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TECHNICAL ASSISTANCE AND DTP
KOMPJUTERSKA OBRADA TEKSTA

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KEYNOTES PAPERS/UVODNA PREDAVANJA

CATALYSIS WITH ECO-RESPONSIBLE MATERIALS: OPPORTUNITIES AND CHALLENGES

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Keywords: **s**ustainable catalytic materials, noble metal replacement, Eco-friendly catalysis

ABSTRACT

The growing need for sustainable and environmentally friendly catalytic processes has driven intense research into the replacement of noble metals with eco-responsible materials. While noble metal-based catalysts often exhibit superior activity and selectivity, their high cost, limited availability, and environmental impact necessitate alternative solutions.

In this presentation, we will discuss the opportunities and challenges of developing noble metal-free catalysts, focusing on transition metals, bio-sourced supports, and naturally occurring materials. We will illustrate these challenges through examples from our research, conducted in international collaborations. Tunisian clays and eggshell-derived materials from Algeria have been explored for water depollution, particularly for the oxidation of organic pollutants. Zeolites have been investigated both for air pollution control and for biomass valorization, specifically in selective hydrogenation reactions, in collaboration with Cuba.

The transition towards more sustainable catalysis requires balancing activity, stability, and selectivity, which remains a significant challenge. By sharing insights from our experimental work, we aim to contribute to the ongoing discussion on how to bridge the gap between eco-responsibility and catalytic efficiency.

HYDROMETALLURGICAL TREATMENT OF SPHALERITE CONCENTRATE IN OXIDATIVE ACID SOLUTION

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Keywords: hydrometallurgy, sphalerite concentrate, oxidative acid solution, zinc extraction

ABSTRACT

Sphalerite is the most abundant and economically significant zinc sulfide mineral, typically found dispersed within complex concentrates alongside other sulfide minerals, such as copper, lead, and iron sulfides, as well as associated gangue minerals. Due to its fine-grained structure and intricate mineralogical composition, effective extraction of zinc from sphalerite often necessitates sophisticated leaching processes. This paper reviews current advancements in the acidic leaching of sphalerite, with special emphasis placed on the kinetics and oxidation mechanisms induced by various oxidizing agents, including hydrogen peroxide, oxygen, dichromates), nitrate and nitrite salts, ferric and cupric ions, among others. Furthermore, novel findings from leaching experiments employing sulfuric acid solution in combination with manganese dioxide and potassium iodide an oxidation system not previously investigated, are presented and discussed in detail. Comprehensive characterization techniques, such as Atomic Absorption Spectroscopy (AAS), X-ray Diffraction (XRD), Scanning Electron Microscopy coupled with Energy Dispersive Spectroscopy (SEM/EDS), and optical microscopy, were utilized to analyze the original concentrate and the resulting leach residues. Finally, the obtained results are systematically compared with previously published data involving leaching of sphalerite concentrates in sulfuric acid solutions using sodium nitrate or hydrogen peroxide as oxidants, providing new insights into their relative effectiveness and mechanisms.

METALLIC MATERIALS/METALNI MATERIJALI

ISOTHERMAL QUENCHING STEEL 100Cr6

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Keywords: bearing steel, 100Cr6 steel, isothermal quenching, microstructure, hardness

ABSTRACT

Steels for rolling bearings are important in the world production of special steels. They are used for the production of rolling bodies and rings. Since these are very responsible parts in machine construction, high-quality standards are required for these steels. The service life of rolling bearings, in addition to working conditions also depends on the properties of the steel used for their production and the production technology. Heat treatment is one of the phases in the production of the bearing and has a significant influence on the final properties of the bearing. This paper presents the results of testing the influence of isothermal quenching at two different temperatures and for different holding times on a microstructure and hardness of steel 100Cr6. Isothermal quenching is often used in practice to avoid tempering after quenching.

STRUCTURAL AND MORPHOLOGICAL PROPERTIES OF Y-TiO_2

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Keywords: SEM, EDS, photocatalysis, water pollution

ABSTRACT

Water pollution by organic matters is in increase. Photocatalytic degradation of various pollutants presented in environment has promising future. Different materials have been applied in previous scientific works, while TiO_2 based materials posse's great physico-chemical characteristics. Therefore, researchers are constantly developing various heterostructures with advanced properties with aim to readily degrade present pollution. In this paper, our goals were to investigate structural and morphological properties of novely synthesized Y-TiO_2 photocatalyst. With those purposes, several tests were done, like Scanning electron microscopy (SEM), Energy-dispersive X-ray spectroscopy (EDS), structural stability (SS) etc. Results show that obtained material has prominent photocatalytic activity in five consecutive cycles.

PRODUCTION OF ALUMINUM COMPOSITES WITH BORON NITRIDE REINFORCEMENT: MICROSTRUCTURAL AND MECHANICAL ENHANCEMENTS FOR ADVANCED APPLICATIONS

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Keywords: aluminium composites, boron nitrude, microstructure, mechanical properties

ABSTRACT
In this study, aluminum-based composites reinforced with nano-sized boron nitride (BN) were produced by using the casting method. Particle sizes of BN were reduced down to nanoscale via milling for 96 h at room temperature. The casting process ensured a homogeneous distribution of BN within the alloy matrix by melting the aluminum alloy, introducing BN powders under optimal conditions, and solidifying the mixture in molds. Microstructural analyses were conducted to assess phase structure, grain size, and BN dispersion by XRD, OM, SEM, and SEM-EDX techniques, while mechanical properties of composites were evaluated through microhardness tests. Results showed significant improvements in alloy properties, highlighting the potential of these composites as lightweight, durable materials for aerospace and automotive applications.

SYNERGY BY MOLYBDENUM AND NIOBIUM ON PERFORMANCE OF COLD WORK TOOL STEELS

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Keywords: refractory metals, tool steels, carbides

ABSTRACT

For die industry where the future products have a decisive role for material selection, the subject of steel is an area of interest with high potential for innovation. With new production and processing technologies that prioritize knowledge, the quality of materials has improved significantly and these developments continue. Material selection in die design is an important part of engineering to produce sustainable solutions to problems. Die manufacturing is open to innovation as of the main input is steel. Cold work tool steels (CWTS) are frequently preferred in die industry. Recently, in addition to traditional CWTS, new generation CWTS have been put into use. This article examines the use of one traditional and two new generation CWTS as punch tool in press of sheet metal and thread rolling dies for screw manufacure. It has been observed that the new generation CWTS offer longer lifespan compared to traditional one. The microstructures were investigated and the fine and evenly distributed and multiple carbide structures they could form were evaluated using FactSage® thermodynamic software. The carbides in new generation CWTS were also rich in Molybdenum and Niobium. With the help of new generation materials, modern heat treatments and advanced coating technologies, it is possible to design unique special products suitable for each work. For innovation approach of modern tool steels in the context of cold forming dies, traditional and new generation Cold Work Tool Steels (CWTS) were compared in terms of chemical composition and the use of refractory metals as alloying elements, and their performances were evaluated and interpreted.

