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The The International Conference on Material and Mechanic (ICMM'2024) will be held in Faculty of Technology / Boumerdes University, Algeria. The main goal of which is to strengthen communication between the higher education family and industrialists, bring the socio-economic sector closer to academic skills and public administration. Our goal is to establish a national ecosystem favourable to investment, through communicationbetween the sectors concerned. Also, through this conference, we wish to draw a roadmap that pushes the economy and national development towards progress.

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3rd International Conference on Mechanics and Materials (ICMM'2024)

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Boumerdes 2024

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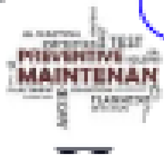

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3- Vibration, dynamic, Maintenance and Tribology

4- Fracture Mechanics, Fatigue, Damage, Non Destructive Testing

5- Energy and Renewables, Green hydrogen and recycling

6- Mechatronic, Electromechanical and Industrial Engineering

7- Civil engineering and Process Engineering

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ANALYSIS OF THE VIBRATORY BEHAVIOR OF POROUS PLATES FUNCTIONALLY GRADED IN FREE VIBRATIONS

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Abstract

The vibrational behavior of simply supported functionally graded porous plates is studied and analyzed in this paper, using higher order non-polynomial theory, transverse shear effects are studied as a function of plate thickness. Without application of a shear correction coefficient, the current model contains only four unknowns. Hamilton's principle is used to obtain the equations of motion. The solutions are obtained using Navier's method, then the fundamental frequencies are found, by solving a system of eigenvalue equations, the results of this analysis are presented and compared with those available in the literature.

Keywords: *Porous plates, Hamilton's principle, Fundamental frequencies.*

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PIEZOELECTRIC EFFECT OF ZNO-BI2O3 BINARY MATERIAL THIN FILMS PREPARED BY SPRAY TECHNIQUE

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Abstract

Piezoelectric nanocomposites based semiconductor oxides are one of the major challenges studing for their applications in energy harvesters. Herein, a simple, cost effective, large utilisation and industrially designs is reported for the integration of high electrical performances piézoelectric generators based on metal oxides .Pure and ZnO-Bi_2O_3 films were prepared carrefully under well defined steps.

Investigations were made by XRD, AFM, SEM and TEM to determine the structural properties and morphological grain sizes of Bi obtained phases. XRD spectra confirmed the würtzite structure for ZnO and the presence of many transition phases for ZnO- Bi_2O_3 films with an average grain size varying from 65 nm to 52 nm . TEM and SEM images of the films allowed us to investigate the location of the different phases and their morphologies , they show a mixture of different shapes.

On the other hand AFM images allowed us to study the location of nano islands of the formed grains. Statistics on the piezoelectric effect has been recorded.

Keywords: *Semiconductor oxides piezoelectric effect Energy harvesters*

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STUDY OF THE EFFECT OF ZIRCONIUM OXIDE (ZRO2) INCORPORATION ON THE THERMAL BEHAVIOR OF ALUMINUM-13 WT.% SILICON ALLOY

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Abstract

In this study, an Al-Si-ZrO_2 composite was prepared by mixing an Al-Si alloy with 7% by weight of zirconium oxide (ZrO_2) using the dispersion method (stir casting process). Microscopic analyses, including optical microscopy (OM), scanning electron microscopy (SEM), and energy dispersive spectroscopy (EDS), revealed a dendritic structure in both the Al-Si alloy and the Al-Si-ZrO_2 composite, with a uniform distribution of ZrO_2 particles within the alloy matrix. The addition of reinforcing ZrO_2 particles to the Al-Si alloy significantly altered the thermal properties of the composite material. This is due to the lower thermal conductivity of ZrO_2 particles compared to the alloy matrix. As a result, the cooling rate (CR) increased, reducing solidification time (ts), porosity (P), coarseness of primary silicon particles, and secondary dendrite arm spacing (SDAS (λ_2)). Furthermore, the incorporation of ZrO_2 particles led to an increase in specific heat capacity (Cp), along with decreases in thermal conductivity (λ), thermal diffusivity (a), and the coefficient of thermal expansion (CTE). The study concluded that the Al-Si-ZrO_2 composite exhibits exceptional mechanical and thermal properties, making it highly desirable for applications in the automotive engine industry.

Keywords: *Keywords: Al-Si-ZrO2 Composite, Cooling rate (CR), Solidification time (ts), Secondary dendrite arm spacing (SDAS (λ2)), Thermal properties.*

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THE IMPACT OF THERMAL EXCITATION ON THE NONLOCAL RESONANCE SHIFT IN A TIMOSHENKO FGP NANOBEAM WITH SURFACE STRESS AND COMPRESSIVE FORCE.

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Abstract

This study focuses on analysing the effects of applied temperature on the dynamic vibration of functionally graded porous (FGP) nanobeam, incorporating both nonlocal behavior and axial loads as well as shear distortion and rotary inertia. The nanomaterial properties of functionally graded porous nanobeam are supposed to vary throughout the thickness according to a power law. The Timoshenko beam model (TBM) and Euler-Bernoulli beam model (EBM) for nonlocal resonance frequency are developed by modifying the standard dynamic beam equations. Eringen's nonlocal elasticity theory is employed to assess the nonlocal effects, while temperature-induced loads are accounted for by incorporating additional thermal forces. The computations reveal that the volume fraction of porosity, power law index, and material parameters influence changes in nonlocal frequency and temperature-induced loads. These findings have significant practical implications for the design and performance of nanoresonators integrated into micro/nanoelectromechanical systems (M/NEMS), providing valuable insights for future research and development in this field and inspiring further exploration of the dynamic behavior of nanomaterials.

Keywords: *Keywords: Functionally Graded Porous Nanobeams, Timoshenko Beam Model, Surface Stress, Eringen's Nonlocal Elasticity Theory, Power Law Index, Thermal Excitation.*

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RHEOLOGICAL CHALLENGES AND OPTIMIZATION OF BIORESORBABLE POLYMERS FOR 3D PRINTING IN DRUG DELIVERY APPLICATIONS

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Abstract

3D printing, or additive manufacturing, is an emerging technology that offers innovative approaches to material production. In the pharmaceutical field, polymeric 3D printing is gaining traction as it enhances productivity in terms of cost and time while enabling controlled drug release. This research explores the formulation of bioresorbable polymers with active pharmaceutical ingredients (APIs) for use in pellet-based Fused Deposition Modeling (FDM) 3D printing. Pellets were prepared from these polymer-API mixtures, followed by physicochemical characterization of raw materials and final products. Printing parameters were optimized using Cura Ultimaker computer-aided design software. The results showed that Polylactic Acid (PLA) is a feasible candidate for 3D printing. However, formulations based on PLGA and PCL presented challenges due to their high viscosity and complex rheological properties. These issues, along with the interaction between printing parameters and polymer characteristics, impacted printability. Differential Scanning Calorimetry (DSC) results revealed thermal degradation and recrystallization of the API, along with poor interlayer adhesion, which further compromised print quality. This study underscores the need for comprehensive rheological investigations to address the challenges associated with polymer-based formulations for 3D printing in pharmaceutical applications.

Keywords: *3D Printing, Bioresorbable Polymers, Drug Delivery, Fused Deposition Modeling (FDM), Rheological Properties.*

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HARNESSING SILICON DIOXIDE FOR SUSTAINABLE PHOTOCATALYSIS: EXPLORING ITS POTENTIAL IN ORGANIC POLLUTANT DEGRADATION AND HYDROGEN PRODUCTION

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Abstract

The global increase in organic pollutants and the need for sustainable energy solutions have heightened interest in innovative photocatalytic materials. Silicon dioxide (SiO_2), valued for its chemical stability, low toxicity, and cost-effectiveness, offers significant potential despite its moderate photocatalytic efficiency compared to conventional materials like ZnO. This study evaluates the photocatalytic performance of SiO_2 in degrading organic pollutants and producing hydrogen via water splitting.Characterization techniques, including XRD, DSC, SEM, and UV-Vis spectroscopy, provided insight into the material's properties. Additionally, antibacterial properties of undoped and cobalt-doped SiO_2 nanoparticles were assessed, and MATLAB-based image processing quantified antifungal inhibition zones with precision.

While SiO_2 demonstrates moderate photocatalytic efficiency, its robustness and safety highlight its potential for applications in environmental and energy technologies, such as self-cleaning surfaces and renewable hydrogen production. Ongoing research aims to enhance its photocatalytic activity for broader utilization.

Keywords: *[1] Silicon Dioxide (SiO_2) [2] Photocatalysis [3] Organic Pollutants [4]image processing*

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A COMPREHENSIVE COMPUTATIONAL INVESTIGATIONS ON THE PHYSICAL PROPERTIES OF HALF-HEUSLER ALLOYS AND DOUBLE HALF-HEUSLER

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Abstract

Recently, the half-Heusler alloys have been gained intensive research interests due to the increasing amount of their applications. In this paper, we have investigated the structural, elastic, optoelectronic and thermoelectric properties of the new half-Heusler alloys TiXSb (X:Ru,Pt)andTi2RuPtSb2 double half-Heusler compound, using the full-potential linearized augmented plane wave method. Different approximations for the exchange-correlation functional were performed as generalized gradient approximation + Hubbard potential (GGA + U) and its combination with the modified Becke–Johnson potential. The negative values of the calculated formation energy indicate that these compounds are energetically stable.BothhalfHeusleralloysarehalf-metallicferromagneticmaterialsandexhibitaninte- ger magnetic moment of Mt= 1.00 μB. While, the Ti 2RuPtSb2 is a direct semiconductor at center symmetry. The calculations of optical properties revealed that Ti2RuPtSb2 com- pound exhibits an excellent optical efficiency. The thermoelectric properties such as the Seebeck coefficient (S); electronic thermal conductivity (κe/τ), power factor (PF), and figure of merit (ZT) have been studied and discussed in detail. Consequently, the investigated compounds were identified as candidate materials for high technological applications.

Keywords: *ab-initio calculations, double half Heusler, electronic structure, optical properties, thermoelectric properties.*

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EXPLORING VISCOPLASTIC FLUID DYNAMICS IN PIPES: A STUDY EMPLOYING IN-SITU LASER DOPPLER VELOCIMETRY

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Abstract

This experimental study focuses on exploiting Laser Doppler Velocimetry (LDV), a non-intrusive technique, for rheological characterization based on analyzing flows of Carbopol solutions at two distinct concentrations and at two different temperatures within a pipe. The velocity profiles obtained using LDV and the pressure drops associated with each flow rate were exploited to establish the behavioral law of aqueous Carbopol solutions. Two approaches were used: the first was an analytical velocity model to fit the experimental profile, and the second used the first derivative of the experimental velocity profile and the pressure drops to reconstruct the flow curve. In addition, a third reference characterization was carried out using a rotary rheometer equipped with a vane geometry. This study's three rheological characterization methods showed excellent agreement concerning the Herschel-Bulkley model. Finally, all the laws resulting from these three methods were validated using an empirical law relating to Darcy's coefficient of friction.

Keywords: *viscoplastic fluid; Carbopol solutions; Herschel–Bulkley; LDV; flow curve*

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MODELING THE MECHANICAL BENDING BEHAVIOR OF FIBER-REINFORCED SELF-PLACING MORTARS

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Abstract

In this work, we propose to model six variants of fibered self-placing mortars studied experimentally [1] using the Abaqus finite element code. These variants are 40*40*160 mm3 beams subjected to three-point bending tests under static loading. These six variants of self-placing fiber-reinforced mortars are produced in layers to study the influence of the distribution of hooked steel fibers on their flexural strength. Layers of M20, M30 and M40 self-placing mortars contain 20, 30 and 40 kg/m3 of hooked steel fibers respectively. These layers are assembled in such a way as to reproduce the six variants studied. Comparison of the numerical results with the experimental ones has shown the relevance of the numerical approach followed.

