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On behalf of the organizing committee, we are pleased to announce that the International Conference On Engineering Technology And Innovation is held from on November 04-08 in Skopje, North Macedonia. ICETI 2020 provides an ideal academic platform for researchers to present the latest research findings and describe emerging technologies, and directions in Engineering Technology And Innovation. The conference seeks to contribute to presenting novel research results in all aspects of Engineering Technology And Innovation.

The conference aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results about all aspects of Engineering Technology And Innovation. It also provides the premier interdisciplinary forum for scientists, engineers, and practitioners to present their latest research results, ideas, developments, and applications in al lareas of Engineering Technology And Innovation. The conference will bring together leading academic scientists, researchers and scholars in the domain of interest from around the world. ICETI 2020 is the oncoming event of the successful conference series focusing on Engineering Technology And Innovation.

The International Conference on Engineering Technology and Innovation (ICETI 2020) aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results about all aspects of Engineering Technology and Innovation. It also provides the premier interdisciplinary forum for scientists, engineers, and practitioners to present their latest research results, ideas, developments, and applications in all areas of Engineering Technology and Innovation. The conference will bring together leading academic scientists, researchers and scholars in the domain of interest from around the world. The conference's goals are to provide a scientific forum for all international prestige scholars around the world and enable the interactive exchange of state-of-the-art knowledge. The conference will focus on evidence-based benefits proven in technology and innovation and engineering experiments.

Best regards,

Prof. Dr.Özer ÇINAR

ICETI

ENGINEERING TECHNOLOGY INNOVATION

IV INTERNATIONAL CONFERENCE ON ENGINEERING TECHNOLOGY AND INNOVATION

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INVESTIGATION OF THE EFFECT OF THE MORTAR THICKNESS IN MASONARY DOME BY USING ANISOTROPIC MODEL

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Abstract:

The masonry structures, together with the main structural materials such as stone or brick, consist of mortar material which serves as the adhesive between these materials. In general, the mechanical properties of brick, stone and mortar materials are different. However, they have been used throughout history and have been the unchanging materials used in masonry structures. The structural walls are formed by heterogeneous joining of two materials with different mechanical properties. However, these heterogeneous structural elements are generally considered homogeneous for ease of calculation. In this study, the effects of different joint thicknesses on masonry structures on dome structure were investigated. Changes in structure behavior were investigated by using different material properties to a masonry dome structure. The masonry dome structures are simulated by the SAP2000 software using anisotropic material properties By examining these differences, the effect of isotropic or anisotropic modelling on the result, the effect of mortar thickness on the result was compared and the results were interpreted.

Keywords: Masonary Structure, Dome Structure, Anisotrop Materials

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INVESTIGATION OF THE INFLUENCE OF HEAT INPUT ON THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF GAS METAL ARC WELDED AISI 304/AISI 430 DISSIMILAR STAINLESS STEEL JOINTS

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Abstract:

Nowadays, there is an increasing demand for the use of joining dissimilar metals in various industrial applications owing to the economic benefits and better joint performance. Ferritic stainless steel grades is a good alternative for austenitic ones in several applications as they display higher ductility and strength as well as better corrosion resistance in chloride environments. However, the poor ductility and low impact toughness of ferritic stainless steel welded joints have limited their application. Thus, the demand for joining dissimilar ferritic and austenitic stainless steels is ever increasing in several engineering applications in various industries such as nuclear power plants, coal fired boilers, automobile manufacturing industry, chemistry and petro-chemistry industries, etc. Therefore, successful joining of these two different types of stainless steel grades using conventional fusion welding methods is rather important.

In this study, the weldability of AISI 304 austenitic and AISI 3430 ferritic steel plates using gas metal arc welding and the effect of heat input on microstructure and the mechanical properties were investigated. For this purpose, AISI 3430 and AISI 430 plates with a thickness of 5 mm were joined using different heat input values. The microstructures evolved in the weld region of the joints and their mechanical properties were determined by detailed optical microscopy investigations, micro-hardness measurements and tensile tests. Thus, the influence of the heat input on the weldability of these two different stainless steel plates using gas metal arc welding was also studied.