THE INFLUENCE OF EXPANDED MEASUREMENT UNCERTAINTY IN THE STATEMENT OF CONFORMITY FOR HAND TORQUE TOOLS CALIBRATION

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Keywords: hand torque tools, expanded measurement uncertainty, statement of conformity, decision rule, level of risk

ABSTRACT
The BAS EN ISO/IEC 17025 standard gives the laboratory the opportunity to accredit the statement of conformity. The statement of conformity is provided in accordance with the specification, standard or costumer requirement. Prior to issuing the statement of conformity, the accredited laboratory, in cooperation with the costumer, must document the decision rule to be applied taking into account the level of risk associated with the decision rule. This paper describes the procedure for calibrating hand torsion tools with measurement uncertainty assessment, a practical example of calibration with a statement of conformity in terms of two possible decision rules and the risk that will be accepted by the laboratory or the costumer.

DAMAGES INVOLVING PLASTIC DEFORMATION OF STRUCTURES RELATED TO MAINTENANCE COST REDUCTION

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Keywords: equpment maintenance, maintenance costs, construction components, failure, breakdown, plastic deformation.

ABSTRACT

This paper presents some aspects of the correlation between maintenance cost reduction and accidents—specifically, damages due to plastic deformation in steel constructions at production companies in Bosnia and Herzegovina. In the theoretical part, a tension testing diagram for typical structural steels (I, U, T, etc.) is used to explain the nature of failures in the discussed support constructions. The practical part includes a series of photographs taken during forensic examinations following accidents, providing evidence of prior plastic deformation. This section is complemented by data on corresponding maintenance costs. It is emphasized that using loads above 60% of the yield stress, even if within the elastic range, is a dangerous practice for steel constructions in Bosnian manufacturing companies, let alone exceeding the yield point into the plastic deformation range. The most common causes for this practice, i.e., 'overloading' that results in plastic deformation or structural accidents, include poor quality of planned-preventive maintenance and a policy of reducing maintenance costs. These accidents often lead to injuries among workers, partial or complete destruction of structural components, or the decommissioning of entire facilities, thereby causing technological delays and triggering enormous costs due to lost production. These total costs are further increased due to the necessity to remedy the state of equipment and/or production technology.

SOME CHALLENGES IN MEASURING THE MICROHARDNESS OF METALLIC GLASSES

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Keywords: microhardness testing, metallic glasses, CCD camera

ABSTRACT

Measuring the material's microhardness is generally easy and quick. However, since the operator reads the dimensions, i.e., the ends of the imprint formed in the material, the measurement result is greatly influenced by the operator's assessment.
We present the research results in which three operators measured Vickers microhardness on the same impression by reading the dimensions in two ways: on the instrument's eyepiece and using a CCD camera connected to a computer. Three samples of metallic glasses from the same system, with similar properties but significantly different thicknesses (approximately 20, 50, and 90 μm), were used. We made 20 impressions on each sample and compared and discussed the results.

THE EFFECT OF CHLORIDE IONS ON THE CORROSION CHARACTERISTICS OF Cu-Al-Zn BIOALLOY

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Keywords: shape memory alloys, corrosion, chloride ions

ABSTRACT

The Cu-Al-Zn alloy is used as a functional material in industry, and also as a biomaterial. These alloys have excellent electrical properties, good thermal conductivity, and can also be used for biomedical purposes.The basic characteristic of alloys that remember their shape is their independent return to some of their remembered shape when the temperature changes.

The electrochemical behavior of Cu-Al-Zn alloy in phosphate buffer without and in the presence of chloride ions was investigated. Electrochemical researches were performed in a traditional three-electrode system by means of the Tafel extrapolation method and cyclic voltammetry. Reduced corrosion currents in the anodic and cathodic parts of the voltammogram in the presence of chloride ions indicate their effective inhibitory property for most of the tested bioalloy. With an increase in the concentration of chloride ions, the rate of corrosion decreases, that is, with an increase in the concentration of chloride ions, the efficiency/effectiveness of the inhibitor increases. This bioalloy showed the best resistance to corrosion in a solution of chloride ions in which the concentration was 4.104 mM. The effectiveness of the inhibitor for this concentration is 31.81%.

INFLUENCE OF CORROSION ON MECHANICAL CHARACTERISTICS OF STEEL SAMPLES (42CrMo4)

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Keywords: steel sample, corrosion behavior, mechanical properties

ABSTRACT
Specific environmental conditions, such as marine environments, often influence steel applications in marine industries. These conditions are commonly simulated using a NaCl solution in order to simplify the study and eliminate the complexities of seawater's chemical and biological variability. In this study, 42CrMo4 steel samples, a widely utilized material in components subjected to static and dynamic stresses found in vehicles, engines, and machinery, were selected for analysis due to their susceptibility to various forms of corrosion. The corrosion behavior of the samples was monitored using mass loss and corrosion rate. The results were then correlated with changes in mechanical properties, including tensile strength and Brinell hardness. The study provides insight into how corrosion impacts the degradation of mechanical properties.

SURFACE DEGRADATION MONITORING CAUSED BY CAVITATION EROSION AFTER CORROSION IN MARINE ENVIRONMENT

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Keywords: corrosion, cavitation, image analysis, degradation level.

ABSTRACT

Monitoring cavitation erosion in materials is crucial for their performance in environments characterized by severe fluid flow conditions. Materials such as metals, ceramics, and composites, commonly used in these applications, must possess specific mechanical properties to effectively resist cavitation erosion. Additionally, various environmental factors, including different chemical solutions, can significantly alter a material's response to cavitation. In this study, the impact of a marine environment was investigated using a prepared NaCl solution, following the standard procedure of ISO 11130:2017 (E), to evaluate its influence on further the cavitation erosion exposure of materials. Cavitation erosion tests were performed on steel samples (42CrMo4) after immersing them in the NaCl solution for 120 days. An ultrasonic vibratory test, conducted according to the ASTM G-32-16 standard, was employed to assess the material's erosion resistance. To evaluate the extent of cavitation damage, various methods were utilized, including monitoring mass loss and calculating the mass loss rate, as well as conducting image analysis to quantify pit dimensions, the number of pits, and overall degradation levels. The results provide valuable insights into the relationship between material properties, environmental exposure, and cavitation erosion, with implications for the design and selection of material for use in marine and intensive fluid flow applications.

EFFECT OF HEAT TREATMENT ON THE MECHANICAL AND STRUCTURAL PROPERTIES OF X155CrVMo12-1 STEEL

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Keywords: X155CrVMo12-1 steel, microstructure, quenching, hardness, tempering

ABSTRACT

This paper investigates the effects of oil quenching and tempering at various temperatures on the mechanical and structural properties of X155CrVMo12-1 tool steel. The steel specimens were austenitized at 1030 °C for half an hour, followed by quenching and tempering at different temperatures. Mechanical properties were assessed by measuring the hardness of the samples after each heat treatment. Using the conversion formula, the tensile strength values were calculated based on the measured hardness. Structural changes were analyzed using optical microscopy. The results indicate that the highest hardness values were achieved after the quenching process. However, an increase in tempering temperature led to a decrease in hardness. Optical microscopy revealed that quenching caused the appearance of martensite in the microstructure, while tempering at various temperatures caused alterations in the martensite structure.