Keywords: *Modelling, Mortar, Steel fibers, Distribution, Bending*

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PYROLYSIS CHARACTERISTICS ANALYSIS OF TRANSFORMER OIL UNDER VARIOUS AGEING CONDITIONS USING ATG/DSC TECHNIQUE

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Abstract

The transformer performance is intricately linked to the state of the insulating oil, which serves as an insulating medium for its internal components and contributes to detecting defects and dissipation of heat produced during its operation. Prolonged operation at high temperatures causes oil characteristics to degrade, leading to potential faults, including transformer fire risks. Consequently, examining the thermal decomposition process is essential for assessing the condition of the oil. This paper investigates the pyrolisis process of mineral transformer oil samples (borak 22) collected from transformers operating in the Algerian electrical grid, using thermogravimetric (TGA) analysis and differential scanning calorimetry (DSC) at a heating rate of 10 °C/min by a simultaneous gravimetric thermoanalyzer. The findings indicated that the thermal decomposition of mineral oil is a one-step reaction, occurring between 150 and 360 °C. As the oil age, the initial, maximum, and final temperatures of oil decomposition decrease, with fresh oil samples showing significantly higher heat flow compared to aged samples. The activation energy of transformer oil was also determined using the Coats-Redfern method, revealing an inverse relationship between the activation energy of mineral oil and the increase in its ageing. The results of this study indicate a relationship between oil degradation and thermal stability, which may provide substantial insights for scientists and engineers concentrating on oil
condition monitoring in this field.

Keywords: *Transformer oil, ageing, Thermogravimetric analyses, Differential scanning calorimetry, Activation energy.*

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ESTIMATING THE DEPTH OF LAYER (DOL) IN ION-EXCHANGED GLASSES USING THE HF ETCHING

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Abstract

In this work, we estimated the depth of the compressed layer (DOL) in soda-lime-silica glass treated by ion exchange in a potassium nitrate (KNO3) bath at a temperature of 480°C for different immersion times: 2 h, 20 h, 30 h, 40 h, and 50 h. The glass used is flat glass, of soda-lime-silica type, manufactured by Mediterranean Float Glass MFG company (Algeria), using floating process.

The estimation of the layer (DOL) was done using chemical etching with 2% diluted hydrofluoric acid (HF). Additionally, we determined the residual stresses in depth, their profiles and the profile of potassium concentration.

The concentration of potassium diffused on the surface of the glass increases with increasing temperature and treatment time. The molar concentration of potassium decreases as one move away from the surface toward the depth. At a high exchange temperature, there is a relaxation of the surface compression stress viscous flow. The maximum compression was developed below the surface. The increasing in immersion time during ion exchange reduces the intensity of residual compression stresses.

Keywords: *Glass, strengthening, ion exchange, depth of layer, instrumented indentation, HF etching.*

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ENHANCING CONDUCTING POLYMERS ELECTRODES FOR SUPERCAPACITORS APPLICATION

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Abstract

In recent years, supercapacitors, also known as electrochemical capacitors, have received particular attention due to their great potential as energy storage devices with excellent electrochemical performance. Conducting polymers (CPs) are organic polymers which, unlike conventional polymers, are capable of generating electricity thanks to conjugated structures consisting of alternating double bonds and single bonds along the CP chain. Polyaniline (PANI) and poly (3,4-ehtylenedioxythiophene) (PEDOT), are among the most studied electroactive materials for supercapacitors application, due to their excellent properties such as conductivity, stability, good processability and reversible ability between redox states. Herein, we studied the performance of the PANI/PEDOT:PSS composite material for supercapacitor applications, which was prepared using the in situ electropolymerization method, which promotes the synergy effect between PANI and PEDOT:PSS.
The obtained specimen were characterized by using X-ray diffraction (XRD) and scanning electron microscopy (SEM) for structure and morphology investigation. The recorded graphs confirm the amorphe nature of the composite and the morphology observed was porous structure. The optical properties studied by UV-Visible spectroscopy demonstrate the enhancing in optical gap of composite.
Whereas, the electrochemical performances achieved demonstrated that the highest specific capacitance value found for PANI was 1020 F/g at a scan rate of 10 mV/s, however this value was increased by 24% to reach 1265.38 F/g for the PANI/PEDOT:PSS composite at a scan rate of 20 mV/s. Electrochemical impedance spectroscopy confirmed the low resistance of the solution, reflecting favorable charge transfer characteristics. Equivalent circuits and corresponding Nyquist diagrams validated the supercapacitive behavior of the synthesized composites.

Keywords: *Supercapacitors, Conducting Polymers, PANI, PEDOT:PSS*

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MECHANICAL, CHEMICAL AND THERMAL PROPERTIES OF CHAMAEROPS FIBERS REINFORCED BIOCOMPOSITES

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Abstract

Natural fibers are of great interest among researchers and are widely used by various industries to produce environmental products. Natural fibers are widespread it is used in the composite industry as a substitute for synthetic fibers in many applications new sources of fibers are constantly being explored. New Cellulose fibers are derived from Chamaerops humilis, and they play a major role in this field of the environment as a preferred alternative for enhancing and strengthening biocomposites.CH fibers were extracted from the branches of the dwarf palm plant by anaerobic analysis to determine the distinctive properties of the fibers. This search provides a comprehensive study of Chemical, thermal, and mechanical properties, as well as thermogravimetric analysis (TGA) demonstrated the fibers' resistance to temperatures of 352 ◦C and the kinetic activation energy reached (79.78 kJ/mol). X-ray diffraction (XRD) proves the availability of cellulose, with (CI = 37.98 %) and (CS= 2.92 nm). Fourier-transform infrared (FTIR) succeeded in detecting functional groups and chemical compounds of fibers. The fibers exhibited an average stress of (110.85 ± 77.08 MPa), an elongation at a break rate of (2.29 ± 1.27%), and Young's modulus of (6.05 ± 3.9 GPa). The ML method (Weibull distribution with two parameters) was used to analyze the distribution. The extracted fibers have demonstrated industrial potential similar to successful naturel fibres, such as fine cord, line pins, and plate. Through the favorable results obtained from these tests, Chamaerops Humilis fibers (CHFs) are possible as reinforcement materials in lightweight biocomposite applications across various industries.

Keywords: *Natural fibers, thermal properties, FTIR, XRD, Weibull distribution*

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MECHANICAL, CHEMICAL AND THERMAL PROPERTIES OF CHAMAEROPS HUMILIS FIBERS REINFORCED BIOCOMPOSITES

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Abstract

Natural fibers are of great interest among researchers and are widely used by various industries to produce environmental products. Natural fibers are widespread it is used in the composite industry as a substitute for synthetic fibers in many applications new sources of fibers are constantly being explored. New Cellulose fibers are derived from Chamaerops humilis, and they play a major role in this field of the environment as a preferred alternative for enhancing and strengthening biocomposites.CH fibers were extracted from the branches of the dwarf palm plant by anaerobic analysis to determine the distinctive properties of the fibers. This search provides a comprehensive study of Chemical, thermal, and mechanical properties, as well as thermogravimetric analysis (TGA) demonstrated the fibers' resistance to temperatures of 352 ◦C and the kinetic activation energy reached (79.78 kJ/mol). X-ray diffraction (XRD) proves the availability of cellulose, with (CI = 37.98 %) and (CS= 2.92 nm). Fourier-transform infrared (FTIR) succeeded in detecting functional groups and chemical compounds of fibers. The fibers exhibited an average stress of (110.85 ± 77.08 MPa), an elongation at a break rate of (2.29 ± 1.27%), and Young's modulus of (6.05 ± 3.9 GPa). The ML method (Weibull distribution with two parameters) was used to analyze the distribution. The extracted fibers have demonstrated industrial potential similar to successful naturel fibres, such as fine cord, line pins, and plate. Through the favorable results obtained from these tests, Chamaerops Humilis fibers (CHFs) are possible as reinforcement materials in lightweight biocomposite applications across various industries.

Keywords: *Natural fibers, Chamaerops humilis, thermal properties, FTIR, XRD, Weibull distribution*

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MITIGATING ADDITIVE MIGRATION IN FOOD PACKAGING : IMPACT OF NANOSILICA ON THE DIFFUSION OF PHENOLIC ANTIOXIDANTS IN LDPE MATRICES

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Abstract

The migration of additives from packaging materials into food poses a significant public health risk. Many of these additives exhibit toxicity when their concentration exceeds legal thresholds, making their use in packaging a regulatory concern and a potential hazard for consumers.

To mitigate additive migration, strategies such as using high molecular weight additives and incorporating nanofillers into the polymer matrix have been explored. This study investigates the effect of Nano-silica on the diffusion of a high molecular weight phenolic antioxidant, Ir1010, within two LDPE matrices (pure LDPE and LDPE/1wt. %Nano-silica). The diffusion behavior was analyzed using the Roe model. Results indicate that the diffusion of Ir1010 in pure LDPE is relatively slow, with a diffusion coefficient of Dp=1.69. E-12 cm^2/s at 23°C. The incorporation of 1wt. % Nano-silica further reduces this diffusion, with the coefficient dropping to Dp=9.94. E-13 cm^2/s. Additionally, the activation energies associated with the temperature dependent diffusion process, as described by the Arrhenius equation, are significantly high. The activation energy is 94.23 kJ/mol for pure LDPE and increases to 100.09 kJ/mol with the addition of 1wt. % Nano-silica.

Keywords: *Nano-silica, LDPE, Ir1010, diffusion, packaging films.*

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IMPACT OF THERMAL TREATMENT IN HUMID ATMOSPHERE ON A-RELAXATION BEHAVIOR DURING PLLA CRYSTALLIZATION

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Abstract

The objective of this study is to examine the dynamic crystallization of transparent and amorphous PLLA films at fixed frequencies, considering temperature and thermal history. We investigated the effects of thermal treatment in a humid atmosphere, focusing on the temperature and duration of annealing.

Crystallization occurs over a broad exothermic peak ranging from 102 to 163 °C, involving the formation of the a' structure (around 107 °C) and the a-structure (around 134 °C). The dielectric strength increases with temperature above approximately 100 °C and varies according to the thermal history of the film.

During dynamic crystallization, the dielectric loss data revealed a relaxation process characterized by two unresolved relaxation peaks. At low frequencies (100 Hz), dielectric polarization involves long-range segmental motions, with relaxation observed only during subsequent scans. As frequency increases, the a'-process diminishes with rising temperature, and the a-process becomes dominant. The crystalline dipoles appear more tightly bound and respond differently based on the thermal history preceding crystallization. Chain mobility decreases, and long-range segmental motions are suppressed, leading to a shift in relaxation toward higher frequencies and temperatures.

Optical transmittance decreases progressively with annealing time and temperature. Infrared characteristic bands show sensitivity to disorder and thermal history. Additionally, PLLA films undergo degradation influenced by temperature and treatment duration. For short annealing times above the glass transition temperature (Tg), hydrolysis is the dominant mechanism, competing with pyrolytic elimination. At higher temperatures and longer annealing times (3 hours), crystallization is initiated, reducing the rate and extent of degradation. Furthermore, films annealed below Tg maintain their transparency and stability against humid degradation.