Keywords: Austenitic Steel, Ferrictic, Heat Input, Carbide Precipitation, Grain Coarsening.

*None

INVESTIGATION OF THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF GAS METAL ARC WELDED AISI 304 AUSTENITIC STAINLESS STEEL BUTT JOINTS

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Abstract:

Austenitic stainless steels exhibit very good properties such as very good formability even at low temperatures, good mechanical properties and high corrosion resistance. Austenitic steels are the grades which are produced most in quantity among all stainless steels and AISI 304 is the most widely used grade among the austenitic stainless steels. They are used widely in several industries such as chemistry and petro-chemistry industries, food processing industry, machinery and manufacturing industry, medical and dental equipments and kitchenware. However, several difficulties such as carbide precipitation along the grain boundaries in heat affected zone, and hot cracking and formation of brittle sigma phase in the fusion zone are encountered in fusion joining of these steels. High heat inputs involved in arc welding may even increase the occurrence of these problems. Thus, successful joining of these alloys using conventional fusion welding methods is rather important.

This study aims at investigating the influence of heat input on microstructural evolution in the weld region and the mechanical properties of the welded joints in gas metal arc welding of AISI 304 austenitic stainless steel plates. For this purpose, AISI 304 austenitic steel plates with a thickness of 5 mm were joined using different heat input values. The microstructures in the weld region and mechanical properties of the welded plates were investigated by detailed optical microscopy investigations, micro-hardness measurements and tensile tests. Thus, it was attempted to determine the optimum heat input required for obtaining sound welded joints in gas metal arc welding of these steels.

Keywords: Austenitic Stainless Steel, AISI 304, Heat Input, Carbide Precipitation, Weld Performance.

*None

BIDIRECTIONAL VISIBLE LIGHT COMMUNICATION SYSTEM DESIGN FOR DETECTING SECURITY DEFICIENCY

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Abstract:

As the radio spectrum becomes increasingly crowded, the superior spectral capacity in the visible light range becomes increasingly attractive. Visible light communication (VLC) technology uses the light waves from light emitting diode (LED) lamps and overheads to stream data and connect people as a more efficient, more available and more secure alternative to Wi-Fi. One may presume that VLC is secure by design because light waves do not penetrate most walls and obstacles. Nevertheless, a potential security weakness of this technology arises from the very basic working principle of VLC. Since intensity of the LEDs on the transmitter unit undergoes subtle and rapid changes during data transmission, instantaneous power consumption of the electrical components in the VLC circuitry varies accordingly. This difference in instantaneous power consumption introduces a huge security vulnerability. In this paper, the author has shown that intruding into VLC is not only feasible but also implementable with side-channel attacks through instantaneous power consumption analysis. For this purpose, the author not only designed and implemented a bidirectional basic VLC system, she also implemented a current sensor on the power line from the power supply to the transmitter unit. The author then deployed an op-amp comparator and a USB/UART converter in order to interpret the current sensor's outputs. Despite its limited applicability only to UART driven VLC systems, this interpretation approach tested the current sensor measurements very fast, and put forward 86 error-free messages on the attacker's end. These error-free results enabled the authors to deduce that side-channel attacks through the current sensor measurements and power consumption analysis are indeed effective in jeopardizing the security of VLC systems.

Keywords: Visible Light Communication, Side-Channel Attack

*

RECENT DEVELOPMENTS FOR COMPUTER-AIDED ANALYSIS OF SOLID MECHANICS FAILURE EXAMPLES

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Abstract:

