated with an Autonomous system (AS) is made and hence malicious parties get access to the untraceable IP addresses. On the internet, IP space is associated in blocks and remains under the control of AS's. An autonomous system can broadcast information of an IP contained in its regime to all its neighbours. These ASs communicate using the Border Gateway Protocol (BGP) model. Sometimes, due to some

error, a faulty AS may broadcast wrongly about the IPs associated with it. In such case, the actual traffic gets routed to some IP other than the intended one. Hence, data is leaked or reaches to some other destination that it actually should not. An autonomous security system for autonomous systems has been explained in [37].

3.3. Application Level Security

Application level security refers to the usage of software and hardware resources to provide security to applications such that the attackers are not able to get control over these applications and make desirable changes to their format. Now a days, attacks are launched, being disguised as a trusted user and the system considering them as a trusted user, allow full access to the attacking party and gets victimized. The reason behind this is that the outdated network level security policies allow only the authorized users to access the specific IP address. With the technological advancement, these security policies have become obsolete as there have been instances when the system's security has been breached, having accessed the system in the disguise of a trusted user. With the recent technological advancements, it's quite possible to imitate a trusted user and corrupt entire data without even being noticed.

Hence, it is necessary to install higher level of security checks to minimize these risks. The traditional methods to deal with increased security issues have been to develop a task oriented ASIC device which can handle a specific task providing greater levels of security with high performance [41]. But with application-level threats being dynamic and adaptable to the security checks in place, these closed systems have been observed to be slow in comparison to the open ended systems.

The capabilities of a closed system as well as the adaptability of an open ended system have been incorporated to develop the security platforms based on Check Point Open Performance Architecture using Quad Core Intel Xeon Processors [41]. Even in the virtual environment, companies like VMware etc are using Intel Virtualization technology for better performance and security base. It has been observed that more often websites are secured at the network level and have strong security measures but there may be security loopholes at the application level which may allow information access to unauthorized users. The threats to application level security include XSS attacks, Cookie Poisoning, Hidden field manipulation, SQL injection attacks, DoS attacks, Backdoor and Debug Options, CAPTCHA Breaking etc resulting from the unauthorized usage of the applications.

Security concerns with the hypervisor

Cloud Computing rests mainly on the concept of virtualization. In a virtualized world, hypervisor is defined as a controller popularly known as virtual machine manager (VMM) that allows multiple operating systems to be run on a system at a time, providing the resources to each operating system such that they do not interfere with each.

As the number of operating systems running on a hardware unit increase, the security issues concerned with those that of new operating systems also need to be considered. Because multiple operating systems would be running on a single hardware platform, it is not possible to keep track of all and hence maintaining all the operating systems secure is difficult. It may happen that a guest system tries to run a malicious code on the host system and bring the system down or take full control of the system and block access to other guest operating systems [33].

It cannot be denied that there are risks associated with sharing the same physical infrastructure between a set of multiple users, even one being malicious can cause threats to the others using the same infrastructure [35], and hence security with respect to hypervisor is of great concern as all the guest systems are controlled by it. If a hacker is able to get control over the hypervisor, he can make changes to any of the guest operating systems and get control over all the data passing through the hypervisor.

Various types of attacks can be launched by targeting different components of the hypervisor [51]. Based on the learning of how the various components in the hypervisor architecture behave, an advanced cloud protections system can be developed by monitoring the activities of the guest VMs and inter-communication among the various infrastructure components [36, 64].

Denial of service attacks

A DoS attack is an attempt to make the services assigned to the authorized users unable to be used by them. In such an attack, the server providing the service is flooded by a large number of requests and hence the service becomes unavailable to the authorized user. Sometimes, when we try to access a site we see that due to overloading of the server with the requests to access the site, we are unable to access the site and observe an error. This happens when the number of requests that can be handled by a server exceeds its capacity. The occurrence of a DoS attack increases bandwidth consumption besides causing congestion, making certain parts of the clouds inaccessible to the users. Using an Intrusion Detection System (IDS) is the most popular method of defence against this type of attacks [14]. A defence federation is used in [4] for guarding against such attacks. Each cloud is loaded with separate IDS. The different intrusion detection systems work on the basis of information exchange. In case a specific cloud is under attack, then the co-operative IDS alert the whole system. A decision on trustworthiness of a cloud is taken by voting, and the overall system performance is not hampered.