Keywords: *PLLA films; dynamic crystallization; a-relaxation; thermal history; humid degradation.*

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IMPACT OF THERMAL TREATMENT IN HUMID ATMOSPHERE ON A-RELAXATION BEHAVIOR DURING PLLA CRYSTALLIZATION

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Abstract

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Keywords: *PLLA films; dynamic crystallization; a-relaxation; thermal history; humid degradation*

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HIGHLY EFFICIENT REMOVAL OF TEXTILE DYE UNDER NEUTRAL CONDITIONS BY UV PHODEGRADATION PROCESS USING NOVEL DIATOMITE-FE

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Abstract

In order to overcome these limitations a variety of materials have been used as catalytic supports for TiO_2 . TiO_2 is a highly investigated photocatalyst for such a purpose but it suffers from few demerits which hamper its practical application. Commercially available TiO_2 (Degussa P25) has low photocatalytic efficiency owing to its low surface area (50 m^2 /g) and porosity and it is difficult to separate it from the reaction mixture which makes it less reusable. Among these clays have gained immense attention since they are cheap, highly available in the earth's crust and possess thermal, chemical and mechanical stability. Kieselguhr Diatomite-Fe provides TiO_2 with the high surface area, porosity, high number of surface active sites which makes TiO_2 / kieselguhr diatomite-Fe nanocomposites highly active photocatalyst than pure TiO_2 . The review represents different methodologies for TiO_2 /diatomite-Fe synthesis and the impact of kieselguhr diatomite-Fe on the physical and photocatalytic activity of TiO_2 . Also, the role of different diatomite-Fe supports for TiO_2 and comparison of their effect on the photocatalytic activity of TiO_2 has been covered. The mixture Diatomite kieselguhr biosillica- Fe_2O_3 / $Fe(OH)_2$ / TiO_2 gave a better colour remove rate about 97 % at pH=4. The Objective of this work is the industrial textile dye in wastewater.

Keywords: *TiO2 , kieselguhr, diatomite-Fe , nanocomposites, photocatalysis, degradation,*

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LINEAR CORRELATION BETWEEN SOME PHYSICAL PARAMETERS OF CUBIC BORIDES AND CARBIDES PEROVSKITE MATERIALS AND THEIR NEAREST-NEIGHBOR DISTANCES

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Abstract

The current research aims at investigating the linear correlation between some physical parameters of rare earth (R) rhodium borides RRh3B (R = Sc, Y, and La) and carbides RRh3C (R= Sc, Y, and La) perovskite-type materials as well as the logarithm of their nearest-neighbor distances. The physical parameters and the lattice nearest-neighbor distances were taken from the literature. High degree of the linear correlation between the different physical parameters of our materials of interest and the logarithm of their nearest-neighbor was found.

Keywords: *Physical properties, borides and carbides perovskite materials, linear correlation, nearest-neighbor distance.*

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TO MODELLING OF THE SIMPLE MEMORY EFFECT OF SHAPE MEMORY ALLOYS

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Abstract

Shape memory materials are a singular family of materials known by their behavior completely different of that one of the rest of materials, and because of this behavior they are widely used in many applications in the economic, aerospace, medical and military fields. Their behavior is a result of application of a thermomechanical load, it can be exhibited in many forms like pseudoelasticity effect, superthermal and simple shape memory effect.

In this paper, we focused on simple memory effect, we adopted a simpler approach based on linearization.

The implementation of the model is based on nitinol alloy data, for which we developed an algorithm and the results were in good agreement with the experimental data.

Keywords: *SMA, SME, Developing, pseudo-elastic, Memory*

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DFT INVESTIGATIONS INTO THE ELECTRONIC PROPERTIES OF GOLD CLUSTER DOPING TIAUN AND THEIR APPLICATIONS.

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Abstract

In this work, we give a small insight into the structural and electronic properties of pure gold clusters and the effect of substituting a single gold atom with Titanium. The paper also discusses the use and research areas of noble metal nanoparticles, and how to develop these nanomaterials' multiple properties and prospects. Using density functional theory implemented in the SIESTA code we focus on the relationship between the binding energy and the size of clusters. We find that the binding energy increases with increasing the size of the blocks, which means that the system continues to gain energy during the growth process. The binding energy is increased for a fixed cluster size by replacing a single gold atom with titanium. Now looking at the electronic properties, we find that the HOMO-LUMO gap decreases mainly by increasing the size of the clusters. For a given group, substituting a single gold atom with a titanium atom reduces the HOMO-LUMO gap. When analyzing the ionization energy and electronic affinity of different groups, we show that they decrease and increase, respectively, by increasing the size of the clusters(n =1-9). In addition, including a titanium atom leads to a decrease in this stability.

Keywords: *Gold clusters 1; Ab-initio DFT 2; Structural properties 3; Binding energies 4; nano gold applications 5.*

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PARAMETERIC STUDY FOR THE BUCKLING OF FGM PLATES COMPRESSED UNDER DIFFERENT LIMIT CONDITIONS

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Abstract

ABSTRACT :This study involves conducting a parametric analysis of compressed functionally graded material (FGM) plates under various boundary conditions. We examine FGM plates composed of different material combinations (such as steel-ceramic, steel-ceramic-steel, steel-carbon, etc.) and subject them to different boundary conditions (e.g., ssss, ccff, cfff, etc.). By applying a fixed loading, we calculate the load multiplier factor λcr. The results are presented in comparative tables and graphs that illustrate how the variation in material property gradation and boundary conditions affects the buckling factor λcr. The findings highlight a significant impact of both the boundary conditions and the gradation of material properties on the buckling factor λcr.

Keywords: *plate, FGM, buckling, parametric, boundary condition, buckling factor.*

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OPTIMIZING MN AND CE-BASED CATALYSTS FOR VOC COMBUSTION: COMPARISON OF PREPARATION METHODS AND CATALYTIC PERFORMANCE

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Abstract

The volatile organic compounds constitute a very important class of atmospheric pollutants due to their ability to deplete the ozone layer. Additionally, some of these compounds can exhibit acute or chronic toxicity to humans. Catalytic oxidation is a promising technique for VOC elimination because it allows the lowering of the treatment temperature used in thermal combustion of VOCs and also operates on low concentrations of VOCs that cannot be treated by other techniques. The use of transition metal-based catalysts presents a clear economic advantage compared to noble metal-based catalytic systems. In particular, manganese oxide-based systems are effective in several industrial oxidation processes. Additionally, ceria is an oxide widely used for its remarkable redox properties. Mixed MnO_x-CeO_2 oxides have been extensively studied for their catalytic performance in various reactions. Selecting an effective preparation method is crucial to obtaining a catalyst with interesting textural and structural properties that lead to good catalytic performances. The aim of this study is to investigate the catalytic properties of single and mixed oxides based on manganese and cerium (Mn/Ce=1) prepared by several methods (complexation, combustion).

The obtained samples were characterized by (XRD),(TPR),(O_2-DTP), (SEM),UV-Visible (XPS),and BET surface area measurements. The superiority of the catalytic activity of mixed oxides can be attributed to the incorporation of manganese into the ceria lattice, the formation of fine particles, an improvement in oxygen mobility, and an increase in the proportions of oxygen vacancies and Mn^{4+} species.

Keywords: *manganese oxide, ceria, nanoparticles, Mn-Ce mixed oxides, toluene combustion,*

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FIRST-PRINCIPELS STUDY OF THE STRUCTURAL, MAGNETIC AND ELECTRONIC PROPERTIES OF THE HEUSLER COMPOUND CO2MNGE

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Abstract

In this research work, a first-principles study is conducted on the structural, magnetic and electronic properties of the Heusler ternary compound Co_2MnGe in its cubic phase. These materials have made the most demanding in biomechanical endoprosthetics and smart sensor design applications due to their high-level characteristics. For this purpose, the "full-potential linearized augmented plane wave (FP-LAPW+lo)" method implemented in the WIEN2k code is used. The generalized gradient approximation (PBE-GGA) is applied for the exchange-correlation (XC) potential term to study the structural properties (lattice parameter and bulk modulus). The stability of the magnetic phase is predicted by total-energy quantum mechanical calculations for both the nonmagnetic and magnetic phases. Our results for the total energy show that the material is stable in the ferromagnetic phase. Density of states (DOS) profile analysis, band structure curves and spin magnetic moment calculations confirm the semi-metallic nature of the compound.

Keywords: *WIEN2k; structural properties; magnetic; electronic; Co_2MnGe Heusler compound.*

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ENERGY TRANSFER FROM SM^{3+} TO EU^{3+} IN POTENTIAL RED PHOSPHOR $LI_2B_4O_7$ GLASS

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Abstract

Lithium borate-based materials (Li2B4O7) find applications in diverse fields such as supercapacitors, energy storage, and photonic devices. Doping with rare earth elements introduces appealing photoluminescent characteristics, and the presence of point defects significantly influences the optical properties. Energy transfer between rare earth ions in solids can occur through radiative or non-radiative processes and the mechanism and kinetics involved have been extensively addressed.

This paper examines the energy transfer of Sm3+ as a sensitizer to Eu3+ as an activator in Li2B4O7:Sm3+, Eu3+ phosphors. The energy transfer efficiency was investigated according to the emission intensity and lifetime of the energy donor Sm3+. The effective energy transfer from Sm^{3+} to Eu^{3+} results in more intense red light compared to that of Eu3+-doped sample under UV light excitation. The enhancement mechanism is clearly attributed to the increase in the quantum efficiency of 5D0 state of Eu3+.

Keywords: *Keywords: Phosphor, Photoluminescent, Sensitizer, Activator, Quantum efficiency*

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STUDY OF THE STRUCTURAL, ELASTIC AND MECHANICAL PROPERTIES OF HALF-HEUSLER COMPOUND COMNAS BASED ON DFT

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Abstract

Density functional theory (DFT) with generalized gradient approximation was used to study the elastic properties and structural stability of CoMnAs half-Heusler ternary compounds. These materials have become the most demanding in biomechanical stent applications and smart sensor design due to their high-level characteristics and interesting mechanical and thermal properties. This predictive study determines the mechanical properties such as compression, shear, Young's modulus, and Poisson's ratio, while taking into account the control parameters that define the nature of these compounds, such as hardness, Zener anisotropy factor, and Cauchy pressure. The Pugh coefficient and Poisson's ratio helped to identify the ductile nature of these compounds. The sound speed and Debye temperature of these compounds were also estimated from the calculated elastic constants which meet the Born-Huang criteria for mechanical stability and also satisfy the cubic stability condition, confirming that the alloys are elastically stable. The theoretically predicted lattice constant and bulk modulus are in good agreement with experimental data and the theoretical values and elastic constants confirm the ductile nature of the material with C1b cubic phase stability.

Keywords: *Half-Heusler CoMnAs compound, DFT, elastic properties, transport properties*

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SYNTHESIS AND CHARACTERIZATION OF KEGGIN TYPE VANADOPHOSPHOMOLYBDATE

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Abstract

Polyoxometalates (POMs) are a class of discrete anionic metal oxides that can be viewed as transferable building blocks that can be applied in the preparation of functional materials. They are composed of metal ions (M = W, Mo, V, Nb, etc.) and oxo ligands.

Catalysis by polyoxometalates, especially heteropolyanions (HPAs), continues to attract extensive attention during recent years because HPAs possess a very strong Brønsted acidity; exhibit fast reversible redox transformations under mild conditions. Their acid–base and redox properties can be adjusted over a wide range; and POM compounds show high proton mobility, good solubility in polar solvents and they are thermally and oxidatively stable in comparison with common organometallic complexes.

In this present work, vanadium substituted polyphosphomolybdate with Keggin structure H4PMo11VO40 Cs4PMo11VO40 and CsAPMo11VO40 (A: Sb or Sn) were prepared by precipitation and characterized by FT-IR, TG-TD analysis, XDR, 31P NMR and SEM. This study exhibit that the partial substitution of the cesium ions hardly affects the structure of the Keggin anion and whatever the composition of the counter ion, the heteropolysalts are thermally stable.

All prepared materials are potential candidates for catalytic and photocatalytic applications. They are stable and have redox properties, which can vary according to their chemical composition.