Structural integrity has been a significant field for the researchers, with an increasing interest in the last few decades. As a result of the recent developments in engineering technologies, experimental procedures together with computational methodologies have been commonly used for the solution of complex problems. However, experimental procedures bring up serious issues which lead to higher costs. To overcome this difficulty, commercial finite element tools are used for the analysis of failed components. On the other hand, other computer programs in the literature were presented to provide a solution procedure for specific failure modes, such as fatigue and fracture. Being highly complicated in their details, these two failure modes require a depth in understanding for their theories and solution algorithms. The optimum solution tool must be chosen in order to obtain accurate results in a timely manner. It is also quite possible that single software may not be adequate to accomplish a given task in this form. Failure examples in structural integrity is presented with special interest being in the methodologies and/or software used. Comparisons among multiple techniques are made with the aid of industrial failure examples. This will also be a leading and explanatory analysis for engineers who are intended to work on computational solid mechanics problems. Obstacles that may be seen during the analysis of these problems are explained in detail. Solution tools for multiple durability problems are shown. Specifically speaking, stress, fatigue and fracture analysis are the subjects under review.

Keywords: Computer-Aided Solid Mechanics, Finite Element Programming, Structural Integrity Software, Fatigue And Fracture Failures

*

CLASSIFICATION OF LIVE / LIFELESS ASSETS FROM LONG DISTANCE WITH LASER SIGNALS BY USING DEEP LEARNING NETWORK

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Abstract:

In this study, it is aimed to classify targets as living/lifeless with low-power laser signals in cases of the fight against terrorism, chemical, biological or radioactive attack, urban warfare operations, natural disasters such as earthquakes, floods, storms, and in situations where people such as high-altitude falls are not directly reached. For this purpose, people as living samples and different types of lifeless materials at a certain distance were pointed with a low-powered laser light source and laser signals reflected from the targets were recorded with the receiving system. In the classification of Live / Lifeless, human vitality and other materials (non-living) in nature are compared. In the study, laser signal samples are taken from different points of the arm of 9 volunteer men for living assets and 17 materials frequently used by people for lifeless assets. For lifeless assets, often found in nature, aluminum, black, fabric, frosted glass, glass, pottery, iron, galvanize, granite, linden, magnet, mdf, marble, cardboard, polyethylene, polystyrene, PVC and artificial marble are selected. The laser signals obtained from the targets are classified as live/lifeless by undergoing training in Long-Short Term Memory networks (LSTM) after preprocessing and feature extraction steps. As a result of the study, a live / lifeless assets distinction are made with an accuracy rate of 99.1%.

Keywords: Laser, Laser Signs, Deep Learning, Artificial Intelligence, Live Detection, Target Detection

*

THE USE OF BIOMATERIALS IN FURNITURE DESIGN: TOWARDS SUSTAINABLE ECOLOGY

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Abstract:

Recent proposals on London Design Fair, 2019, and many design awards since 2016 on the International stage have made it clear that our future, sustainable living belongs to bio-based materials inspired by nature. The abundant availability of resources and material studies in exploring and creating alternatives to existing synthetic materials suggest a promising future of sustainable living and environmental protection, which are important initiatives for human survival. This opens up a whole new world, and perspective of looking at materials and nature informed design.

The importance of furniture design which provides for the welfare and well-being of individuals as well as society, socially, culturally, and influences the living quality directly has long been advocated based on the idea of human-oriented, human-centric, meets the needs of user form physiology and psychology. This idea of design and manufacturing which has such a huge impact on everyday life should include nature-based along with human-oriented in its premise.

This can further help in creating sustainable ecology around us and instead of creating static forms of bio-inspired designs, we could actually be creating bio-informed designs that are more sustainable, biodegradable and have very little impact on the environment. While significant progress and research are being done over the years on a wide array of biomaterials, this idea needs to be widely accepted and implemented at a global scale, so that it does not remain as just another folly of the design world in search of new materials and actually is a significant step towards sustainable development. This paper aims at detailing investigation on the idea of using biomaterials in furniture design, and corresponding manufacturing processes by evaluating case studies based on factors contributing to sustainability and how biomaterials can help in creating sustainable ecology around us.