INVESTIGATION OF THE PORTEVIN-LE CHATELIER EFFECT IN AlMg ALLOYS: EFFECT OF TESTING RATE

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Keywords: AlMg alloy, Portevin-Le Chatelier effect, testing rate, DIC

ABSTRACT

The study investigates the Portevin–Le Chatelier (PLC) effect in the cold rolled Al-Mg alloy EN AW-5754. The tensile tests were performed on dog bone specimens at test speeds of 10, 20, and 50 mm/min. Digital image correlation (DIC) and infrared thermography were used to monitor strain rate and temperature changes. The results showed a strong correlation between PLC line propagation, strain rate variations and temperature changes. Regardless of the test speed, the characteristic jagged shape of the material was observed due to the PLC effect. As the deformation progressed, both the strain rate and the temperature increased, with the changes being more pronounced at higher test speeds. DIC and infrared images show that temperature peaks correspond to moments of increased plastic deformation and sudden drops in strain rate. The formation of overlapping PLC lines also showed the random and unpredictable nature of the phenomenon.

SELECTION OF THE MINIMUM RADIUS OF THE PUNCH IN THE “CLINCHING” JOINING PROCESS FOR ACHIEVING MINIMUM JOINT STRENGTH FORCE

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Keywords: metal forming, clinching, regression analysis, sheet metal

ABSTRACT

In order to meet the increasingly stringent requirements and growing needs of customers across most industrial sectors, particularly in the modern automotive industry, environmental protection, and energy consumption reduction, new materials and methods for their joining that cannot be performed using conventional joining technologies are increasingly being applied. The development of new metal joining technologies is moving towards reducing the use of additional materials and energy. In this regard, modern metal joining processes based on deformation processing principles are being intensively developed. One such material joining process, which presents a serious alternative to spot welding, is the "clinching" method. Clinching is a pressure-based joining technique aimed at joining thin sheets using specially shaped fasteners by plastic deformation of the base materials being joined. The quality of the formed joint is influenced by a number of factors. This paper presents the specifics of the clinching joining process and analyzes the impact of key process factors on the joint quality, with a particular focus on the effective determination of the punch radius required to achieve the minimal force necessary for the joint strength.

ANALYSIS OF FORMABILITY IN BENDING USING SOLIDWORKS SOFTWARE

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Keywords: formability, V-die bending, SolidWorks, material testing

ABSTRACT

Formability is the ability of a material to deform without fracturing, and the assessment of this property depends on various factors such as temperature, deformation speed, and stress state. There are two main approaches to determining formability: one is based on testing different materials under controlled stress conditions, and the other on developing failure criteria that depend on stress, deformation, deformation speed, and temperature. Bending of materials induces different stresses on the inner and outer sides of the sheet, which can lead to the Bauschinger effect during re-bending. Although the sheet formability test is outdated, it is still used to illustrate the properties of materials like high-strength steels. In this study, SolidWorks software was used to analyze the formability of the sheet during bending in a V-die, using different sheet thickness and materials.

THE ASSESSMENT OF THE FORMABILITY OF SHEET METAL USING NUMERICAL SIMULATION IN DEEP DRAWING PROCESSES

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Keywords: deformability, sheet metal, deep drawing, numerical simulation

ABSTRACT

Traditionally, the design of manufacturing technology and tool construction for metal forming processes relies on literature guidelines and the extensive experience of engineers. Today, the technology of deformation processing is in rapid development based on the application of computers, which enable extensive research and studies. This is also true in the area of sheet metal processing, as a specific group of 2D forming processes. Regarding of this, modern software for simulating the entire sheet metal forming process is increasingly being used. These software tools allow for a detailed analysis of the process, enabling the verification of preliminary design solutions and resolving potential dilemmas that arise during the design phase. These dilemmas most often relate to finding the most favorable relationship between material behavior and process parameters during forming, or the change of shape. This relationship, in recent decades, has been characterized by the concept of formability, which refers to the ability to form sheet metal without cracking, wrinkling, or other defects. Determining or estimating formability means predicting the material's behavior in a specific forming process in advance. One of the many methods used to assess formability is numerical process simulation. This scientific work presents an example of using numerical simulation as a useful tool for verifying the feasibility of manufacturing a redesigned filter housing according to the designed deep drawing technology, with a special emphasis on the direct assessment of sheet metal formability. FormingSuite software was used for simulating the deep drawing process.

MICROSTRUCTURAL ANALYSIS OF COPPER ALLOYS WITH DIFFERENT ZINC CONTENT

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Keywords: copper alloys, brass, microstructural analysis, Vickers microhardness, Copper Mill Sevojno

ABSTRACT

The paper presents the results of a microstructural analysis of copper alloys produced in the Copper Mill Sevojno. The analyzed materials include high-purity copper (Cu-ETP and Cu-DHP) and a series of brass alloys with varying zinc content (CuZn10, CuZn15, CuZn28, CuZn30, CuZn33, CuZn37). Various thermomechanical treatments were conducted on the samples, including plastic deformation to varying degrees and annealing at different temperatures, in order to obtain materials with soft, semi-hard, and hard properties. The structure and composition of the samples were examined using optical microscopy and scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM–EDS). Vickers microhardness testing was also performed in order to assess mechanical properties and observe possible changes caused by thermomechanical processing. The obtained results provide useful insights into the internal structure of the alloys and how processing conditions influence their structural and mechanical characteristics.

ALUMINUM DROSS USE IN METALLOTHERMIC FERROCHROMIUM PRODUCTION

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Keywords: aluminium dross, ferrochromium, aluminothermic reduction

ABSTRACT

Aluminum dross contains high amount of metallic Al (up to %60 wt. Al) and regarded as a waste in aluminum casting operations. High metallic value in Al dross can be utilized via recycling procedure. In this study, Al dross was used in aluminothermic ferrochromium production with chromite ore and mill scale. Enthalpy, Gibbs Free Energy and Entropy of reactions calculated via HSC software. Propane-Butane heated furnace was used in the study. Experimental procedure was carried out in a graphite crucible. Effects of stochiometric ratio of Al and mixing was evaluated in metallization of chromite and mill scale. Results of experimental studies were examined by XRD and SEM/EDS techniques. Results showed that metallization had occurred very limited and further investigations to increase efficiency is mandatory to obtain a fully developed process.

CORROSION INHIBITION OF BRASS IN CHLORIDE SALT SOLUTION APPLYING WILD RASPBERRY FRUIT AS A GREEN, NON-TOXIC INHIBITOR OF CORROSION

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Keywords: wild raspberry fruit, DC techniques, electrochemical impedance spectroscopy, green inhibitor

ABSTRACT

The paper presents an examination of the possibility of applying wild raspberry fruit extract as a green inhibitor of general corrosion of brass in 3% NaCl. Wild raspberry fruits were collected from the Moševac near Maglaj city, Bosnia and Herzegovina. Wild raspberry fruit extract was obtained by ultrasonic method. By UV/VIS spectrophotometry analysis a significant content of polyphenol was found in the wild raspberry fruit extract.

*Results obtained by DC techniques (by the methods of Tafel extrapolation and linear polarization) prove that the corrosion rate decreases in the presence of the wild raspberry fruit extract. Tests performed by the method of electrochemical impedance spectroscopy prove that the tested extracts slow down the kinetics of the corrosion process, which is visible through the increase in resistance. The results of the conducted tests prove that in an aggressive medium, such as 3% NaCl solution, wild raspberry fruit extract can be used as an inhibitor of brass corrosion in concentration of 0.04828 g/*L.