Keywords: *Polyoxometalates; vanadophosphomolybdate, cesium salts.*

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STRUCTURAL, OPTICAL AND ELECTRICAL PROPERTIES OF CU-DOPED IN2O3 THIN FILMS

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Abstract

The highly transparent Cu-doped indium oxide thin films were prepared on glass substrates by sol gel via spin coating method. The structural, optical and electrical studies were carried out by X-ray diffraction (XRD), UV-Visible spectroscopy and four probe method, respectively. After doping, all the films revealed two phase of cubic In2O3 polycrystalline structure and the cubic structure of Cu2O phase. The crystallite size of the films was almost constant (about 11.27–12.15 nm). The optical transmittance of Cu doped In2O3 thin films is in the range of 83-91% in visible region and the optical band gap (E_g) was varied between 3.98 and 4.07 eV. All films exhibit a low resistivity about 1.77×10-3 – 6.34×10-3 (Ω.cm).

Keywords: *Thin films, In2O3, Doping, Sol gel.*

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MECHANICAL BEHAVIOR OF FUNCTIONALLY GRADED MATERIAL PLATES UNDER TRANSVERSE LOAD

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Abstract

Functionally graded materials « FGMs » present difficulties in analysing the distribution of displacements and stresses in their thickness for reasons inherent to their constitution where mechanical characteristics vary continuously along the thickness. In this work, a numerical model implemented around a special mixed finite element (RMQ-7) capable of ensuring the continuity of the stress field and the displacement field is proposed to analyze the plane elements of the FGM structures. The studied element is assumed to be isotropic at all points, with a Young's modulus varying exponentially through the thickness, while the Poisson's ratio remains constant.

However, the main results are applicable to other types of elements and to property gradients. The numerical results obtained by this study on a rectangular FGM plate subjected to uniform traction are presented and compared to those available in the literature.

Keywords: *FGM, Composite materials, RMQ-7 element, mixed finite element, stress distribution.*

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COMPUTATIONAL INVESTIGATIONS OF NOVEL HYBRID AUXETIC METAMATERIALS WITH ENHANCED LOAD-BEARING AND ENERGY ABSORPTION PROPERTIES

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Abstract

This study explores the mechanical behavior of a novel lightweight hybrid metamaterial designed by integrating elliptic-chiral structures to enhance energy absorption and optimize Poisson's ratio characteristics. Using High Impact Polystyrene (HIPS) as the primary material, compression tests were conducted via Abaqus simulation software. The results indicate that the hybrid metamaterial exhibits superior energy absorption capabilities compared to traditional structures. This addresses the limitations of existing designs, such as elliptical perforated plates, which often struggle with compressive strain. The research highlights the unique properties of the auxetic structure, contributing valuable insights into its potential applications in energy absorption and structural design across various engineering fields

Keywords: *Auxetic materials, hybrid metamaterial, elliptic-chiral structures, High Impact Polystyrene (HIPS), energy absorption, Poisson's ratio*

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MICROCRACKS EVOLUTION INDUCED BY HYDROGEN AND HELIUM CO-IMPLANTATION ON SILICON

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Abstract

In order to obtain nano thin layers of silicon onto Silicium substrates by ion-implantation, hydrogen microcracks -microscopic flat internal surfaces- are produced by both ion implantation and thermal annealing technical. The thickness of the transferred layer is controlled by adjusting the energy of hydrogen ion implantation.

Transmission electron microscopy has been used to study the evolution of these microcracks formed by hydrogen and helium co-implantation and during thermal annealing. Upon annealing, it is shown on the depth of layer a continuous (001) oriented microcracks , which are parallel to the Si surfaces are formed. These microcack grow in size, reduce their density and the overall volume they occupy remains constant. This phenomenon is due to a conservative Oswald ripening

In this work, we report the microcracks evolution induced by H and He co-implantation on Si and we identify the different mechanisms responsible for their thermal evolution from “microcracks” of a few nanometer in diameter to cracks of a few micrometers in diameter and the possibility for them to transfer thin film of silicon.

Keywords: *Thin layer; Silicon; Microcracks ; Ion implantation; Nanomaterials; isothermal annealing.*

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THERMOELECTRIC PROPERTIES OF BARIUM AND CALCIUM SELENIDE USING MODIFIED BECK-JOHNSON POTENTIAL

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Abstract

Thermoelectricity offers a promising route to addressing global energy challenges through efficient energy conversion technologies. In this study, the thermoelectric properties of Barium Selenide (BaSe) and Calcium Selenide (CaSe) were analyzed using Boltzmann transport theory under the constant scattering time approximation and a modified Beck-Johnson potential. Both compounds exhibit significant potential, with thermopower exceeding 400 μV/K for both n-type and p-type doping, and p-type doping showing superior performance. Additionally, their mechanical stability, soft phonons, and low lattice thermal conductivities further enhance their thermoelectric efficiency. However, to fully realize the potential of these materials, their relatively wide band gaps need to be reduced to optimize carrier generation and increase electrical conductivity. Enhanced electrical conductivity is critical for improving the overall thermoelectric performance, as it directly impacts the power factor. Addressing these limitations through targeted material engineering, such as doping or structural modifications, could significantly boost their thermoelectric figure of merit (ZT). With a thermal expansion coefficient of approximately 6.10-5 K−1, BaSe and CaSe demonstrate stability under operational conditions. By advancing their electrical properties alongside their already favorable thermal characteristics, these compounds could become leading candidates for sustainable thermoelectric applications, bridging the gap between performance and environmental responsibility.

Keywords: *Thermoelectricity, Boltzmann transport theory, Modified Beck-Johnson potential, Thermal conductivities.*

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APPLICATION OF X-RAY FLUORESCENCE TO EVALUATION OF METALS IN THE AGRICULTURAL SOIL

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Abstract

Soil pollution involves the alteration of the earth's surface by chemical substances that are harmful to life, endangering ecosystems as well as our health. This alteration in the quality of the earth can come from a variety of causes and, equally, the many consequences cause serious health problems that seriously affect flora, fauna and human health.

The aim of this work is to determine the heavy metals in the agricultural soil around using XRF or X-ray fluorescence and physico-chemical methods for analysing industrial influents. The XRF technique and physico-chemical methods will be used to answer three fundamental questions: the type of pollutants, their concentration, and possible ways of avoiding pollution or remedying it. At the same time, the experimental results will be analysed and compared with Algerian and international standards.

Keywords: *Soil pollution involves the alteration of the earth's surface by chemical substances that are harmful to life, endangering ecosystems as well as our health. This alteration in the quality of the earth can come from a variety of causes and, equally, the ma*

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ANISOTROPIC TUNNELING MAGNETO-RESISTANCE IN AFM JUNCTION, WITH AFM MNPT AS MAIN ELEMENT

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Abstract

In the field of conventional spintronics, the magnetic junction is based on ferromagnetic materials (FM), while in the new field of antiferromagnetic spintronics(1), the basic element is an antiferromagnetic material (AFM) .
In the present theoretical work, we investigate the junction combining a FM as polarizer (Fe) and an AFM as analyzer (MnPt) , separated by an insulator (MgO), all grown on gold electrodes (001).
In this study we use DFT implemented in different codes (2) within PBE parametrization combined with NEGF (3) to investigate the
Au/MnPt/MgO/Fe/Au junction.
We show that when the two magnetic materials (Fe, MnPt) are collinear, the junction present different magneto-resistance compared to noncollinear state, this is called ATMR (Anisotropic Tunneling Magneto-Resistance). In addition we show that these two states are stable and switchable and thus can be used in AFM spintronic device.

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Keywords: *Magnetic junction, Antiferromagnetic spintronics, ATMR*

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KINETIC AND THERMODYNAMIC ANALYSIS OF SYAGRUS ROMANZOFFIANA FIBER PYROLYSIS VIA THERMOGRAVIMETRIC INVESTIGATION AND COATS-REDFERN METHOD

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Abstract

This study uses thermogravimetric analysis to explore the kinetic and thermodynamic behavior of Syagrus Romanzoffiana fibers (SRFs). The fibers were heated non-isothermally from 25 to 800 °C in a nitrogen atmosphere at three different heating rates: 5 °C/min, 10 °C/min, and 15 °C/min. The thermogravimetric analysis indicated that SRF pyrolysis occurs in three distinct stages. The focus was on the second stage, where low-temperature stable components decomposed. This decomposition occurred in the temperature ranges of 218 – 376 °C, 218 – 391 °C, and 218 – 394 °C for heating rates of 5 °C/min, 10 °C/min, and 15 °C/min, respectively. To analyze the kinetics, the Coats-Redfern method was applied to twenty-one different kinetic models representing four primary solid-phase reaction mechanisms. Among these, the diffusion model, using the Zhuravlev equation, provided the best fit, evidenced by high correlation coefficient values ($R^2 > 0.99$) for all heating rates. The activation energy values derived were 114.02 kJ/mol, 118.77 kJ/mol, and 119.44 kJ/mol for heating rates of 5 °C/min, 10 °C/min, and 15 °C/min, respectively. Additionally, the kinetic parameters were utilized to compute the thermodynamic properties, specifically the changes in enthalpy (ΔH), Gibbs free energy (ΔG), and entropy (ΔS). These thermodynamic characteristics are crucial for assessing the feasibility of SRFs as a renewable biomass energy source. The insights gained from this study are significant for the design of reactors and the production of chemicals, highlighting the potential of SRFs in sustainable energy applications.

Keywords: *Syagrus Romanzoffiana fibers; Thermogravimetric analysis; Coats-Redfern method; pyrolysis; kinetics.*

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NUMERICAL MODELING OF THIN FILM GROWTH DURING DEPOSITION WITH PARTICLE EVAPORATION

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Abstract

In this work, we propose a generalization of particle deposition to improve the physics of the simulation process and bring it closer to real thin film deposition processes. This process is tuned to attract vapor particles and gas particles by reducing air pressure and crowding by other air molecules. This not only reduces the energy required for evaporation, but also allows a more direct path to the deposition zone, with vapor particles being less frequently deflected by other particles in the chamber. Although our approach does not address bombardment, we propose a method to generate clusters of random shapes and sizes, ranging from a single particle to an ensemble of particles, to make the simulation more representative of experimental reality. According to the results obtained, the growth of interfaces in random vapor deposition follows two distinct regimes: the first clusters grow randomly forming an interface resulting from the deposition or evaporation of particles due to the difference between the average chemical potential of the vapor (Uv) and the interface (Ui). The growth (β) and roughness (α) exponents remain stable with increasing substrate size (L) and the number of bombarded particles (N). These exponents are sensitive to the variation of Ui, where α decreases when Ui goes from 0 to −6, inversely to the exponent β. All surfaces obtained by this model exhibit fractal properties. Moreover, the technique of Greenwood and Williamson, which consists in replacing the rough-rough contact by a rough-smooth contact, is geometrically valid at the interstices but less valid for thermal problems depending on the roughness of the interfaces of the contacting surfaces.

Keywords: *Particle deposition, Vapor evaporation, Growth exponents, Random clustering.*

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DEFLECTION ANALYSIS OF A SANDWICH BEAM BY THE DIFFERENTIAL EQUATION.

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Abstract

In this research, the deflection of a sandwich beam is determined by the differential equation at presence of the shear deformation. The system beams is structured by two prismatic beams, connected between them by an adhesive very thin and rigid, subjected to uniform bending moment and uniformly distributed load. The fundamental differential equation of the sandwich beam will be obtained from the equation of total energy functional. The extreme moments creating normal forces are applied to each beam. The differential equation will be compared to those found in sandwich beams without shear deformation. Consequently, the theoretical results of deflection with and without shear deformation will be compared between them.