Cookie poisoning

It involves changing or modifying the contents of cookie to make unauthorized access to an application or to a web-page. Cookies basically contain the user's identity related credentials and once these cookies are accessible, the content of these cookies can be forged to impersonate an authorized user. This can be avoided either by performing regular cookie cleanup or implementing an encryption scheme for the cookie data [52].

Hidden field manipulation

While accessing a web-page, there are certain fields that are hidden and contain the page related information and basically used by developers. However, these fields are highly prone to a hacker attack as they can be modified easily and posted on the web-page. This may result in severe security violations [53].

Backdoor and debug options

A common habit of the developers is to enable the debug option while publishing a web-site. This enables them to make developmental changes in the code and get them implemented in the web-site. Since these debug options facilitate back-end entry to the developers, and sometimes these debug options are left enabled unnoticed, this may provide an easy entry to a hacker into the web-site and let him make changes at the web-site level [59].

Distributed denial of service attacks

DDoS may be called an advanced version of DOS in terms of denying the important services running on a server by flooding the destination sever with an umpteen number of packets such that the target server is not able to handle it. In DDoS the attack is relayed from different dynamic networks which have already been compromised unlike DOS. The attackers have the power to control the flow of information by allowing some information available at certain times. Thus the amount and type of information available for public usage is clearly under the control of the attacker [2].

The DDoS attack is run by three functional units: A Master, A Slave and A Victim. Mater being the attack launcher is behind all these attacks causing DDoS, Slave is the network which acts like a launch pad for the Master. It provides the platform to the Master to launch the attack on the Victim. Hence it is also called as co-ordinated attack.

Basically a DDoS attack is operational in two stages: the first one being Intrusion phase where the Master tries to compromise less important machines to support in flooding the more important one. The next one is installing DDoS tools and attacking the victim server or machine. Hence, a DDoS attack results in making the service unavailable to the authorized user similar to the way it is done in a DoS attack but different in the way it is launched. A similar case of Distributed Denial of Service attack was experienced with CNN news channel website leaving most of its users unable to access the site for a period of three hours [50].

In general, the approaches used to fight the DDoS attack involve extensive modification of the underlying network. These modifications often become costly for the users. [2] proposed a swarm based logic for guarding against the DDoS attack. This logic provides a transparent transport layer,

through which the common protocols such as HTTP, SMTP, etc, can pass easily. The use of IDS in the virtual machine is proposed in [8] to protect the cloud from DDoS attacks. A SNORT like intrusion detection mechanism is loaded onto the virtual machine for sniffing all traffics, either incoming, or out-going. Another method commonly used to guard against DDoS is to have intrusion detection systems on all the physical machines which contain the user's virtual machines [16]. This scheme had been shown to perform reasonably well in a Eucalyptus [17] cloud.

CAPTCHA breaking
CAPTCHA's were developed in order to prevent the usage of internet resources by bots or computers. They are used to prevent spam and overexploitation of network resources by bots. Even the multiple web-site registrations, dictionary attacks etc by an automated program are prevented using a CAPTCHA.

But recently, it has been found that the spammers are able to break the CAPTCHA [14], provided by the Hotmail and G-mail service providers. They make use of the audio system able to read the CAPTCHA characters for the visually impaired users and use speech to text conversion software to defeat the test. In yet another instant of CAPTCHA Breaking it was found that the net users are provided some form of motivation towards solving these CAPTCHA's by the automated systems and thus CAPTCHA Breaking takes place.

GOOGLE hacking
Google has emerged as the best option for finding details regarding anything on the net. Google hacking refers to using Google search engine to find sensitive information that a hacker can use to his benefit while hacking a user's account. Generally, hackers try to find out the security loopholes by probing out on Google about the system they wish to hack and then after having gathered the necessary information, they carry out the hacking of the concerned system. In some cases, a hacker is not sure of the target. Instead he tries to Google out the target based on the loophole he wishes to hack a system upon. The hacker then searches all the possible systems with such a

loophole and finds out those having the loopholes he wishes to hack upon. A Google hacking event was observed recently when login details of various g-mail users were stolen by a group of hackers in China. These had been some of the security threats that can be launched at the application level and cause a system downtime disabling the application access even to the authorized users.