Keywords: Biomaterials, Furniture Design, Human-Centric, Sustainability, Manufacturing Processes, Bioinformed Design, Sustainable Ecology

*

MICRO-STRUCTURE ANALYSIS OF BALL STUD FRACTURE SURFACE WITH SEM AND EDS METHODS

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Abstract:

Ball joint is the one of the main component of the suspension and steering systems of the vehicles. This component is responsible to connect two vehicle modules – control arm and steering knuckle – allowing rotation and oscillation movements in both suspension and steering systems of the vehicles. Ball joints have critical function in both systems and defined as a safety part. These components are exposed to different kind of loads during ride. That is why each sub-component of the ball joint must be durable enough. Unfortunately, the ball stud component of the ball joint has broken from the neck area – which is the narrowest spot – while riding and caused customer complaints. In this study, the reasons for fracture are investigated and chemical composition, micro-structure of fracture surface are also investigated with SEM (Scanning Electron Microscope) and EDS (Energy Dispersive X-Ray Spectroscopy) methods. After interpreting the analysis results, it has been seen that fracture caused because of fatigue.

Keywords: Fracture, Ball Stud, SEM, EDS, Steering And Suspension

*

CEREBRAL PALSY TREATMENT ASSISTANT

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Abstract:

Cerebral Palsy is a neurological disease. People with this disease have difficulty in doing daily movements such as walking, speaking, and comprehension. This neurological disease is tried to be treated with rehabilitation techniques. In this study, an exercise game is designed for cerebral palsy patients. The aim is to develop a system in which children with cerebral palsy can perform daily exercises that they need amused and the treatment can be followed. The kinect sensor is used to detect the position in the study, the Unity 3D game engine is used to feedback the accuracy of the movement. In the designed system, the avatar and the patient's exercise are matched. The game avatar verbally informs the patient whether he/she is doing it correctly or not. Scoring is done according to whether the move is made right or wrong. Thus, exercises that are mandatory for pediatric patients and other age groups are turned into a fun activity regardless of location and time. With the development of such a system, the crowd in physical therapy centers will decrease, and patients will be able to continue their treatment under all conditions, such as pandemics.

Keywords: Cerebral Palsy, Kinect Camera, Unity 3D Game

*

ASSESSMENT OF DURABILITY OF INKJET PRINTS ON LABORATORY PAPER SUBSTRATES WITH WHEAT PULP BASED ON RUB RESISTANCE

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Abstract:

Recycling paper is becoming increasingly important as the production of packaging and various printed products grows. As alternative to wood fibre that is the most common raw material in paper production this research examines the quality of paper which is made with addition of non-wood fibres derived from wheat straw. For this purpose, laboratory paper substrates were made by blending recycled newspaper pulp and wheat straw pulp in different proportions. In this paper we analyse rub resistance of laboratory papers with variable content of wheat pulp printed in full tone of black and yellow inks by digital ink jet printing technique. The main objective of this research is to determine whether this kind of print has necessary durability for carrying stable illustrations. One of the main characteristics of print quality is resistance to rubbing which is very important for packaging during transport, storage and the end use. Rub resistance test was executed according to BS 3110 standard. The print durability was assessed through the Euclidean colour difference and the individual CIE L*a*b* differences before and after the rub tests. The analysis showed that the increase of wheat pulp content in paper substrates has affected the increase of colour difference. Greater rub resistance was observed on substrates with lower share of wheat pulp. Samples printed with yellow ink showed overall greater durability than samples printed with black ink. In further analysis we observed that for the black prints the difference in lightness (ΔL*) of the CIEL*a*b* colour space was most affected as the prints became lighter with the number of rubbing cycles. In samples printed with yellow prints most affected was the colour difference on yellow-blue axis (Δb*) meaning that the yellowness of the prints was degrading with the number of rubbing cycles.