Keywords: *sandwich beam, differential equation, adhesive, deflection.*

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CHARACTERIZATION OF MAGNESIA PRODUCED FROM ALGERIAN DOLOMITE ORE

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Abstract

Magnesium oxide, or magnesia (MgO) possesses attractive properties such as high melting point (~ 2800 °C), good chemical resistance, high electrical resistance, low thermal conductivity, nontoxicity. It is used in many application fields including cement production, refractories elaborations, and water purification. Usually, it is produced prom magnesite, seawater, and dolomite. Throughout our study, a nanometric MgO particles with high purity was successfully synthesized from Algerian dolomite via a leaching-precipitation-calcination process. The experimental process used in this study consisted of three steps: dissolution, precipitation, and calcination. In the first step, the dolomite was dissolved at sulfuric acid. Then, magnesium hydroxide particles (Mg(OH)2) were precipitated by using potassium hydroxide. Finally, the Mg(OH)2 particles were calcined to form MgO. The obtained magnesium oxide particles were physicochemically characterized. The results show that the synthesized magnesium oxide has a high purity (≈99.45 %), with a crystallite size of (≈16.5 nm), and a high specific surface area (SSA) (70.42 m2/g).

Keywords: *Dolomite, precipitation, magnesium oxide, calcination*

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LINEAR CORRELATION BETWEEN SOME PHYSICAL PARAMETERS OF CUBIC BORIDES AND CARBIDES PEROVSKITE MATERIALS AND THEIR NEAREST-NEIGHBOR DISTANCES

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Abstract

The current research aims at investigating the linear correlation between some physical parameters of rare earth (R) rhodium borides RRh3B (R = Sc, Y, and La) and carbides RRh3C (R= Sc, Y, and La) perovskite-type materials as well as the logarithm of their nearest-neighbor distances. The physical parameters and the lattice nearest-neighbor distances were taken from the literature. High degree of the linear correlation between the different physical parameters of our materials of interest and the logarithm of their nearest-neighbor was found.

Keywords: *Physical properties, borides and carbides perovskite materials, linear correlation, nearest-neighbor distance.*

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PHYSICO-CHEMICAL AND MECHANICAL CHARACTERIZATION OF NEW CELLULOSE FIBERS EXTRACTED FROM THE DRAGON TREE PLANT.

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Abstract

This study examines the feasibility of using Dracaena draco fiber (DDF) to create biodegradable natural composites, with the aim of contributing to the development of environmentally friendly materials. This study provides an in-depth examination of the morphological, thermophysical and mechanical characteristics of DDF. Results show that average density is 1.2043 g/cm3, linear density is 18.87 Tex, and moisture recovery and moisture content values are 12.88% and 11.54% respectively. These results represent the first comprehensive analysis of these factors for DDF. X-ray diffraction (XRD) and Fourier transform infrared spectroscopy (FTIR) provide useful information on the crystal structure and chemical functional groups present in DDF. The studies indicate a crystallite size of 3.14 nm and a degree of crystallinity of 30.42%. The TGA study reveals that the DDF fiber consistently maintains a temperature of 329.5 ◦C. Precise characterization of a material's behavior can be effectively demonstrated by accurately modeling its water uptake, as illustrated by the models created by Sikame et al. Mechanical test results indicate that DDF has a notable average yield strength of 553 MPa, a strain at break of 2.5% and a Young's modulus of 24.9 GPa. This study uses ML estimation and statistical analysis using the two-parameter Weibull distribution to comprehensively assess the mechanical properties of DDF. Comparison of DDF with other entities. The available literature discusses other natural fibers and proves their potential as suitable reinforcements for lightweight biocomposites. This makes them a viable choice for many applications encompassing thermoplastic or thermoset polymers. The results presented above demonstrate the potential of DDF in the creation of sustainable materials for many industrial uses [1].

Keywords: *Biocomposites, Dracaena draco fibers, thermal properties; mathematical model; mechanical properties*

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A NEW METHOD TO DETERMINE THE VOLTAGE DROP ACROSS ANY PARASITIC RESISTANCE IN MOS STRUCTURE

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Abstract

The discrepancy between the experimental and simulated data relate to the value ΔV, which presents the voltage drop across any parasitic resistance.

In order to calculate the value accurately of ΔV, we show in this communication a new method based on energy band diagram of the Metal-Oxide-Semiconductor (MOS) capacitor. The efficiency of this method was verified by simulation results of gate leakage current-gate voltage (IG-VG) and capacitance-gate voltage (C-VG) by SILVACO-TCAD of a submicron n-channel MOSFET and conventional MOS capacitor, and then we use the parameters employed for the TCAD simulation to calculate the difference between the voltage drop across the oxide from energy band formula and from Gauss's law (i.e. Semiconductor-Oxide and Oxide-Metal), this difference between the two values corresponds exactly to the value of the voltage drop across any parasitic resistance ΔV.

Therefore, this method is important in extracting parameters accurately, whether computationally or graphically.

Keywords: *Keywords: [MOS structure, Voltage drop, Parasitic resistance, Energy band]*

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PROMOTING SUSTAINABLE CONCRETE PRODUCTION THROUGH PARTIAL CEMENT REPLACEMENT WITH DAM SILT

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Abstract

This study investigates the use of dam silt as a partial cement replacement in concrete, with the goal of reducing CO_2 emissions associated with cement production. Four mortar mixtures were prepared, incorporating 10%, 20%, and 30% dam silt. Both the fresh-state performance, including slump, and the mechanical properties of hardened concrete were assessed. The findings indicate that adding dam silt increases water absorption, thereby reducing the workability of the mixtures. Nevertheless, despite this reduction in workability, the mechanical performance of mortars containing dam silt was comparable to, and in some cases even exceeded, that of conventional mortar, showing particularly promising long-term durability. In conclusion, this study underscores the ecological and mechanical viability of dam silt as an alternative material in concrete production, fostering more sustainable and environmentally friendly construction. This valorization of geo-waste opens the door to significant innovations within the construction sector.

Keywords: *Mortar, Eco-Friendly Mortar, Geo-waste, Dam mud, Compressive Strength.*

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CHARACTERIZATION OF HEAVY METALS IN ROCKY SEDIMENTS BY NON-DESTRUCTIVE METHODS

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Abstract

In the field of geosciences and environment, nuclear techniques allow us to study the life of sediment samples at the core of their material, providing insights into human activity and past practices.

These studies play a crucial role in shaping the strategies necessary for transitioning to more sustainable lifestyles. Supported by nuclear analysis techniques, they could provide information on the nature, source, and extent of pollution in the region.

Our study, employing non destructive analysis techniques requires following interdisciplinary protocols and methods to ensure that sediments from different sites can document the environmental impact of an ecological system. It can be used to track the effectiveness of environmental management measures and pollution reduction over time.

The aim of our study is to determine trace concentrations of heavy metals (lead, mercury, cadmium, copper, zinc…) in sediments from various sites in Algeria, using multi elemental analysis as XRF, PIXE and DRX.

These methods based on the detection of X rays, use a beam of rays to irradiate samples for the simultaneous determination of all the elements present in the sample. They offer high precision and the possibility of quickly analyzing a large number of samples.

This makes the detection of heavy metals in rocky sediments highly useful, as it provides the opportunity to analyse trace elements crucial for characterizing metals in various samples.

The experimental results of the samples analyses will be compared with existing experimental data.

Keywords: *Non-destructive analysis, X-Ray Fluorescence, heavy metals, rocky sediments.*

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CHARACTERIZATION OF FLEXURAL AND TENSILE MECHANICAL PROPERTIES OF LUFFA MAT REINFORCED COMPOSITES

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Abstract

This study uses tensile tests to examine two distinct configurations: quasi-unidirectional (Part A) and random (Part B) in order to explore the impact of fiber orientation in luffa mat composites. On composites reinforced with luffa fiber mats created using a resin transfer molding (RTM) technique, flexural and tensile tests were carried out. Additionally, the impact of mat stacking and the manufacturing method on the composites' mechanical characteristics were investigated in this study. The tensile properties of the luffa mat show better Young's modulus and tensile strength when fibers are positioned quasi-unidirectional (Part A), but strain at break increases when fibers are randomly oriented (Part B). The preparation, luffa mat superposition, and manufacturing method of the luffa/epoxy composites have shown better mechanical properties in tensile and flexural, with Young's modulus values of 7.41 ± 0.42 and 6.79 ± 0.3 GPa, and strengths of 67.77 ± 1.82 and 67.57 ± 4.29 MPa, respectively, compared to other luffa fiber-reinforced composites already cited in the literature.

Keywords: *Luffa mat; Fibers orientation; Luffa/ epoxy composites ; Tensile properties; Three-point flexural properties*

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MAGNETO-MECHANICAL RESPONSE OF SILICONE-BASED MR ELASTOMERS: AN EXPERIMENTAL STUDY

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Abstract

Magnetorheological elastomers (MREs) are known for their viscoelastic properties, allowing them to store and dissipate energy when subjected to shear deformation and the influence of magnetic fields. The dynamic storage modulus (G') and loss modulus (G'') are essential parameters for characterizing the rheological behavior of these materials.
In this study, dynamic shear tests (DMA) were conducted on an MRE composed of a silicone rubber matrix (RTV 141) and carbonyl iron particles (CIP). The effects of mechanical and environmental parameters, such as deformation amplitude, excitation frequency, magnetic field intensity, and temperature, on the magnetorheological properties were investigated and analyzed.
A maximum relative MR effect of 1908% was achieved under a magnetic field of 300 mT, at low deformation amplitudes and excitation frequencies. The results indicate that the dynamic moduli increase with the magnetic field intensity but decrease at higher deformation amplitudes, reflecting a nonlinear response. Moreover, increased stiffness and energy dissipation of the elastomer at higher frequencies, especially in the presence of a magnetic field, were observed.
Additionally, rising temperatures reduced the overall elastic properties of the MRE while enhancing the effect of the applied magnetic field. These findings highlight the potential for optimizing silicone-based MREs for innovative and promising mechanical applications.

Keywords: *Magnetorheological elastomer, Silicon rubber, CIP magnetic particles, DMA shear tests, MR effect, magnetic flux density.*

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EXPERIMENTAL AND NUMERICAL ANALYSIS OF THE FLEXURAL BEHAVIOR OF SANDWICH COMPOSITES

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Abstract

The development of modern technologies demands materials with high mechanical properties and low densities, tailored to specific applications. Composite sandwich materials meet these requirements due to their low density, high strength, significant rigidity, and excellent durability. Currently, sandwich structures have a significant presence in all industrial sectors, particularly in the aerospace sector. The use of composite skins and full or hollow cores has multiplied their applications.

Our work aims to experimentally and numerically analyze, using finite element methods, the flexural mechanical behavior of composite sandwiches. We analyze the effect of the mechanical properties of the skins and cores, as well as their thicknesses, on the variations in flexural strength and stiffness of sandwich composites. Finite element modeling helps determine the distribution of flexural stresses within the different components of the sandwiches.

The obtained results show that the flexural behavior of sandwich composites largely depends on the nature and thickness of the skins and cores. The flexural strength and stiffness vary from one sandwich to another, depending on the reinforcement of the laminated skins. Flexural stiffness increases significantly with skin thickness and decreases with core thickness. The maximum tensile and compressive stresses, localized at the upper and lower skins, increase significantly with the thickness of the skins.