Some general points on cloud security
Neural Net Algorithms has a big part in Intrusion Detection system. [72] describes a novel way of Neural Net algorithms. [73] and [74] describes two other algorithms on Intrusion Detection Systems. Data travelling between Cloud and Point of action does go through areas, vulnerable to virus attacks. [75] provides a novel way of Data Transfer in such cases, offering possible minimization of data destruction.

4. DATA STORAGE AND SECURITY
Many cloud service providers provide storage as a form of service. They take the data from the users and store them on large data centres, hence providing users a means of storage. Although these cloud service providers say that the data stored in the cloud is utmost safe but there have been cases when the data stored in these clouds have been modified or lost may be due to some security breach or some human error.

Various cloud service providers adopt different technologies to safeguard the data stored in their cloud. But the question is: Whether the data stored in these clouds is secure enough against any sort of security breach? The virtualized nature of cloud storage makes the traditional mechanisms unsuitable for handling the security issues. These service providers use different encryption techniques like public key encryption and private key encryption to secure the data resting in the cloud. A similar technique providing data storage security, utilizing the homo-morphic token with distributed verification of erasure-coded data has been discussed in [21]. Trust based methods are useful in establishing relationships in a distributed environment. A domain based trust-model has been proposed in [7] to handle security and interoperability in cross clouds. Every domain has a special agent for trust management. It proposes

different trust mechanisms for users and service providers.

Another major issue that is mostly neglected is of Data-Remanence. It refers to the data left out in case of data transfer or data removal. It causes minimal security threats in private cloud computing offerings, however severe security issues may emerge out in case of public cloud offerings as a result of data-remanence [42].

Various cases of cloud security breach came into light in the last few months. Cloud based email marketing services company, Epsilon suffered the data breach, due to which a large section of its customers including JP Morgan Chase, Citibank, Barclays Bank, hotel chains such as Marriott and Hilton, and big retailers such as Best Buy and Walgreens were affected heavily and huge chunk of customer data was exposed to the hackers which includes customer email ids and bank account details.

Another similar incident happened with Amazon causing the disruption of its EC2 service [15, 20]. The damage caused had proved to be quite costly for both the users and the system administrators [18]. Popular sites like: Quora, Four-Square and Reditt were the main sufferers [57]. The above mentioned events depict the vulnerability of the cloud services.

Another important aspect is that the known and popular domains have been used to launch malicious software or hack into the companies' secured database. A similar issue happened with Amazon's S3 platform and the hackers were able to launch corrupted codes using a trusted domain [49] and hence the question that arises now is who to be provided the "trusted" tag. It proved that Amazon is prone to side-channel attacks, and a malicious virtual machine, occupying the same server as the target, can easily gain access to confidential data [12]. The question is: whether any such security policy should be in place for these trusted users as well?

An incident relating to the data loss occurred last year with the online storage service provider "Media max" also known as "The Linkup" when due to system administration error, active customer data was deleted, leading to the data loss. SLA's with the Cloud Service providers should contain all the points that may cause data loss either due to some human or system generated error. Hence, it must be ensured that redundant copies of the user data should be stored in order to handle any sort of adverse situation leading to data loss.

Virtualization in general increases the security of a cloud environment. With virtualization, a single machine can be divided into many virtual machines, thus providing better data isolation and safety against denial of service attacks [10]. The VMs provide a security test-bed for execution of untested code from un-trusted users. A hierarchical reputation system has been proposed in the paper [10] for managing trust in a cloud environment.

5. ENSURING SECURITY AGAINST THE VARIOUS TYPES OF ATTACKS

In order to secure the cloud against the various security threats and attacks like: SQL injection, Cross Site Scripting (XSS) attacks, DoS and DDoS attacks, Google Hacking and Forced Hacking, different cloud service providers adopt different techniques. A few standard techniques in order to detect the above mentioned attacks are as: Avoiding the usage of dynamically generated SQL in the code, finding the meta-structures used in the code, validating all user entered parameters, disallowing and removal of unwanted data and characters, etc. A generic security framework needs to be worked out for an optimized cost performance ratio. The main criterion to be filled up by the generic security framework are to interface with any type of cloud environment, and to be able to handle and detect predefined as well as customized security policies.