Keywords: Durability, Inkjet Printing, Paper Substrate, Rub Resistance, Wheat Pulp

[*]This work is supported by Croatian Science Foundation under the project UIP-2017-05-2573

COMPARISON OF OPTICAL STABILITY OF PAPERS CONTAINING WHEAT PULP PRINTED WITH DIGITAL AND FLEXOGRAPHIC PRINTING TECHNIQUE AFTER ACCELERATED AGEING

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Abstract:

Flexographic and digital printing are currently the fastest growing branches in the printing industry. The selection of printing substrates for these printing techniques is large, but paper substrates are the most widely used. Paper manufacturing is based mainly on the use of renewable fibres, and the dominant fibre resource for the pulp and paper industry is wood which is accounting for 90% of the world's fibre utilization. As woods consumption for paper production is still high, there are various possibilities to reduce it. One way is by reducing the proportion of wood pulp in paper by adding straw pulp of various cereals such as wheat. Wheat straw has numerous advantages and can be used in pulp form as a source of primary fibres for paper production. Paper as a multi-component material besides fibres composed of cellulose, hemicellulose and lignin also includes additives, minerals and synthetic polymers. Due to its complex nature it is prone to deterioration when exposed to elevated temperature, humidity and light. Paper ageing is irreversible change and is the best indicator of paper optical permanence. Objective of this study was to determine the optical stability of prints after undergoing aging treatment with elevated temperature and UV light for 48 and 96 hours. Laboratory papers containing wheat pulp were printed by two printing techniques with cyan and yellow inks to compare better optical stability: UV inkjet and flexographic technique. The optical stability of all prints was observed based on the difference in the reflection spectra (ΔR). The results indicated that all laboratory papers printed with cyan ink with flexographic technique show better optical stability than the ones printed with digital technique. Laboratory papers printed with yellow ink by both techniques show good optical stability.

Keywords: Accelerated Ageing, Digital, Flexographic, Optical Stability, Prints, Wheat Pulp

[*]This work is supported by Croatian Science Foundation under the project UIP-2017-05-2573

EFFECT OF ANIONIC FUNCTIONAL GROUP CHANGE OF WATER REDUCING ADMIXTURE AND UTILIZATION RATE OF FLY ASH ON TIME DEPENDENT FLOWABILITY PERFORMANCE AND SOME HARDENED PROPERTIES OF MORTAR MIXTURES

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Abstract:

In this study, the effect of chemical structure of polycarboxylate-ether based high range water reducing admixture (WRA) and utilization rate of fly ash on time dependent flowability performance, compressive strength and water adsorption capacity of the mortar mixtures was investigated. For this purpose, five WRA having same anionic/non-ionic group ratios, free non-ionic group contents, molecular weights, main chain and side chain lengths but different anionic functional groups were synthesized. In this direction, in addition to the control admixture having 100% of carboxylate as anionic functional group, four different types of admixture were synthesized by replacing 10 and 30 mol% of anionic functional group with sulfonate and phosphate functional groups. In all of the mixtures CEMI 42.5R type cement and fly ash were used as binder. In all mortar mixtures water/cement ratio, sand/binder ratio and slump-flow values were kept constant as 0.485, 2.75 and 270±20 mm, respectively. Both of substitution of phosphate and sulphonate monomer increased the fluidity and decreased the time dependent flowability of the mortar mixtures. The change of WRA properties had no did not significant effect on compressive strength and water adsorption capacity of the mortar mixtures. Regardless of the WRA type, the fly ash utilization adversely affected the early age compressive strength of the mixtures and also had a favorable effect on the advanced age strengths. The optimum fly ash utilization ratio was determined as 30% in terms of strength. Moreover, regardless of WRA properties, the fluidity and time dependent flowability performance of the mixtures were adversely affected with the increase of fly ash substitution level and also their water adsorption capacity decreased.

Keywords: Water Reducing Admixture, Anionic Functional Group, Fly Ash, Flowability Performance, Mortar

*

INVESTIGATION OF POZZOLANIC ACTIVITIES OF NEW TYPE POZZOLANES

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Abstract:

Many studies are carried out to develop new alternatives to products that seriously harm the environment during production, such as cement, due to the globally climate crisis, the rapid depletion of natural resources, and the increasing energy consumption from year to year. Because of these reasons, it is important to research new type of pozzolans that can be used instead of cement. In this study, the usability of three different wastes as binders in the production of cementitious systems was investigated. For this purpose, the brewed black tea waste, the shell that occurs after roasting the inner hazelnut, and the waste brick powder released during the production of the threshing brick were selected as pozzolan. Tea waste and inner hazelnut shell were prepared by two different methods. First, the materials were burnt by means of a tray and left cooling under ambient conditions. Second, after the materials were burnt at 800°C for 1 hour in the ash furnace and the ashes removed from the furnace and cooled quickly with the help of a water bath. The products obtained were grinding with a laboratory-type grinding device at a speed of 500 rpm for 15 min. Brick powder, was shieved by passing through a No. 200 (70µm) mesh before using. The 7 and 28-days pozzolanic activity index value of each three wastes was determined according to ASTM C618. The results obtained were compared with F-class fly ash with 7 and 28-days pozzolanic activity index of 70.9% and 77.7%, and silica fume with 96.08% and 102.73%, respectively, which are widely used in the market. Accordingly, the highest pozzolanic activity value of 7 and 28-days among the three wastes was obtained from tea waste burnt on the tray (TT) with 70.9% and 75%, respectively. Tea waste burnt in the oven (TO), inner hazelnut shell burnt on the tray (HT), inner hazelnut shell burnt in the oven (HO) and brick powder (BP) were lower in 7 and 28-days pozzolanic activity experiment according to the TT, respectively; 19.4% and 19.9%, 13.3% and 18.7%, 30.2% and 34.9%, 1.8% and 5.5%. Results indicate that the TT is the pozzolan which shows the closest feature to fly ash and silica fume in terms of pozzolanic activity index.

Keywords: Pozzolanes, Pozzolanic Actvity, Black Tea Waste, Waste Brick Powder, Roasted Hazelnut Shell

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THE EFFECT OF SILICA FUME AND WATER / CEMENT RATIO ON WORKABILITY OF CONCRETE

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Abstract:

The use of silica fume in the concrete composition enables the production of high complexity and high strength concrete in the construction sector. However, since silica fume, which is used as a mineral additive, is a very thin material, it absorbs a high amount of water. Therefore, it affects workability negatively when used in concrete mixture. In this study, this effect of silica fume on the workability of fresh concrete was investigated. For this, six series concrete mixture with water / binder ratios of 0.30, 0.45 and 0.55 was prepared. 5% silica fume was added to the prepared mixtures by replacing it with cement. Chemical additives were used to ensure workability. After the mixtures were prepared and blended, a slump experiment was performed. The mixture for slump test was put back into the concrete mixer before it was placed in the mold and mixed again for a certain time. Then, measurements were taken by performing a second slump experiment. As a result of the experiment, it was determined that the second blending of the mixture has no effect on the precipitation. The same mixtures and-be test was also applied. Slump test and and-be test results of the produced samples were compared. The batch in which optimum workability was achieved was determined by considering the water / binder ratio and the amount of chemical additives.

Keywords: High Strength Concrete, Silica Fume, Water / Cement Ratio, Workability.

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AN APPROXIMATE MIXTURE DESIGN FOR HIGH STRENGTH CONCRETES OBTAINED BY USING SILICA FUME AND STEEL FIBER SUMMARY

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Abstract:

With the developing material technology, the production of high strength concrete (YDB) has gained popularity in recent years. The widespread use of large structures such as multi-storey buildings, bridges, viaducts and tunnels has led researchers to work on YDB. YDB is a special type of concrete obtained by adding a variety of pozzolanic mineral additives to the concrete mix or replacing them with cement. In addition, in this special type of concrete, steel fibers are added together with mineral additives to increase strength. In the literature, there are many studies in which various mineral additives related to YDB are used, and tests and analyzes are carried out by adding steel fibers to the mixtures. In this study, it is aimed to develop a practical mixture design for high strength concretes produced by using silica fume and steel fiber. This mixture design is based on the purpose of obtaining formulation using SPSS statistical analysis program. For this purpose, data on the mechanical properties of concrete were obtained from the literature, from studies on high strength concretes. Analyzes were made with these data and optimum mixture design was developed for high strength concretes using silica fume and steel fiber. Thus, a practical formulation for YDB has been obtained. A good agreement has been obtained by comparing the obtained formulation with the experimental results in the literature. Accordingly, in practice, it was thought that by using the developed formulation, savings in terms of time, cost and labor will be achieved..