Keywords: *Laminate composite; Sandwich; Skin; Core; Flexion; stiffness; Deflection*

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NONLINEAR FINITE ELEMENT ANALYSIS OF HYPERELASTIC CURVED TIMOSHENKO BEAMS USING ISOGEOMETRIC FORMULATION

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Abstract

This study presents a nonlinear finite element formulation for hyperelastic curved Timoshenko beams, incorporating both geometrical and material nonlinearities. The constitutive behavior is modeled using the incompressible neo-Hookean and Saint Venant-Kirchhoff hyperelastic models, which are widely employed to describe the behavior of materials undergoing large deformations. The formulation is based on a total Lagrangian description, and the geometry of the curved beam is discretized using Non-Uniform Rational B-Splines (NURBS), where the same NURBS basis functions are used for both the geometry description and the field approximation. This approach enables a seamless integration of computer-aided design (CAD) and finite element analysis, thereby eliminating the need for mesh generation. The proposed formulation is validated through a series of numerical examples, involving both conservative and nonconservative loads. The results demonstrate that the proposed formulation accurately captures the complex behavior of hyperelastic beams, as reported in the literature. A comparative study is also conducted to investigate the performance of the two hyper-elastic models under various loading conditions. The results reveal that, for large rotations, both models exhibit similar behavior. However, in the presence of large deformations and strains, the Saint Venant-Kirchhoff model is found to behave stiffer than the neo-Hookean model. This study contributes to the development of robust numerical models for the simulation of hyperelastic beams, which is essential for a wide range of engineering applications. The findings of this re-search provide valuable insights into the selection of suitable constitutive models for the analysis of complex beam structures undergoing large deformations.

Keywords: *Isogeometric analysis, Curved beam, Timoshenko theory, NURBS, Geometric nonlinearity, Hy-perelasticity.*

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STUDY OF THE THERMAL EFFECT AND RESISTANCE TO INTERNAL PRESSURE OF A CRANK ROD IN A FOUR-STROKE ENGINE

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Abstract

This work deals with the study of the thermal effect on a cranked connecting rod of different types of material (Steel, Aluminium, Aluminium (3003-H18)) of a four-stroke internal combustion engine, as well as its resistance to internal pressure. Starting with an analysis of the characteristics and properties of each type of connecting rod material, followed by a design and modelling of its geometry in 2D and 3D using design software, and ending with a simulation using Abaqus calculation software. By determining its behaviour to thermal effects and its resistance to internal pressure, by calculating the maximum stresses, displacements and deformations undergone by the body of this connecting rod, by deducing the equivalent stress by the von Mises criterion exerted on each different type of connecting rod body material.

The results obtained show that the resistance to thermal stress, internal pressure and deformation of the aluminium connecting rod (3003-H18) is greater than that of connecting rods made from other materials aluminium and alloy steel.

Keywords: *Connecting rod; Design; Thermal stresses; Deformation; Displacement; von Mises criterion*

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SIMULATING THE SINGLE IMPACT OF LASER SHOCK PEENING ON RESIDUAL STRESS AND DEFORMATION STATES IN AEROSPACE ALLOYS

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Abstract

The objective of this study is to present a numerical simulation that calculates the mechanical states of both residual stresses and deformations in a structure induced by Laser Shock Peening (LSP). Since full-scale testing is costly, advanced techniques like LSP, often used on expensive components, rely heavily on simulations. Using Abaqus, the traditional explicit-implicit simulation method involves varying the pulse length and magnitude until a stable solution is achieved. Laser shock peening generates high-pressure pulses on the metal surface by applying a high-energy laser beam with the appropriate overlays. These pulses create an internal stress wave within the material, leading to plastic deformation and the development of beneficial residual compressive stresses. These stresses, along with the induced deformation, enhance surface properties such as fatigue resistance, wear resistance, and corrosion protection. The simulation employs a model that replicates both the deformation and residual stress development in the aluminum alloy fuselage base (AA2024-T351).

Keywords: *LSP; Residual stress; AA2024-T351; Finite element analysis; Johnson–Cook model.*

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ANALYSIS OF THE VIBRATORY BEHAVIOR OF POROUS PLATES FUNCTIONALLY GRADED IN FREE VIBRATIONS

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Abstract

The vibrational behavior of simply supported functionally graded porous plates is studied and analyzed in this paper, using higher order non-polynomial theory, transverse shear effects are studied as a function of plate thickness. Without application of a shear correction coefficient, the current model contains only four unknowns. Hamilton's principle is used to obtain the equations of motion. The solutions are obtained using Navier's method, then the fundamental frequencies are found, by solving a system of eigenvalue equations, the results of this analysis are presented and compared with those available in the literature.

Keywords: *Porous plates, Hamilton's principle, Fundamental frequencies*

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PREPARATION AND CHARACTERIZATION OF NANO-COMPOSITE CLAYS USED FOR ELIMINATION OF CHLORINE ANIONS OF THE ALGERIA INDUSTRIAL WASTE WATER.

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Abstract

This study is based on preparation of three different clays (Untreated-Bentonite noted Un-Bt , Sodic-Bentonite noted Na-Bt, and Organic Bentonite clay noted Or--Bt).

These three complexes clays were characterized by bothXray diffraction (XRD) and Fluorescence (XRF)Scanning Electron Microscopy (SEM), Fourier transform infrared spectroscopy (FTIR),textural measurements (BET specific surface areas and porosities) and the cationic exchange capacity (CEC).

Corresponding results obtained confirm the good purification and sodification of raw bentonite, then the obtention of the sodic bentonite indicated by Na-Bt also the intercalation of the cationic surfactant into the sodic bentonite by cationic excheangeable process mechanism,then the formation of nanocomposite clay or organoclay identified by Or-Bt.

The results obtained give basal spacing values around 15.34 A°,13.25 A° ,and 18 A°, respectively for verified two aims firstly: The originality of this research, secondly to decrease the cost production of the adsorbents.

Sorption kinetic study of Chlorine anions (Cl-) on these two matrices Na-Bt, Or--Bt respectively:

Were carried out using kinetic models of pseudo-first, pseudo-second-order .

Results obtained at the conditions studies (room temperatureT= 〖25〗 ^o C), at low concentration of Hydrochloric acid (0.025 M)and (acidic medium pH=4.83) show clearly the good validity of the pseudo-second-order model which gives a better correlation coefficient both, for

HY-Bt (R^2=0.999) Compared to that obtained results by Na-Bt (R^2=0.960).

Adsorption isotherms give adsorbed amounts of about 60. 25 mg.g^(-1)onto Or-Bt complexes, respectively, and 25.55 mg.g^(-)for Na-Bt as reference adsorbent. These results indicated the adsorption of Chlorine ions (Cl_^-) by the Algerian organo clays named the nano composites

(by the sorption kinetic through chemisorptions) on the surface sites of each used modified complexes clays.

Keywords: *Key Words: Bentonite clays, Cationic Surfactant, Characterization; Hydrochloric acid; Kinetic.*

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EFFECT OF CARBON BLACK FILLERS ON THE PROPERTIES OF NATURAL RUBBER COMPOSITES

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Abstract

The present study investigates the effect of carbon black load, on the curing characteristics and mechanical properties such as tensile strength, elongation at break, hardness and abrasion resistance of natural rubber (NR) composites. For that, Natural rubber filled with different content of two types of carbon black N220 and N550 were prepared. The curing results indicate that the scorch and cure times decrease with increasing of filler content. In addition, the viscosity and the crosslink density of natural rubber composites increase; this indicates that there are an improvement in the filler–rubber interaction. Mechanical properties such as tensile modulus and hardness of composites are remarkably improved, indicating the inherent reinforcing potential of carbon black. Regarding tensile strength and abrasion resistance, they increase with the addition of carbon black, up to 50 phr for N220 filler and 70 phr for N550 filler. After, these properties decrease slightly with filler addition and this for the two fillers.

Keywords: *Naturel rubber, Carbon black, Curing characteristics, tensile strength, abrasion resistance.*

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EFFECT OF SEVERAL MICROMECHANICAL MODELS ON THE BUCKLING AND FREE VIBRATION OF FG SANDWICH THICK BEAMS RESTING ON WINKLER-PASTERNAK ELASTIC FOUNDATIONS

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Abstract

In this research work, an analysis of the bending , buckling and free vibration of functionally graded sandwich beams resting on elastic foundation by using a refined quasi-3D theory in which both shear deformation and thickness stretching effects are included. Present theory exactly satisfies stress boundary conditions on the top and the bottom of the plate.The principle of virtual work isused to obtain the equilibri umequations . The governing equations are obtained by the principle of Hamilton and then are solved via Navier solution for the simply supported beam and then fundamental frequencies are found by solving the results of eigenvalue problems. A detailed parametric study is presented to show the influence of the micromechanical models on the general behavior of FGM sandwich beams laid on an elastic foundation which is modeled using Pasternak's mathematical model.The accuracy of the proposed theory can be noticed by comparing it with other 3D solutions available in the literature.

Keywords: *FG sandwich beam, Micromechanical model, Bending, Buckling, Free vibration*

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MECHANICAL PROPERTIES AND ANTIOXIDANT ACTIVITY OF PHBV/PLA/CHITOSAN BIOCOMPOSITES

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Abstract

In this work biocomposites films based on a blend of Poly (3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBV) and poly (lactic acid) (PLA) with PHBV-g-MA compatibilizer were prepared by melt compounding. Moreover chitosan was added to biocomposites films as reinforcing and antioxidant agent. Physical, optical, mechanical properties and antioxidant activity of blends were investigated through Fourier transform infrared (FTIR) spectroscopy, UV-Visible spectroscopy, X-ray diffraction (XRD), tensile test and calculating the inhibition of free radical by DPHH . The results indicates that the blending of chitosan with PHBV/PLA films enhance the optical properties as evidence by significantly lower UV-Vis lighand. Futher the tensile results indicated a significant increase in Young's modulus and tensile strength compared to neat blend. It is also reported that chitosan-blend films had lower antioxidant properties than neat films.

Keywords: *Biocomposites, Blends, Chitosan, PHBV, PLA*

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MICROSCOPIC INVESTIGATION OF PVD-RF AMORPHOUS AL2O3/TI6AL4V DEPOSITS AT DIFFERENT SUBSTRATE POLARIZATIONS

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Abstract

As part of the technological advances aimed at developing thermally insulating materials, particularly in the dielectric, aerospace and electronics sectors, particular attention has been paid to the development of alumina (Al_2O_3) deposits. These deposits were made on Ti6Al4V grade 5 titanium alloy substrates using the radio-frequency magnetron sputtering (PVD-RF) technique at different substrate biases (0V, -50V, -100V and no bias). SEM images show good coverage of the substrate surface by the amorphous Al_2O_3 deposit. EDS analysis revealed the presence of the various Al and O elements that make up the deposit, as well as those of the Ti6Al4V substrate. The X-ray diffraction spectra of the Al_2O_3/Ti6Al4V system in 2q mode in the amorphous state, showed peaks characteristic of the partially crystallized Al_2O_3 phases and those of the phases resulting from the interaction of the elements of the $Al_{0.3}Ti_{1.7}$ and $Ti_{0.7}V_{0.3}$ substrate. Finally, the AFM images showed very good homogeneity of the film surface, with low arithmetic roughness ranging from 3.45 to 4.75 nm.

Keywords: *Alumina, Amorphous, PVD-RF, Polarization*

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STUDY AND CHARACTERIZATION OF A NOVEL GENERATION OF PHOTOCOMPOSITES FOR DYE TREATMENT

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Abstract

The main objective of this work is to prepare and characterize a new generation of photocomposite supports intended for the treatment and purification of water. This new matrix is prepared in the form of beads based on alginate, activated carbon, and zinc oxide (Alg/ZnO/CA). The beads thus obtained undergo a morphological and compositional characterization. Different analytical techniques are used, including X-ray diffraction (XRD), Scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR), and thermogravimetric analysis (ATG), Specific Surface Area analysis (BET), solid UV spectroscopy analysis, isoelectric points determination, and assessment of the effect of pH on the chemical stability of the beads. These methods allow us to explore and understand in detail the structure and physico-chemical properties chemicals of the photocomposite beads, as well as to identify the optimal combination of materials used, and the capacity and limitations of the prepared photocomposite beads.