FERRITIC HIGH-Si DUCTILE CAST IRONS – PERFORMANCE MATERIALS

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Keywords: castings, ductile cast iron, Si-alloying, mechanical properties, structure, graphite shape factors, graphite nodularity, inoculation

ABSTRACT

There is a significant increase in industrial applications of ferritic high-Si ductile cast irons (3 - 6%Si), such as the automotive and maritime industries, wind power technology and mechanical engineering. Ferritic high-Si ductile cast irons replace un-stable mixed ferrite-pearlite matrix, with a unique combination of high elongation, strength and hardness (ideal for automotive drive train components) and resistance to oxidation and corrosion at high temperatures (automotive exhaust and turbocharger systems). The present paper evaluates the defining mechanical properties and the peculiar structural characteristics of Si-solid solution strengthened ferritic spheroidal graphite cast irons compared with ferritic to pearlitic spheroidal graphite conventional (less than 3%Si) cast irons.The state-of-the art as the actual knowledge on the structure characteristics and possible solutions to improve the graphite particles parameters in these cast irons, affected by Si-alloying, are presented, with focus on the proper experiments.

DUCTILITY CAPACITY STUDY OF LARGE-SCALE, BUCKLING-RESTRAINED BRACES IN STEEL STRUCTURES

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Keywords: ductility capacity, steel structures, large-scale braces, buckling-restrained braces

ABSTRACT

One of the new methods of anchoring steel structures is the use of large-scale buckling-restrained braces (BRBs) on the lateral system of this type of structures. This study investigates the behavior of BRBs and compares them with buckling braces. In this study, a two-dimensional frame with four stories and four spans was taken and analyzed in eight different ways and each in the form of buckling and buckling-restrained braces. The results show that making the braces buckling-restrained has a positive effect on increasing ductility and energy dissipation.

CONTRIBUTION TO INVESTIGATION OF THE INFLUENCE OF WELDING ON THE HARDNESS AND MICROSTRUCTURE OF SUPERALLOY NIMONIC 80A

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Keywords: superalloys, Nimonic 80A, welding, experimental tests

ABSTRACT

Because of their properties, superalloys are primarily used for the production of structural parts whose operating conditions correspond to elevated temperatures and often extremely aggressive environments. Because of that, they require a combination of high strength, good fatigue and creep resistance, and good corrosion resistance. Nimonic 80A is a nickel-chromium alloy, which is precipitation hardened with the addition of Al and Ti. The chemical composition of Nimonic 80A alloy has a dominant influence on its mechanical and technological properties. The combination of strength (max. tensile strength 1220 N/mm^2) and hardness (HB 370) at room and elevated temperatures with thermal stability at high temperatures makes this alloy most commonly used in extreme working conditions. Nimonic 80A has the widest application in the automotive industry where it is most often used for various parts of turbines, also, a significant part of the application is made up of industrial gas turbines, as well as the application of these materials in medicine. Standard methods and compatible filler metals can be used for welding Nimonic 80A alloy. In this work, TIG (tungsten inert gas) method used for welding samples with a different chemical composition. The aim of testing was investigating the effects of chemical composition on mechanical properties of welding joints superalloy Nimonic 80A.

NONMETALLIC MATERIALS/NEMETALNI MATERIJALI

CHARACTERIZATION OF LIMESTONE AND DOLOMITE FILLERS FOR INDUSTRIAL APPLICATIONS

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Keywords: fillers, limestone, dolomite, particle size distribution, mineralogical composition, chemical composition

ABSTRACT

Fillers play a crucial role in enhancing product performance and reducing production costs. To be used in various industries, fillers must be readily available, affordable, pure, non-toxic, and meet specific physical and chemical standards. This study examines limestone and dolomite fillers, focusing on their chemical composition, mineralogical properties, and particle size distribution. Advanced analytical techniques were employed: laser granulometry for particle size distribution analysis, X-ray fluorescence spectroscopy for chemical analysis, and X-ray diffraction for mineralogical analysis. To assess whether harder components, such as quartz, are concentrated in the coarser fractions, all the fillers were divided into two fractions - above 45 microns and bellow 45 microns The findings indicate that the quality and composition of fillers significantly impact their industrial suitability. While limestone and dolomite fillers differ in purity and mineral content, both offer potential applications across various industries.

LOCALIZED ELECTRON STATES IN CRYSTALLINE NANOFILM WITH COMPLEX LATTICE

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Keywords: electrons, Green’s function, ultra-thin films, localized states

ABSTRACT

This paper examines all transport properties (such as e.g. mechanical resistance, electrical and thermal conductivity, photosensitivity, magnetization, etc.) which are caused by the electron motion in crystalline nanofilms, with two sublattices. We have performed theoretical research using the method of two-time and temperature-dependent Green's functions and calculated the energy spectra and spatial distribution of electrons in these structures. Comparing obtained results with bulk, we have fond that the presence of boundaries (and change of the boundary parameters) lead to completely new physical properties and specific effects, which are essential both for fundamental science and for the precise application of such (and similar) structures in nanotechnology. We found that the energy spectrum has two allowed and one forbidden zone, and that localized electronic states can appear. In addition, by analyzing the spatial distribution of these states, we determined that the probability of finding electrons is particularly high at the boundaries of the film and decreases toward its inner layers.

EXCITON DISPERSION LAW IN CRYSTALLINE SUPERLATTICES

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Keywords: superlattice, exciton, dispersion law, Green’s function.

ABSTRACT
In this paper, we studied the superlattice model, as a special class of materials in which the "nodes" of the crystal lattice are made up of interconnected thin films with a certain regular and periodic arrangement. We have theoretically determined the energy spectra that exciton quasiparticles can have in these structures. The number of film layers that make up the basic periodically repeating motifs within the superlattice, as well as the ratio of exciton energy transfer within each motif (film) and exciton energy transfer between neighboring motifs proved to be important parameters that influence the behavior of the calculated quantities in the external electromagnetic field.

SYNTHESIS AND STRUCTURAL ANALYSIS OF HIGH-ENTROPY OXIDE $(CoCrFeMnNi)_3O_4$

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Keywords: high entropy oxide, density functional theory, solution combustion synthesis

ABSTRACT

Technological developments and the demand for innovative products in catalysis and energy conversion/storage have driven the development of high entropy alloys (HEAs) and high entropy oxides (HEOs). HEAs, formed by combining four or more elements in nearly equal ratios, and HEOs have become prominent research topics for above mentioned technologies. HEOs are typically synthesized through solid-state reactions due to easy processability. In this study, high entropy oxide was designed and optimized using atomic level modeling [(density functional theory (DFT)] to guide synthesis studies. Accordingly, synthesis of $(CoCrFeMnNi)_3O_4$ high entropy oxide with AB_2O_4 type spinel structure having $Fd\bar{3}m$ cubic space group symmetry was carried out using solution combustion synthesis.

OPTIMIZING DEMAGNETIZATION PROCESS FOR RECYCLING END-OF-LIFE NdFeB MAGNETS

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Keywords: demagnetization, NdFeB, recycling, sustainability

ABSTRACT

NdFeB (Neodymium-Iron-Boron) magnets are vital in technologies like electric vehicles, wind turbines, and medical devices because of their high energy density. Rising demand and limited rare earth resources highlight the need for recycling end-of-life (EOL) NdFeB magnets to enhance sustainability. Demagnetization, essential for dismantling and sorting, is typically conducted above the Curie temperature (300–400°C, composition-dependent) but remains underexplored for metallurgical recycling. This study evaluated demagnetization of EOL NdFeB magnets at 250°C, 300°C, and 350°C for 20, 30, and 40 minutes using a muffle furnace. The findings provided a basis for optimizing demagnetization, a key step for efficient hydro- and pyrometallurgical recycling.