Keywords: High Strength Concrete, Silica Fume, Steel Fiber, Mixture Design.

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EFFECT OF HOT EXTRUSION ON THE MECHANICAL AND CORROSION PROPERTIES OF THE MG-ZN-GA ALLOYS FOR MEDICAL APPLICATIONS

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Abstract:

One of the most important and promising directions in modern medicine is the development a new materials for biodegradable implants with high performance properties. The most biocompatible and safe implants are made from magnesium-based alloys currently. The object of research is a new biodegradable magnesium alloys of the Mg-Zn-Ga system. The unique feature of the new magnesium alloys is the addition of gallium as an alloying element. Currently, gallium used for treatment diseases, associated with accelerated bone loss, such as osteoporosis, Paget's disease, hypercalcemia, and multiple myeloma. Also gallium, like silver, has an antibacterial effect on the human body, which is very important when installing implants and at post operation period. In this work the effect of severe plastic deformation (SPD) on the mechanical and corrosion properties of Mg-Zn-Ga alloys containing from 2 to 6.5 wt.% Zn and 2 to 4 wt.% Ga has been investigated. Hot extrusion were used as the deformation processing method. The extrusion temperature varied from 150 °C to 250 °C.

According to the in-vitro corrosion and mechanical tests results, it was identified that the properties of Mg-Zn-Ga alloys depend not only on the chemical composition of the alloys, but also on the extrusion temperature. The maximum mechanical properties is observed in the alloy Mg – 4 wt.% Zn – 4 wt.% Ga extruded at 150 °C, for which the tensile strength and yield strength were 343 and 256 MPa, respectively, and the elongation was 14 %. The corrosion rate of this alloy is 0.4 mm/year. Such characteristics of the alloy allow us to confidently recommend in the future as a promising material for the manufacture of biodegradable implants.

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Keywords: Magnesium Alloys, Gallium, Biodegradable Implants, Severe Plastic Deformation, Hot Extrusion, Corrosion Properties

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EFFECT OF SEVERE PLASTIC DEFORMATION ON THE CORROSION PROPERTIES OF BIODEGRADABLE MAGNESIUM ALLOYS FOR MEDICAL APPLICATIONS

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Abstract:

It is well-known that Mg-Zn-Ca-(Mn) magnesium alloys are advanced for biodegradable implants due to their high biocompatibility, since all the listed alloying elements are contained in human tissues in significant quantities and participate in metabolism. The main direction in modern research of biodegradable magnesium alloys is the study of their corrosion properties, in particular, the studying of the ability to control the rate of corrosion and analysis of possible toxic, mutagenic and allergic effects of corrosion products on the human body.

The corrosion rate of Mg-Zn-Ca and Mg-Zn-Ca-Mn alloys containing from 2 to 4 wt% Zn; 0.7 wt.% Ca and up to 1 wt.% Mn in Hanks solution was studied.It was shown that after hot extrusion that the corrosion rate of alloys doesn't depend on the extrusion temperature. Alloys containing 2 wt.% Zn with Mg2Ca and Ca2Mg6Zn3 phases in their structure have a lower corrosion rate than alloys with 4 wt.% Zn containing only the Ca2Mg6Zn3 phase. The addition of Mn leads to a significant reduction in the corrosion rate of the investigated alloys. An alloy with composition: Mg–2 wt.% Zn–0.7 wt.% Ca–1 wt.% Mn is proposed for the manufacture of biodegradable implants, which at extruded condition has the corrosion rate of 0.3 mm/year.

Acknowledgement: The authors gratefully acknowledge the financial support of the Ministry of Science and Higher Education of the Russian Federation in the framework of Increase Competitiveness Program of NUST «MISiS» (№ К2-2019-008), implemented by a governmental decree dated 16th of March 2013, N 211.

Keywords: Biodegradable Implants, Magnesium Alloys, High Biocompatibility, Severe Plastic Deformation, Corrosion Properties, Zinc, Calcium

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