Keywords: *photocomposite beads, characterization, water purification.*

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OPTIMIZATION OF THE BEHAVIOR OF PARTIALLY CONFINED CONCRETE: NUMERICAL MODELING.

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Abstract

Recycling and waste recovery are now considered as a solution for the future in order to meet the deficit between production and consumption and to protect the environment. Composite materials are widely used in the containment of concrete columns to meet the needs of improving their mechanical performance. The different techniques and models of bonded confinement of these composite materials reported in the scientific literature have confirmed that the lateral pressure of the confinement is a function of the geometric and mechanical characteristics of the composites.

This work focuses on the numerical analysis of the compression behavior of short concrete column based on glass waste confined by strips made of glass-fibers-reinforced polymer (GFRP). Abaqus software is used to built the numerical model. Concrete damaged plasticity model coupled with the damage is considered to represent the evolution of the cracks and an orthotropic elastic model to predict the response of composites. In order to optimize the use of confinement strips, a simulation was carried out on a specimen confined with six composite strips of width 3cm corresponding to a confinement rate of 56.25%. It is essential to specify that we maintain the confinement rate constant. We varied the placement and spacing of the strips. The numerical results obtained in terms of stress evolution and damage variables show that there is variation of the concrete specimen's behavior according to the stripe's position. In fact, an improvement in term of strength and ductility are observed.

Keywords: *Confined concrete, glass-fiber, optimization, numerical model, short column*

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STRUCTURAL AND ELASTIC PROPERTIES OF HIGH ENTROPY CARBIDE (TIMOHFNBTA)C: A FIRST-PRINCIPLES STUDY

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Abstract

In this work we have performed a theoretical study using the exact muffin-tin orbitals method EMTO based on the density functional theory (DFT) implemented in the EMTO-CPA
code to investigate the structural and elastic properties of an equimolar high-entropy carbide (TiMoHfNbTa)C. The improved generalized gradient approximation GGA-PBEsol was used for the term of the exchange correlation potential. The structural properties are calculated and the lattice parameter agree well with the available experimental results. The elastic constants, shear modulus G, Young's modulus E and Poisson's ratio are also calculated. We found that the Young's modulus is in excellent agreement with the available experimental result. The elastic constants indicate that the investigated alloy is mechanically stable and the alloy was found to behave in brittle manner according to the Pugh's ratio (B/G) criteria and Poisson's ratio. furthermore, the mechanical anisotropy indicates that the alloy under investigation is elastically anisotropic.

Keywords: *Ab initio calculations, Elastic properties, Ductility, EMTO-CPA.*

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SYNTHESIS AND CHARACTERIZATION OF NANOCOMPOSITE (CU, TI-OXIDE PILLARS/CLAY)

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Abstract

To expand the scope of clay applications as nanocomposite in several fields, it has become necessary to address the issue of the closure of their slips, speaking to 300 ° C. This disadvantage was overcome by pillaring: Intercalation of cationic complexes of large size, which by calcinations, would turn into pillars oxides which are responsible for the acidity, helped maintain their open structure and create micropores in the interlayer space, thus improving their adsorptive properties. The pillared materials were demonstrated to have an increased interlamellar distance, an increased pore volume and were accessible by molecules within a specific size range. The pillared structure has been suggested to produce acid sites through dehydratation and dehydroxylation of the metal cations at high temperature; the number and strength of the acid sites present in the clay are important factors for exchange and adsorption applications. The effect of attack by sulfuric acid on the physicochemical characteristics of clays is very dependent on treatment conditions (acid concentration, temperature, contact time, pH ...).Considering the importance of the phenomenon of acid activation followed by pillaring operation in the clay applications, we study in this work; activation, synthesis and characterization of modified clay material (nanocomposite), can be used as adsorbent or as acidic catalyst in several organic reactions; The experimental study is to determine the optimal activation conditions (Concentration: 5 M at temperature T = 70 ° C, Activation time = 4h, adsorbed H_2SO_4 = 1.40 meq / g of clay, CEC = 96 meq/100 g of clay) to achieve an adequate activated bentonite aimed to apply for pillaring operation .Modified clay were characterized by different techniques (XRD, XRF and SEM) and physic-chemical analysis (CEC: cationic exchange capacity, Specific surface area, Average pore diameter and Density). Cooper and Titanium pillared material or (Cu, Ti-oxides Pillared) Clay was synthesized from activated bentonite using $CuCl_2$ and $TiCl_2$ solutions as pillaring agents. The pillared products was characterized by physic-chemical analysis (SEM, XRD, CEC, surface acidity, specific surface area, Average pore diameter and volume mass). The basal spacing (d-spacing) for the (Cu, Ti-intercalated) bentonite and (Cu, Ti-pillared) bentonite are 39, 55 A° and 35 A°, respectively. The specific surface areas of (Cu, Ti-pillared) and natural bentonites are 370 and 65 $m^2 g^{-1}$ respectively. With specific properties, the complexing Clay matrices are highly reactive nanomaterials and can be used in industrial wastewater treatment process or as catalyst in several organic reactions and can be used as resin for dental treatment.

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Keywords: *Keywords: Activation1, Synthesis 2, Characterization 3, Nanocomposite 4, (Cu, Ti)-Oxide 5.*

INFLUENCE OF THE INTERPHASE ON THE ELECTRICAL CONDUCTIVITY OF GRAPHENE/POLYMER NANOCOMPOSITES

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Abstract

Although polymers are essential and widely used materials, their physical properties remain limited. To overcome these limitations and broaden their fields of application, they are reinforced with fillers. Graphene, with its exceptional properties, emerges as a promising material, offering vast potential for use in various industries and devices. The interfacial interaction between graphene and the polymer matrix promotes a uniform dispersion of graphene within the matrix, thereby enhancing the overall performance of the nanocomposite. Thus, the functionalization of graphene is crucial for optimizing this interaction, preserving its outstanding properties, and preventing its agglomeration. Numerous studies have shown that graphene/polymer nanocomposites possess remarkable properties, paving the way for various applications. The use of these nanocomposites is expected to grow sustainably, transforming graphene from a basic material into an advanced one capable of providing optimal solutions to industries and consumers. Due to their impressive electromechanical performance, graphene/polymer nanocomposites are attracting increasing attention. However, despite the extensive research conducted on these materials, the nanoscale mechanisms remain poorly understood, and their relationship with effective properties remains an open area of investigation. In this context, the development of theoretical models could help elucidate these mechanisms, representing a step forward in studying the influence of nanoscale constituents on properties such as the electrical conductivity of these composite polymers.

This study focuses on the development of models to predict the electrical properties of nanocomposites based on graphene nanosheets and polymer. The theoretical model of Taherian, refined by Yasser Zare and his collaborators, is developed to fit a two-dimensional (2D) distribution of graphene nanosheets. The developed model takes into account the effects of graphene dimensions, interphase thickness, and the portion of graphene nanosheets in the networks. The results show that a high electrical conductivity in the styrene-acrylonitrile (SAN)/graphene nanocomposite is expected for a thicker interphase. However, for a thinner interphase, the nanocomposites exhibit virtually no electrical conductivity.

Keywords: *Electrical conductivity, two-dimensional distribution, graphene nanosheets, interphase*

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A GENETIC ALGORITHM CODE FOR AN OPTIMIMUM DESIGN IN COMPOSITE LAMINATE

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Abstract

Unlike the typical traditional hill-climbing techniques to design a composite laminate A genetic algorithm code programmed in MATLAB is proposed in this work in order to obtain optimized composite laminate panel. where the design variables treating the following geometric parameter: number of layer, fiber orientation angle and thickness of each layer. The objective function of the desired optimization is based on Tsai-Wu criteria and the genetic crossover is applied randomly using MATLAB operator. In order to get the best panels suiting and satifying the engineer needs

Keywords: *design, Genetic Algorithm, composite laminate, optimization, Tsai-Wu MATLAB*

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PARAMETRIC STUDY OF FATIGUE BEHAVIOUR OF COMPOSITE AND EVALUATION OF CHARACTERISTIC WITH VARIATION OF CONSTITUENTS: EXPERIMENTALLY AND MODELLING

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Abstract

Our study will focus on the durability of composite materials and highlight the influence of several parameters. The main objective is to analyse the response of the mechanical behaviour in static fatigue and dynamic in bending of the composite to study the influence of various parameters related to the test or to the material. To do this, several techniques are implemented. Throughout this work, we will try to show the effect of the constituent elements (fibre, matrix and interfaces) on fatigue resistance and crack degradation. The analysis and the evaluation of various quantities that we will define as damage tracers will allow us to model the fatigue behaviour and impact response of these material.

Keywords: *composite material, Mechanical behavior, Fatigue, dynamic, impact.*

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LOW-VELOCITY IMPACT BEHAVIOR OF COMPOSITES (CRFP) REPAIRED WITH STEPPED SCARF UNDER DIFFERENT ENERGY LEVELS

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The effect of low-velocity impact on intact and center-repaired composites was investigated using a structural repair method known as stepped scarf repair. Low-velocity impact tests were conducted on intact and repaired samples using a drop-weight impact testing machine at two energy levels (18J and 30J). The impact response of the repaired laminates was compared to that of the intact composites at each energy level. Furthermore, the impact performance of the tested samples was analyzed by evaluating the contact force, impact duration, and DTL (delamination threshold load). It was observed that the maximum contact force was higher for the repaired samples compared to the intact ones for both energy levels (18J and 30J). Additionally, results indicated that the contact duration for the 18J impact level was longer for the repaired samples than the intact ones, whereas at the 30J level, the intact samples exhibited longer contact durations. Regarding the DTL, the repaired samples consistently demonstrated higher values compared to the intact composites for both energy levels, mirroring the trend observed in contact force

Abstract

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Keywords: *composite ; stepped scarf repair ; low-velocity impact ; DTL, maximum contact force*

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COMPUTATIONAL INVESTIGATION OF THE ELECTRONIC STRUCTURE AND ELASTIC PROPERTIES OF SCNBNI2SN2

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Abstract

The present study investigates the structural, electronic, and elastic properties of multifunctional material known as double half-Heusler alloy ScNbNi2Sn2 using the full potential linearized augmented plane wave method (FP-LAPW) based on density functional theory (DFT) implemented in the WIEN2K code. The calculation of the total energy involves the consideration of the exchange-correlation potential under the Local Density Approximation (LDA) and Generalized Gradient Approximation (GGA). Furthermore, the electronic properties are computed using the Engel-Vosko (EV-GGA) and mBJ approximations. The band structure of our double Heusler alloys displays characteristics of semiconductors, as indicated by the presence of an indirect band gap of about 0.47 eV and the density of the state plot indicates that bands Ni, Nb, and Sc atoms are mostly occupied by d states. The elastic constants were used to calculate the mechanical properties, including bulk modulus, shear modulus, Young's modulus, and elastic anisotropy. The Heusler alloy ScNbNi2Sn2 is a ductile material, as evidenced by the bulk modulus to shear modulus ratio and other parameters.

Keywords: *Heusler alloy, DFT, electronic structure, elastic properties, Bulk modulus, shear modulus.*

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LOW-VELOCITY IMPACT BEHAVIOR OF COMPOSITES (CRFP) REPAIRED WITH STEPPED SCARF UNDER DIFFERENT ENERGY LEVELSLOW-VELOCITY IMPACT BEHAVIOR OF COMPOSITES (CRFP) REPAIRED WITH STEPPED SCARF UNDER DIFFERENT ENERGY LEVELS

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Abstract

The effect of low-velocity impact on intact and center-repaired composites was investigated using a structural repair method known as stepped scarf repair. Low-velocity impact tests were conducted on intact and repaired samples using a drop-weight impact testing machine at two energy levels (18J and 30J). The impact response of the repaired laminates was compared to that of the intact composites at each energy level. Furthermore, the impact performance of the tested samples was analyzed by evaluating the contact force, impact duration, and DTL (delamination threshold load). It was observed that the maximum contact force was higher for the repaired samples compared to the intact ones for both energy levels (18J and 30J). Additionally, results indicated that the contact duration for the 18J impact level was longer for the repaired samples than the intact ones, whereas at the 30J level, the intact samples exhibited longer contact durations. Regarding the DTL, the repaired samples consistently demonstrated higher values compared to the intact composites for both energy levels, mirroring the trend observed in contact force.