SUSTAINABLE ALUMINIUM STRATEGIES: UTILIZING DIASPORIC BAUXITE ORE AND BLACK DROSS FOR ALUMINA, ALUMINA-BASED CERAMIC AND SMELTING FLUX PRODUCTION

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Keywords: aluminium, diaspore, black dross, sustainability

ABSTRACT

Aluminium and its alloys, with superior mechanical properties and recyclability, are essential for industries such as transportation, construction, and packaging. Its recyclability supports sustainability by reducing greenhouse gas (GHG) emissions, energy consumption, and reliance on primary aluminium, making secondary aluminium production increasingly significant. However, the growing demand for aluminium highlights the need for innovative approaches to utilize industrial by-products. This study focuses on the development of sustainable and low-emission aluminium production using diasporic bauxite ore and black dross by improving efficiency. It highlights the evaluation of diasporic bauxite ore and black dross by pyrometallurgical and hydrometallurgical methods to produce alumina, alumina-based compounds and fluxes.

UPCYCLING F PVDF INTO BETA-PHASE-RICH PIEZOELECTRIC POLYMER CANDIDATES

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Keywords: polyvinylidene fluoride (PVDF), β-phase formation, nickel ferrite ($NiFe_2O_4$), strontium titanate ($SrTiO_3$)

ABSTRACT

Polyvinylidene fluoride (PVDF) is a semicrystalline polymer whose piezoelectric performance is maximized in its polar β-phase. In this study, nano-structured PVDF matrix composites incorporating ceramic fillers were fabricated and evaluated as potential sensor materials. The PVDF used in this work was recovered from machining waste of high-performance engineering polymer rods, demonstrating an upcycling approach to transform industrial polymer waste into advanced functional materials. Strontium titanate ($SrTiO_3$) and nickel ferrite ($NiFe_2O_4$) nanoparticles were synthesized and added to PVDF to investigate their effects on phase composition and piezoelectric properties. Composites were prepared by dissolving PVDF in N,N-dimethylformamide (DMF) and inducing polymer crystallization through non-solvent precipitation at controlled temperatures. Fourier-transform infrared spectroscopy (FTIR) was used to characterize the crystalline phases and morphology. Low processing temperature (0 °C) and high PVDF concentration in solution promoted the formation of the electroactive β-phase while suppressing the non-polar α-phase. No α-phase peaks were observed in samples precipitated at 0 °C, indicating predominantly β-phase PVDF. Incorporating $NiFe_2O_4$ at 20% by weight significantly increased β-phase content and improved the material's expected piezoelectric response, whereas $SrTiO_3$ had no clear positive effect on β-phase formation. The optimized PVDF composites—with high β-phase content achieved via controlled crystallization and strategic nanoparticle addition—demonstrate enhanced piezoelectric characteristics.

EXTRACTION OF NANOCELLULOSE FROM AGRICULTURAL WASTES

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Keywords: biomass, agricultural wastes, biomass waste usage

ABSTRACT

The most abundant renewable biomass on the earth is lignocellulosic biomass supplying from the forestry, forestry residue, and agricultural wastes nearly annually 200 billion tones worldwide. Agricultural wastes encompass a lot of cellulose, lignin and hemicellulose in composite form. Cellulose, the most important part of a plant structure, is a renewable, biocompatible, and non-toxic biopolymer possessing numerous hydroxyl functionalities. In plant's structure hemicellulose and cellulose are held together by lignin in which lignin and hemicellulose act as an adhesive and a medium respectively. Utilization of cellulose in a high value-added way may open a new window in a bright future for biomass waste usage. Nanocellulose (NC) is a biopolymer possessing outstanding properties like remarkable mechanical strength, high aspect ratio, reactivity, lightweight, biocompatibility, high flexibility, biodegradability, and self-assembling capability. NC could be achieved from cellulose via chemical, mechanical and biological approaches.

STABILIZATION OF RED MUD WITH NATURAL MINERAL

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Keywords: red mud, pyrophyllite shale, stabilisation, composite, building block

ABSTRACT

The aim of this work was to examine the possibility of stabilizing red mud with a natural mineral, namely pyrophyllite shale, to the extent that it is not harmful to the environment, as well as the use of such a stabilized composite for the production of building materials such as bricks, in order to ultimately achieve a complete circular economy, where on the one hand there would be the utilization of waste material, the preservation of the environment and natural resources, and on the other hand, the production of products of the same quality.

Based on the set goal, the results for the composition of red mud and pyrophyllite shale as well as the stabilized composite before and after thermal treatment at 900 °C are presented in the work, and they show that there is a decrease in the proportion of all oxides present in the mixture except silicon, because it is over 63% in pyrophyllite shale. Based on the stabilized composite, building block samples were formed. After the firing process, the samples cracked, and as such they could not be analyzed further. Based on this, it could be concluded that only stabilized composite cannot be used to make bricks.

MECHANICAL PROPERTIES OF LIGHTWEIGHT CONCRETE WITH RECYCLED EPS AND POLYPROPYLENE FIBERS

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Keywords: lightweight concrete, recycled EPS, polypropylene fibers, mechanical properties

ABSTRACT

Lightweight concrete is increasingly utilized in sustainable construction due to its reduced weight and improved thermal performance. However, replacing conventional aggregates with alternative lightweight materials may result in a reduction in concrete strength. To address this issue, fiber reinforcement has been introduced to enhance the concrete's overall mechanical behavior. This study examines the mechanical properties of concrete mixes incorporating recycled expanded polystyrene (EPS) granules and polypropylene (PP) fibers. The effect of replacing crushed aggregate with EPS was evaluated by comparing a reference mix with mixes including 25 % and 50 % EPS replacement by volume. Additionally, the influence of fiber reinforcement was assessed by comparing a mix with 50 % EPS with mixes containing 0.5 % and 1.0 % fiber by volume. Key properties including density, flexural strength, compressive strength, and dynamic modulus were measured at 7 and 28 days. At 7 days, replacing conventional aggregate with 25 % EPS reduced density by approximately 21 %, flexural strength by 34 %, compressive strength by 57 %, and dynamic modulus by 37 % relative to the reference mix. A 50 % EPS substitution further lowered these properties by approximately 36 %, 54 %, 67 %, and 57 %, respectively. At 28 days, the relative reductions remained consistent. Adding fibers to the 50 % EPS mix improved flexural performance: a 0.5 % fiber dosage increased flexural strength by roughly 10 % at 7 days and 13 % at 28 days, while a 1.0 % dosage increased it by about 28 % at 7 days and 24 % at 28 days. The incorporation of fibers had minimal impact on density, compressive strength, and dynamic modulus.