A similar approach is being used by Symantec Message Labs Web Security cloud that blocks the security threats originating from internet and filters the data before they reach the network. Web security cloud's security architecture rests on two components:

a. Multi layer security: In order to ensure that data security and block possible malwares, it consists of multi-layer security and hence a strong security platform.

b. URL filtering: It is being observed that the attacks are launched through various web

pages and internet sites and hence filtering of the web-pages, ensures that no such harmful or threat carrying web page gets accessible. Also, content from undesirable sites can be blocked.

With its adaptable technology, it provides security even in highly conflicting environments and ensures protection against new and converging malware threats.

A Google hacking database identifies the various types of information such as: login passwords, pages containing logon portals, session usage information etc. Various software solutions such as Web Vulnerability Scanner can be used to detect the possibility of a Google hack. In order to prevent Google hack, the user needs to ensure that only those information that does not affect him should be shared with the Google. This would prevent sharing of any sensitive information that may result in adverse conditions.

The symptoms to a DoS or DDoS attack are: system speed gets reduced and programs run very slowly, large number of connection requests from a large number of users, less number of available resources. Although when launched in full strength DDoS attacks are very harmful as they exhaust all the network resources, still a careful monitoring of the network can help in keeping these attacks in control.

In case of IP spoofing an attacker tries to spoof the users that the packets are coming from reliable sources. Thus the attacker takes control over the client's data or system showing himself as the trusted party. Spoofing attacks can be checked by using encryption techniques and performing user authentication based on Key exchange. Techniques like IPSec do help in mitigating the risks of spoofing. By enabling encryption sessions and performing filtering at the incoming and outgoing entrances spoofing attacks can be reduced.

Every cloud service provider has installed various security measures depending on its cloud offering and the architecture. Their security model largely depends upon the customer section being served, type of cloud offering they provide and the deployment models they basically implement as discussed in [68].

Table 1. Comparative Analysis for Strengths and Limitations of Some of the Existing Security Schemes

Security Scheme	Suggested Approach	Strengths	Limitations
Data Storage security [21]	Uses homomorphic token with distributed verification of erasure-coded data towards ensuring data storage security and locating the server being attacked.	1. Supports dynamic operations on data blocks such as: update, delete and append without data corruption and loss. 2. Efficient against data modification and server colluding attacks as well as against byzantine failures.	The security in case of dynamic data storage has been considered. However, the issues with fine-grained data error location remain to be addressed.
User identity safety in cloud computing	Uses active bundles scheme, whereby predicates are compared over encrypted data and multiparty computing.	Does not need trusted third party (TTP) for the verification or approval of user identity. Thus the user's identity is not disclosed. The TTP remains free and could be used for other purposes such as decryption.	Active bundle may not be executed at all at the host of the requested service. It would leave the system vulnerable. The identity remains a secret and the user is not granted permission to his requests.
Trust model for interoperability and security in cross cloud [35]	1. Separate domains for providers and users, each with a special trust agent. 2. Different trust strategies for service providers and customers. 3. Time and transaction factors are taken into account for trust assignment.	1. Helps the customers to avoid malicious suppliers. 2. Helps the providers to avoid co-operating/serving malicious users.	Security in a very large scale cross cloud environment. This scheme is able to handle only a limited number of security threats in a fairly small environment.
Virtualized defence and reputation based trust management	1. Uses a hierarchy of DHT-based overlay networks, with specific tasks to be performed by each layer. 2. Lowest layer deals with reputation aggregation and probing colluders. The highest layer deals with various attacks.	Extensive use of virtualization for securing clouds	The proposed model is in its early developmental stage and needs further simulations to verify the performance.