BIOACTIVE MATERIAL OBTAINED BY SORPTION OF CEFAZOLIN ON OXYCELLULOSE

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Keywords: oxycellulose, bioactive material, chemism of binding

ABSTRACT

Cefazolin sorption on oxycellulose was performed with the aim of obtaining bioactive material which, as drug carriers, have a possibility of prolonged release and local application. Oxycellulose with different content COOH groups was obtained by selective oxidation. The bonding was performed in antibiotic water solution concentration of $c=3,4\cdot10^{-3}$ $molL^{-1}$*, while desorption was performed in physiological solution. Maximum amount of the bound drug was 0,0337* $mmolg^{-1}$ *and the maximum amount of the released drug was 0,0091* $mmolg^{-1}$*. Antimicrobial activity of the samples with bound cefazolin was tested in vitro against Staphylococcus aureus, Bacillus subtilis and Escherichia coli by agar diffusion test.*

INFLUENCE OF PROCESS PARAMETERS ON THE PHYSICAL AND MECHANICAL PROPERTIES OF EXTRUDED POLYSTYRENE

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Keywords: XPS, process parameters, extruded polystyrene, compressive strength, melt flow index.

ABSTRACT

In this work, I aim to examine the various influences of process parameters on the physical and mechanical properties of extruded polystyrene (XPS). Since XPS belongs to the group of thermoplastic polymers, its properties are significantly affected by thermal treatment, particularly temperature and pressure. However, in addition to these key factors, this paper also seeks to interpret the influence of other parameters. Production, sampling, parameter monitoring, and sample testing were conducted in the production facility and the laboratory for construction materials within the TEMAX BH d.o.o. company. The findings of this research are expected to provide valuable insights into optimizing manufacturing conditions to enhance XPS performance, thereby improving material efficiency and expanding its potential applications in the construction and insulation industries.

EVALUATION OF PROFEX SOFTWARE FOR PHASE ANALYSIS OF CEMENT, CLINKER, AND LIMESTONE: A COMPARATIVE STUDY WITH TOPAS

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Keywords: X-ray diffraction, quantitative phase analysis, Rietveld refinement, Profex, Topas, cement, clinker, limestone

ABSTRACT

X-ray diffraction is a crucial method for characterizing crystalline materials, widely employed in the analysis of both products and raw materials in the cement industry, including clinker, cement, and limestone. Quantitative phase analysis via X-ray diffraction necessitates sophisticated computational tools to accurately interpret diffraction patterns. While commercial software like Topas is renowned for its precision, its high cost can be unaffordable for many academic and small-scale laboratories. This study assesses the reliability of Profex, an open-source graphical user interface for the BGMN Rietveld refinement engine, by comparing its performance against Topas in analyzing clinker, cement, and limestone samples. Our comparative analysis focuses on the quantification of major and minor phases, as well as the weighted profile R-factor as a measure of fit quality. Results indicate that Profex provides comparable accuracy to Topas in quantifying major phases such as alite, belite, and calcite. However, discrepancies arise in the quantification of minor phases and in Rwp values, suggesting potential limitations in Profex's refinement algorithms and peak fitting procedures. Despite these differences, Profex demonstrates potential as a cost-effective alternative for quantitative phase analysis, though caution is advised when interpreting results.

INVESTIGATION OF THE POSSIBILITY OF ENVIRONMENTALLY FRIENDLY PORTLAND-COMPOSITE CEMENT CEM II/C-M (W+LL) PRODUCTION IN THE KAKANJ CEMENT PLANT

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Keywords: clinker, fly ash, limestone, compressive strength, setting time

ABSTRACT

Public demand for environmentally friendly solutions for new types of cement with reduced CO_2 emissions is increasing. Consequently, new types of cement must be developed and introduced to the market. This paper presents test results for cement formulations based on calcium fly ash and marly limestone, following the EN 197-5 standard. The clinker content was set at 50% and 60%, with fly ash content at 25% and 35%, while marly limestone content remained fixed at 11%. Due to the use of marly limestone, which lacks pozzolanic properties, the cements were ground to a higher specific surface area to enhance their physical-mechanical properties. The test results show that these cement formulations meet the EN 197-1 standard requirements for specific cement classes.

PRELIMINARY ANALYSES OF CENTRAL BOSNIA'S DOLOMITE DEPOSITS FOR HIGH-PURITY MAGNESIUM PRODUCTION

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Keywords: dolomite, magnesium, XRD, SEM, TGA, Pidgeon process

ABSTRACT

This project investigated the potential of using dolomite from Central Bosnia as a raw material for high-purity metallic magnesium production. Extensive sampling and mineralogical analyses revealed the suitability of these deposits, particularly for methods like the Pidgeon Process. Preliminary results underscored the strategic value of Bosnia's dolomite, addressing Europe's reliance on magnesium import and aligning with the EU's Critical Raw Materials Act. Advanced analytical techniques, including X-ray diffraction (XRD), scanning electron microscopy (SEM), and thermogravimetric analysis (TGA), were used to comprehensively characterize Central Bosnian dolomite deposits. Thermodynamic modelling was utilized to enhance process optimization for magnesium extraction in the Pidgeon Process (both silicothermic and aluminothermic) to foster innovation in resource utilization.

FINE ALUMINUM HYDROXIDE PRECIPITATION FROM SODIUM ALUMINATE LEACH LIQUOR

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Keywords: alumina trihydrate (ATH), seeded precipitation, Bayer liquor, particle size

ABSTRACT

Fine alumina trihydrate (ATH) is the primary filler of environmentally acceptable flame retardants, artificial agate, and other products, in addition to being the raw material for alumina-based ceramics and catalyst carriers. This study aims to investigate the fine aluminum trihydrate precipitation process from sodium aluminate Bayer leach liquor by adding the two different seeds with varying concentrations: aluminum sulfate and industrial aluminum hydroxide. Optimum precipitation temperature was also determined for finer particle size. The morphology and particle size distribution of seeds and precipitated products were examined using scanning electron microscopy (SEM) images and particle size distribution (PSD) analysis.

PROTECTION ENVIRONMENT AND SUSTAINABLE DEVELOPMENT/ZAŠTITA RADNE I ŽIVOTNE SREDINE I ODRŽIVI RAZVOJ

THE ROLE AND IMPORTANCE OF PREVENTIVE SAFETY MEASURES AT WORK DURING THE PRODUCTION AND PROCESSING OF TECHNICAL STONE AT THE QUARRY

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Keywords: prevention, quarry, technical stone, improvement, safety, training

ABSTRACT

Quarries are surface mines where construction stone is exploatation and processed. Ensuring worker safety in quarries and preventing injuries are crucial for creating a safe working environment and maintaining a productive workplace. In this paper, the critical role and necessity of implementing preventive measures in the production and processing of technical stone in quarries are emphasized to enhance occupational safety measures. The identification of hazards and an accurate assessment of safety risks are fundamental to the success of any safety program. Based on identified potential hazards and risks, it is essential to define all necessary technical and organizational preventive measures. A key component in injury prevention and the mitigation of occupational illnesses is the education and training of workers to ensure safe and healthy work practices. Workers must be fully informed about all hazards and risks associated with their assigned tasks, as well as any potential dangers that may arise during movement and presence within the quarry. If training is limited to formal classroom instruction, workers may lack the ability to recognize all hazards and risks present in the quarry, both at their specific workplaces and within the broader operational environment.

SAFETY MANAGEMENT DURING ENTRY AND STAY IN INDUSTRIAL PREMISES FOR IRON AND STEEL PRODUCTION

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Keywords: safety, occupational safety, industrial space, safety rules

ABSTRACT
Safety management is the implementation of activities that guarantee the achievement of high safety standards in accordance with minimum regulatory requirements. The premises of the Zenica steelwork are classified, from the point of view of safety and health protection, as hazardous areas. Occupational safety and health tasks are organized within a precisely defined department and are in accordance with the company's rules of procedure. This paper will present the rules of conduct for persons entering or staying in the premises of the Zenica steelwork and represent a form of occupational safety for both employees and visitors for a shorter or longer period of time.

THE CONTENT OF As, Pb AND Cd IN ENVIRONMENTAL SAMPLES IN MUNICIPALITY OF KIJEVO

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Keywords: heavy metals, plants, river water, agricultural soil, health risk.

ABSTRACT

Toxic metals like arsenic (As), lead (Pb)and cadmium (Cd) are the major indicators of environmental pollution that have serious impact to human health as well as the environment. Measurement of these metals were done in the samples of: selected plants, Željeznica river, and agricultural soil in the municipality of Kijevo near Sarajevo city; by using the conventional methods of GFAAS. Results showed potential concern to plants and human population posed to long term exposure to identified heavy metals. Therefore, bioremediation could be an effective and sustainable method for treating toxic metals contaminated areas that has many advantages over conventional treatment technologies. It is very important that all necessary measures are taken to avoid contamination of the environment. Emissions of heavy metals and other pollutants would have to be harmonized with the capacity (degree sensitivity) of soil and other environmental components for their safe reception.

PHYTOREMEDIATION POTENTIAL OF WILD PLANTS

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Keywords: wild plants, heavy metals, bioremediation

ABSTRACT

Phytoremediation with wild plant species could be environment friendly and economical solution. Selected wild plants like mint, oregano, chamomile, nettle and St. John's wort, from rural area in Bosnia and Herzegovina, were collected, lyophilized and acid digested for heavy metals analysis. Nickel (Ni), copper (Cu), chromium (Cr), cadmium (Cd), iron (Fe), zinc (Zn), manganese (Mn) and lead (Pb) were determined, by using an Atomic Absorption Spectrometry-flame technique. Results showed that some of investigated wild plants have a high content of multi-heavy metals. This work showed that collected wild plants have ability to accumulate heavy metals and could be used for the phytoremediation of multi-metals contaminated soil.

EFFECTS OF FERROCHROME SLAG ON THE FORMATION OF FIBERS FOR MINERAL WOOL PRODUCTION

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Keywords: ferrochrome slag, mineral wool, fiber morphology, thermal stability

ABSTRACT

Ferrochrome slag is a by-product of ferrochrome alloy production, which is an important component of stainless steel. The total production of ferrochrome slag, which increases significantly every year with the increase in stainless steel production, is more than 1.1-1.5 times higher than the production of ferrochrome metal. In order to conserve natural resources and ensure the sustainable development of the ferrochrome industry, the use of ferrochrome slag in the production of mineral wool should be investigated. In this study, the effects of using different ratios (15-45% by weight) on the formation of fibers in mineral wool production were investigated by morphology of fibers, semi-quantitative analysis, phase analysis, and thermal analysis. It was observed that the morphology of the fibers obtained from briquettes of different compositions with acidity index ranging from 1.78 to 2.21 was more uniform with the use of 5% limestone instead of dolomite, a source of calcium oxide, which decreases the melting temperature and contributes to the basic composition. In this study, fiber formation was obtained with a maximum of 20% ferrochrome slag in basalt limestone composition, while the maximum value of ferrochrome slag in basalt and dolomite composition was up to 45%.

THE INFLUENCE OF MULTIFUNCTIONAL PYROPHYLLITE FERTILIZER (PIROGIPS) ON YIELD OF GARLIC (ALLIUM SATIVUM)

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Keywords: pyrophyllite, Parsovići, garlic, multifunctional fertilizer, PiroGips

ABSTRACT

The aim of this research was to examine the influence of multifunctional pyrophyllite fertilizer (MPF) PiroGips on the growth of garlic (Allium sativum). A field trial was set up in Banja, Aranđelovac, Serbia with two types of fertilization (control: NPK 8:24:16 25 g/m^2, sheep manure 2.5 kg/m^2, MPF 15 g/m^2, irrigated by water; and experimental: NPK 8:24:16 25 g/m^2, sheep manure 2.5 kg/m^2, MPF 15 g/m^2, fertigated by MPF suspension 5 g/L). At the end of the experiment, the total number of garlic bulbs, total mass and average mass of garlic bulbs were measured. Number of the healthy and undamaged garlic bulbs were same in the both treatments. Total mass and average mass of garlic bulbs 11.14 % were higher compared to the control treatment respectively. This ecological MPF, which improving soil properties, slowing nutrient release, and enhancing plant nutrient uptake efficiency, is composed of pyrophyllite and gypsum from the Parsovići, Konjic, B&H. The sum of secondary macronutrients (CaO, MgO and SO_3) contained in PiroGips is higher than 18% which confirms that this product fulfilled the requirements of EU Regulation 2019/1009. The fertigation with MPF PiroGips have a positive effect on the yield of garlic, especially the mass of the bulb as the most relevant part of the garlic.

POSSIBLE IMPACT OF REPLACEMENT OF FOSSIL FUEL IN THE CITY OF ZENICA HEATING SYSTEM ON CADMIUM CONCENTRATION IN THE CITY AIR

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Keywords: cadmium, Zenica heating plant, coal, coke oven gas, blast furnace gas, natural, gas, emission analysis, air

ABSTRACT

The aim of the research conducted in this paper is to analyze the cadmium content in particulate matter PM10 for the period of 2020–2024, and thereby provide a realistic assessment of whether there has been a significant reduction in cadmium emissions into the atmosphere of Zenica due to the replacement of fossil fuels for the city's heating needs by ArcelorMittal. In March 2022, a new heating plant was officially launched within the ArcelorMittal facility, where, instead of decades of coal combustion used in the old heating system of Zenica, thermal energy is now produced by burning coke oven gas and blast furnace gas, with the possibility of also using natural gas. The results of the conducted tests and subsequent analyses show a reduction in cadmium emissions into the atmosphere during the period of 2022–2024 compared to the period of 2020–2021. The reason for this reduction in cadmium emissions into the atmosphere may be the substitution of coal with coke oven gas, blast furnace gas, or natural gas in the Zenica heating plant.

TOWARDS SUSTAINABLE WASTEWATER TREATMENT: COMPARATIVE STUDY OF HYBRID ELECTROCOAGULATION PROCESSES WITH ZEOLITE, ULTRASOUND, AND MAGNET

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Keywords: hybrid electrocoagulation processes, wastewater treatment efficiency, electrode corrosion

ABSTRACT

This study evaluates three hybrid electrocoagulation (EC) processes with aluminium electrodes: EC-zeolite process (EC+Z), EC-zeolite-ultrasound-assisted process (EC+Z+US), and EC-zeolite-magnet-assisted process (EC+Z+MAG) for compost wastewater treatment with large content of organic matter. The focus was on evaluating the effects of these processes on the removal efficiency of pollutants, including chemical oxygen demand (COD) and turbidity. Additionally, the study analysed the pH and temperature variations as well as electrode dissolution and corrosion to assess each hybrid process. The results revealed that the EC+Z+MAG process achieved the highest COD and turbidity decrease, indicating its superior efficiency in particle aggregation and removal. Regarding the pH and temperature, the EC+Z+US experiment exhibited the least changes in pH and temperature, while the EC+Z+MAG exhibited the highest. The EC+Z+US showed improved sludge recovery due to better particle agglomeration while reducing electrode corrosion compared to other processes. Microscopic analysis indicated that ultrasound assistance reduced corrosion damage on the anode, while the magnetic field in the EC+Z+MAG process contributed to the formation of a dendritic structure on the cathode. Even though this study highlights the effectiveness of combining electrocoagulation with zeolite, ultrasound, and magnetic assistance to enhance wastewater treatment efficiency, further optimization of these hybrid processes is recommended to balance performance with sustainability and electrode longevity.