Security Scheme	Suggested Approach	Strengths	Limitations
Secure virtualization [61]	1. Idea of an Advanced Cloud Protection system (ACPS) to ensure the security of guest virtual machines and of distributed computing middleware is proposed. 2. Behaviour of cloud components can be monitored by logging and periodic checking of executable system files.	A virtualized network is prone to different types of security attacks that can be launched by a guest VM, an ACPS system monitors the guest VM without being noticed and hence any suspicious activity can be blocked and system's security system notified.	System performance gets marginally degraded and a small performance penalty is encountered. This acts as a limitation towards the acceptance of an ACPS system.
Safe, virtual network in cloud environment [35]	Cloud Providers have been suggested to obscure the internal structure of their services and placement policy in the cloud and also to focus on side-channel risks in order to reduce the chances of information leakage.	Ensures the identification of adversary or the attacking party and helping us find a far off place for an attacking party from its target and hence ensuring a more secure environment for the other VMs.	If the adversary gets to know the location of the other VMs, it may try to attack them. This may harm the other VMs in between.
Border Gateway Protocol (BGP) [37]	A pretty good BGP (PGBGP) architecture has been suggested to check the cases where an Autonomous system may announce itself wrongly as the destination for all the data that is being transferred over that network..	Checks the autonomous systems (ASs) and performs anomaly detection with a response system to ensure that the data doesn't get routed to the wrong AS. It also gives us the flexibility to run the PGBGP protocol on some of the ASs towards protecting the entire network.	Vulnerable to Denial of Service (DoS) attacks. This approach only takes care of the routing control messages but doesn't verify the path that actual traffic follows.

One of the security measures implemented by SalesForce.com to avoid unauthorized access to its platform is sending a security code to the registered customer every-time, the same account is accessed from a different IP-address and the user needs to provide the security code at the time of logging in, in order to prove its identity [56].

It is equally important to secure the data in transit and security of transmitted data can be achieved through various encryption and decryption

schemes. In such a scenario, even if the data gets into the hands of a hacker, he won't be able to make any unauthorized use until he knows how to decrypt it. A few of the encryption-decryption techniques include private and public key encryption. In a symmetric key (private key) encryption such as: DES, Triple DES, RC2, RC4 etc, the same key is used for encryption and decryption. Before the data is transferred, the key is shared between both the receiver and the sender. Sender then sends the data after having encrypted it using the key and the receiver decrypts it using the same key.
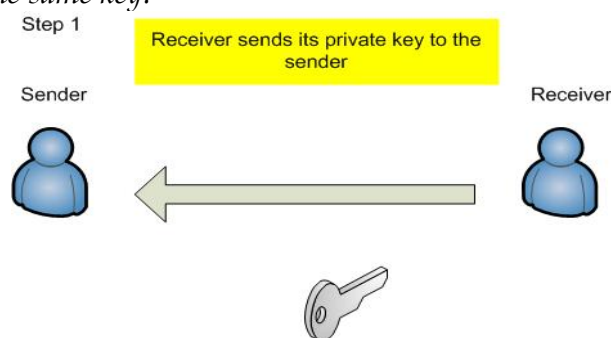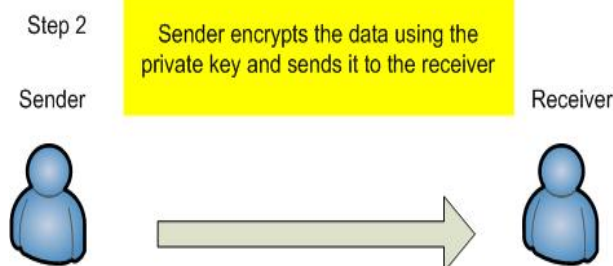

Fig 3. Private key Encryption (Step 1)

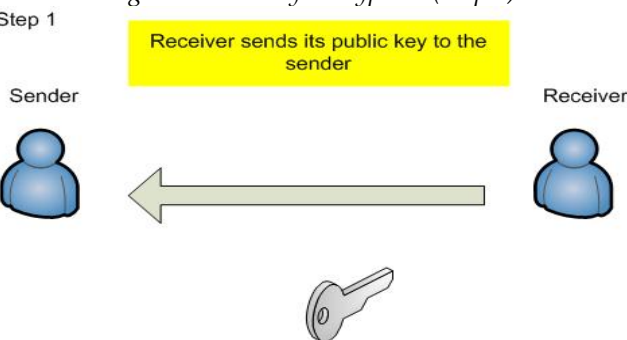Fig 4. Private Key encryption (Step 2)

Fig 5. Public key Encryption (Step 1)

In case of an asymmetric key algorithm (RSA, DSA, PGP etc), there are two sets of keys known as public key and private key. The keys occur in pairs which means that a specific public key can only be decrypted using the private key linked to it. In such an encryption technique the sender encrypts the data using the public key and then sends it to the receiver which at the receiving end

makes use of corresponding private key to decrypt the same.

Hence, we can see that although Public key encryption may take a bit more processing time in comparison to the private key encryption, but in cases where security is more of a concern rather than the speed, public-key encryption provides more secure data transmission in comparison to private-key encryption. Security issues in a virtualized environment wherein a malicious virtual machine tries to take control of the hypervisor and access the data belonging to other VMs have been observed and since traffic passing between VMs doesn't travel out into the rest of the data-centre network and hence cannot be seen by regular network based security platforms [46].

Fig 6. Public key Encryption (Step 2)

Fig 7. Public key Encryption (Step 3)

Hence, there is a need to ensure that security against the virtual threats should also be maintained by adopting the methodologies such as: keeping in check the virtual machines connected to the host system and constantly monitoring their activity, securing the host compute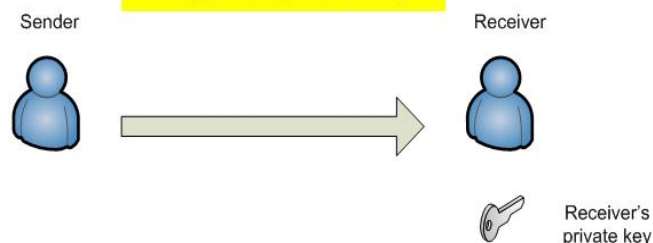rs to avoid tampering or file modification when the virtual machines are offline, preventing attacks directed towards taking control of the host system or other virtual machines on the network etc.

A security model wherein a dedicated monitoring system taking care of the data coming in and out of a virtual machine/machines functional in a virtualized environment on a hypervisor can be presented as shown below:
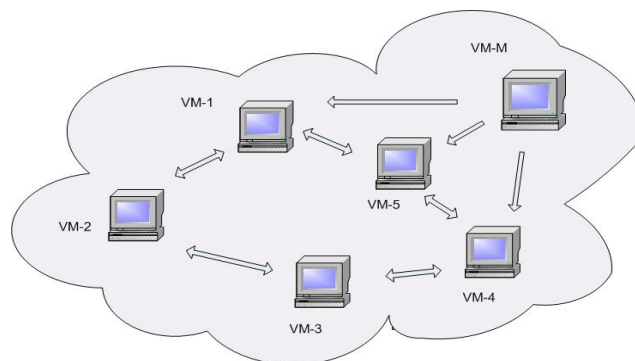

Fig. 8 Security Model in a Virtualized Environment

As can be seen from the above shown security model, a Virtual machine monitor can be placed in a virtual environment which will keep track of all the traffic flowing in and out of a virtual machine network. And in case if there is any suspicious activity observed, the corresponding virtual machine may be de-linked or blocked and hence maintaining the security of the virtualized network.

The security breach of Twitter and Vaserv.com (via a zero-day vulnerability) last year and the data breach at Sony Corporation and Go-Grid [47], this year, compromising 100 million customers' [38], data have made it quite clear that stringent security measures are needed to be taken in order to ensure security and proper data control in the cloud.

Thus we see that the security model adopted by a Cloud service provider should safeguard the cloud against all the possible threats and ensure that the data residing in the cloud doesn't get lost due to some unauthorized control over the network by some third party intruder.

6. CONCLUSION

Cloud Computing, envisioned as the next generation architecture of IT Enterprise is a talk of the town these days. Although it has revolutionized the computing world, it is prone to manifold security threats varying from network level threats to application level threats. In order to keep the Cloud secure, these security threats need to be controlled. Moreover data residing in the cloud is also prone to a number of threats and various issues like confidentiality and integrity of data should be considered while buying storage services from a cloud service provider. Auditing of the cloud at regular intervals needs to be done to safeguard the cloud against external threats. In

addition to this, cloud service providers must ensure that all the SLA's are met and human errors on their part should be minimized, enabling smooth functioning. In this paper various security concerns related to the three basic services provided by a Cloud computing environment are considered and the solutions to prevent them have been discussed.

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