INFLUENCE OF TEMPERATURE AND pH ON THE CAPACITY AND EFFICIENCY OF LEAD (II) IONS ADSORPTION FROM AQUEOUS SOLUTIONS USING NATURAL BENTONITE AS ADSORBENT

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Keywords: adsorption, lead, bentonite, temperature, pH

ABSTRACT

In this research, the results of bentonite characterization by XRF before and after adsorption are presented. The influence of temperature and pH on the capacity and efficiency of adsorption of lead (II) ions using bentonite is determined by adsorption experiments for initial lead (II) concentrations of 200, 300 and 400 mg/L, adsorbent dosage of 1 gram, stirring rate of 200 rpm, contact time between adsorbent and lead (II) ions of 2,5 minutes, for temperature of 25, 30 and 40 °C, and pH of 5 and 8.5. The obtained results showed that at pH 5 adsorption capacity and efficiency decrease with increasing temperature, while for pH 8.5 adsorption capacity and efficiency increase with increasing temperature.

THE INFLUENCE OF TEMPERATURE AND REACTION TIME ON THE YIELD OF FATTY ACID METHYL ESTERS IN THE TRANSESTERIFICATION OF RAPESEED OIL

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Keywords: methanolysis, FAME (Fatty Acid Methyl Esters), temperature, time, commercial hydrated lime

ABSTRACT

The depletion of fossil fuel reserves and the increasing environmental concerns regarding their production and combustion have led to an exponential rise in interest in biofuels [1], among which biodiesel has attracted attention due to its characteristics such as high biodegradability, non-toxicity, and low emissions of carbon monoxide, particulate matter, and unburned hydrocarbons [2,3]. Biodiesel produced from edible oils is currently more expensive than conventional petroleum fuels [4]. In light of this, significant attention has been devoted to research on its production, with the aim of making it more sustainable and cost-effective [5]. Various parameters governing the kinetics of transesterification can contribute to the commercial performance of the overall process [6]. Key reaction conditions that must always be optimized for efficient biodiesel production include the molar ratio of alcohol to oil, the type and amount of catalyst, as well as the reaction temperature and time [7,8]. The aim of this study was to carry out the transesterification reaction of rapeseed oil with methanol (methanolysis) using commercial hydrated lime $Ca(OH)_2$ as a heterogeneous catalyst. The reaction conditions that were varied included reaction temperature (25, 45, and 60 °C) and reaction time (60, 120, and 180 minutes). The obtained results showed that the optimal temperature for the methanolysis process is 60 °C, with an optimal reaction time of 120 minutes.

THE INFLUENCE OF THE ADDITION OF ALTERNATIVE FUEL ON THE MINERALOGICAL COMPOSITION OF CLINKER AND THE COMPRESSIVE STRENGTH OF CEMENT CEM II/B-W 42.5N

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Keywords: fossil fuels, alternative fuels, environment, CO_2 emissions, clinker, cement

ABSTRACT

Traditional cement production depends largely on fossil fuels like coal, significantly contributing to CO_2 emissions and environmental degradation. In response, alternative fuels are being investigated to reduce the industry's ecological footprint. This study explores the use of refuse-derived fuel (RDF) in Portland cement production and its effect on clinker quality. Clinker was produced in an industrial rotary kiln with two fuel regimes: 100% coal (reference) and 90% coal with 10% RDF. X-ray diffraction (XRD) was conducted to quantify the content of principal phases. Cement samples were tested for compressive strength at 2, 7, and 28 days using standard testing procedures. The results showed that clinker produced solely with coal had a higher average alite content, while the RDF addition to fuel increased belite levels. The addition of RDF to the fuel had a negligible effect on the content of tricalcium aluminate and tetracalcium aluminoferrite. Additionally, compressive strength tests conducted at 28 days showed that cement produced from the RDF-blended fuel had approximately 11% lower strength than that from the coal-only process. While both cement types met industry standards, incorporating RDF into the fuel mix altered the clinker's mineral composition and reduced strength, emphasizing the need to optimize RDF processing for better combustion efficiency and cement performance.

CHANGE IN pH AND CONDUCTIVITY DURING THE RINSING AND THE BIOSORPTION OF COPPER IONS ONTO PUMPKIN PEEL

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Keywords: biosorption, pumpkin peel, pH, conductivity

ABSTRACT

The changes in pH and conductivity during the rinsing of the pumpkin peel, and the biosorption of Cu^{2+} ions, were the subject of this work. The obtained data showed that the pH value of the solutions increased during the rinsing of the biosorbent, as a result of the transfer of H^{+} ions from the aqueous phase into the structure of the pumpkin peel. An increase in the conductivity value was observed in the initial period of rinsing the pumpkin peel, followed by a decrease. The increase in conductivity in the initial phase is contributed to the self-leaching of the alkali and alkaline earth metal ions from the structure of the pumpkin peel, which were transferred into the aqueous phase. The further decrease in conductivity is a result of the dilution of the aqueous phase. The pH value decreased during the biosorption of Cu^{2+} ions, as hydrogen ions were transferred from the pumpkin peel structure into the solution, and then exchanged with Cu^{2+} ions. The conductivity value increased during the biosorption process, with a rapid increase in the initial period of 5 minutes, due to the transfer of alkali and alkaline earth metal ions into the solution.

EXAMINATION OF THE POSSIBILITY OF ENHANCING THE PHYTOREMEDIATION POTENTIAL OF PLANTS THROUGH COMPLEXATION OF ALKALINE SOIL

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Keywords: phytoextraction, complexation, EDTA solution, heavy metals, plants, soil

ABSTRACT

This study presents the results of applied phytoextraction as a soil phytoremediation method, based on the analysis of selected heavy metal content in soil and plant material. The selected locations where phytoextraction was applied as a phytoremediation method (Gradišće, Podbrežje, and Tetovo) are situated in the city of Zenica, in proximity to the ArcelorMittal d.o.o. Zenica plant, identified as a potential major source of soil contamination in the surrounding area. The plant species used as potential phytoremediators were maize, Swiss chard, and alfalfa. The study analyzed the heavy metal content (Zn, Ni, Pb, Cd, Cr, and Cu) in soil samples after plant material extraction, as well as in the root samples of the plant material. Additionally, the study presents the pH values of the soil before sowing (initial state) and after plant extraction. The primary objective of this research was to determine whether soil complexation with an aqueous EDTA solution contributed to an increased uptake of selected heavy metals from soil into the selected plants under real environmental conditions. To assess this, one portion of the land plots was treated with a 0.1 M EDTA solution (from sowing until the late growth stage), while the other portion was left untreated. The results presented in this study indicate that soil complexation with the EDTA solution did not significantly enhance the phytoremediation potential of plants in the majority of analyzed samples. One of the key reasons for the reduced mobility of heavy metals from soil into plant material may be the alkaline nature of the soil at all three study locations, with a pH > 8. The mobility of heavy metals is significantly higher in acidic soils compared to alkaline soils.

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