Keywords: *composite ; stepped scarf repair ; low-velocity impact ; DTL, maximum contact force*

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LOW-VELOCITY IMPACT BEHAVIOR OF COMPOSITES (CRFP) REPAIRED WITH STEPPED SCARF UNDER DIFFERENT ENERGY LEVELS

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Abstract

The effect of low-velocity impact on intact and center-repaired composites was investigated using a structural repair method known as stepped scarf repair. Low-velocity impact tests were conducted on intact and repaired samples using a drop-weight impact testing machine at two energy levels (18J and 30J). The impact response of the repaired laminates was compared to that of the intact composites at each energy level. Furthermore, the impact performance of the tested samples was analyzed by evaluating the contact force, impact duration, and DTL (delamination threshold load). It was observed that the maximum contact force was higher for the repaired samples compared to the intact ones for both energy levels (18J and 30J). Additionally, results indicated that the contact duration for the 18J impact level was longer for the repaired samples than the intact ones, whereas at the 30J level, the intact samples exhibited longer contact durations. Regarding the DTL, the repaired samples consistently demonstrated higher values compared to the intact composites for both energy levels, mirroring the trend observed in contact force.

Keywords: *composite ; stepped scarf repair ; low-velocity impact ; DTL, maximum contact force*

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PHASE STABILITY OF SRALGE COMPOUND WITH ALB2-LIKE STRUCTURE: FIRST PRINCIPLE REINVESTIGATION

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Abstract

In the present research, based on the density functional theory computational approach, we investigate the ground state structure of the SrAlGe superconductor compound through energetic, mechanic and dynamic stability. According to the findings, although the equation of state EOS curves present that the SrPtSb phase, derived from AlB2 structure, is the most stable under conditions of zero pressure reflected by the SrAlGe minimum total energy. The calculated elastic constants indicate SrAlGe is mechanically stable. Moreover, elastic properties including bulk modulus, shear modulus, Young modulus and Poisson's ratio are derived from the obtained single-crystal elastic constants. In an overview of dynamic properties, the detailed analysis of the phonon spectrum deduces a stable configuration with a doubled unit cell and buckled AlGe layers. It allows to show how the experimentally accepted AlB2-like structure of the SrAlGe compound is suggested to be dynamically unstable at 0 K.

Keywords: *SrAlGe, Phase stability, AlB2 structure, ab initio calculation.*

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CO-PRECIPITATION SYNTHESIS, CHARACTERIZATION AND APPLICATIONS OF SPINEL FERRITE NANOPARTICLES.

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Abstract

The synthesis of spinel ferrite nanoparticles is rapidly gaining popularity as a research field, driven by technological interests and their appealing magnetic properties. Spinel ferrites have the general formula MFe2O4, with M representing a divalent metal ion. These compounds exhibit a cubic structure and are utilized across a variety of technological applications. Over the past decade, ferrite nanoparticles have attracted considerable interest due to their high permeability, electrical resistivity, and advantageous electromagnetic properties. Consequently, they are well-suited for numerous applications, including magnetic storage, microwave devices, biosensors, drug delivery, disease diagnosis, gas sensors, energy conversion, photocatalysis, and magnetic separation.

Several studies have been conducted on the preparation of this type of ferrite using various

chemical methods. In this study, NiFe2O4 spinel nickel ferrite was synthesized using the coprecipitation method. The physicochemical properties were characterized through various

analytical techniques, including X-ray diffraction (XRD), differential thermal analysis (DTA), scanning electron microscopy (SEM), and Fourier transform infrared spectroscopy (FTIR).

Nickel ferrite (NiFe2O4) is a significant soft ferrite utilized in various industries, appreciated for its qualities that make it ideal for soft magnetic core materials in power transformers and as a photocatalyst. It possesses low coercivity and high electrochemical stability. Ferrites produced using this method display smaller particle sizes, smooth surfaces, stability, and a homogeneous structure.

Keywords: *NiFe2O41, Spinel2, Co-precipitation3, Photocatalysis4, Magnetic5, Ferrites6.*

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VIBRATION BEHAVIOR ANALYSIS OF NANOCOMPOSITE PLATES REINFORCED WITH CARBON NANOTUBES IN HYGROTHERMAL ENVIRONMENTS

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Abstract

This article investigates the free vibration behavior of functionally graded (FG) carbon nanotubes (CNTs) reinforced composite plates under hygrothermal environment for the first time. In addition to the uniform distribution pattern of CNTs, this paper investigates distinct types of non-uniform or FG distribution patterns of CNTs across the thickness of plates. The effective material properties of the carbon nanotube-reinforced composite (CNTRC) are determined using the extended rule of mixture, considering the temperature and moisture dependencies of the composite constituents. The first-order shear deformation theory (FSDT) is used to derive the coupled hygro-elastic, thermo-elastic relations, as well as the governing equations of the CNTRC plates. These equations are solved using the finite element method. A validation study is carried out to verify the accuracy of the employed approaches. Subsequently, a detailed parametric study is undertaken to thoroughly investigate various parameters on the free vibration behavior of the CNTRC plates. The results reveal that the increase in temperature and moisture leads to a decrease in the effective stiffness of the functionally graded carbon nanotube-reinforced composite (FG-CNTRC) plates.

Keywords: *Free vibration; Nanocomposite; Carbon nanotubes; hygrothermal environments; First-order shear deformation theory*

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CARACTÉRISATION MÉCANIQUE DES JOINTS DE SOUDURE DES MATÉRIAUX DISSEMBLABLES

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Abstract

Dans le présent travail, l'intérêt est porté sur la caractérisation des propriétés mécaniques d'un joint de soudure de deux (02) matériaux dissemblables, en acier duplex et en acier fer- carbone. Les propriétés mécaniques du joint de soudure des 02 matériaux considérés, ont été obtenues à partir des essais de caractérisation prévus pour ces éprouvettes, soient le comportement du joint de soudure à la traction et à la dureté. Une simulation est réalisée par le logiciel ABAQUS, pour modéliser les deux joints de soudures et de la zone affectée thermiquement (ZAT) des deux aciers et le métal d'apport. Des analyses d'observation des deux zones de liaisons (ZAT) à l'échelle microscopique au Microscope Electronique à Balayage (MEB) et macroscopique au Microscope morphologique (MM) ont aussi été faites sur ce joint de soudure. En conclusion, on a enregistré une acceptation de la limite d'élasticité et de la ténacité des éprouvettes réalisées. Les propriétés des joints soudés satisfont les critères d'acceptabilité définies par les normes appliquées au transport des hydrocarbures.

Keywords: *Aciers duplex, aciers dissemblables, Z.A.T de deux aciers différents,soudage hétérogène, caractérisation microstructurale, caractérisation mécanique.*

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NUMERICAL SIMULATION OF DAMAGE TO A CRACKED TURBINE BLADE

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Abstract

The aim of this paper was to presents a identification of dynamic behavior and numerical simulation of damage to a cracked turbine blade. The numerical simulation were carried out on model turbine blade, and the corresponding frequency response functions have been calculate. An initial study into the dynamic loads of this method has been considered, the use of the finite element method makes it possible to develop the model of the blade, the model is used to evaluate the maximal (displacement, strain and stress) and the natural frequencies, mode shapes of blade under damage condition.
The stress should be increased to improve the strength of the blade. The numerical results can provide a reference for analysts and designers of composite material in aeronautical systems.

Keywords: *material, crack, frequency, blade.*

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EXPERIMENTAL STUDY OF MECHANICAL BEHAVIOR IN BENDING, COMPRESSION OF SANDWICH PANELS BASED ON GROOVING PVC FOAM AND GLASS /CARBON FABRIC

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Abstract

Sandwich structures are commonly used in the aerospace and marine industries, in this work, we experimentally discussed the core/skin combination on the mechanical behavior of sandwich structures based on a graduated foam composed of closed PVC cells, with thickness of 5 mm wrapped between two laminates composed of three layers of carbon cloth and glass cloth by different weights, the sandwich plates are produced by vacuum infusion of epoxy resin, folding three and four points, Shear and compression tests are performed according to the methods of current standards

Keywords: *sandwich structures,PVC cells,epoxy resin,carbon,glass.*

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NUMERICAL MODELING OF THE DAMAGE OF A NOTCHED PLATE IN POROUS FGMUSING THE ROUSSELIER MODEL.

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Abstract

The main objective of this work is the numerical modeling of the damage of a plate in the presence of a circular central notch in porous FGM of type metal / ceramic by introducing the elastic-plastic behavior with linear isotropic hardening based on the fraction volume for the constituent materials of the FGM. FGM damage is studied using a new constitutive equation based on continuous damage mechanics. The thermodynamic approach of the damage was treated starting from a model of Rousselier based on a variable of state of damage, introduced in addition to the variable of state of hardening and of the tensor of plastic deformation at the ambient temperature. The Rousselier model modifies the von Mises charge potential by introducing a single quantity of scalar damage, namely the volume fraction of the porosities. Our numerical analysis, based on the density and type of adequate mesh, takes into account all the state variables for the different stages of deformation of the two constituent materials of the FGM and by taking into account the constitutive equations of the constitutive laws. In conclusion, the results of our numerical model compared to those of other Lemaitre-type models and experimental results show a good convergence and that the steps followed in the implementation of our model in ABAQUS present a good reliability and can be used to predict the failure behavior of FGM

Keywords: *PlateFGPM 3D (Functional Graded Porous Materials), The Rousselier model, UMAT and HARD (User Materials), The TTO model.*

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NUMERICAL COMPUTATIONAL OF MAGNETIC FIELD EFFECT ON SYMMETRY BREAKING IN CZ CRYSTAL GROWTH

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Abstract

This study focuses on the numerical investigation of the influence of an external magnetic field on symmetry breaking during crystal growth using the Czochralski (Cz) method. The model incorporates the simultaneous rotation of both the crystal and the crucible to account for their coupled effects on fluid dynamics and thermal distribution. The research explores the interactions between electromagnetic forces, convective fluid motion, and thermal gradients, which are crucial in determining the quality of the grown crystal.

The numerical results demonstrate that the application of a magnetic field significantly alters the hydrodynamic and thermal behaviors within the melt, resulting in noticeable symmetry breaking. This phenomenon affects the uniformity of temperature distribution and the stability of the growth process. Furthermore, the relative rotational velocities of the crystal and crucible are shown to play a pivotal role in mitigating these disturbances, providing a potential means to enhance the stability and homogeneity of the crystal structure.

The findings underscore the importance of optimizing process parameters, such as magnetic field intensity and rotation rates, to minimize structural defects and improve crystal quality. This work contributes to a deeper understanding of the physical mechanisms governing Cz crystal growth under electromagnetic conditions and offers practical insights for refining industrial crystal growth processes

Keywords: *Czochralski (Cz) method, Crystal growth, Magnetic field, Convective flows*

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NUMERICAL SIMULATION OF PIPE DYNAMIC BEHAVIOR WITH CORROSION AREA.

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Abstract

Piping failures and damage are often the first sign of a corrosion problem,when pipeline corrosion is the oxidisation and electrochemical break down of the structure of a pipe,pipelline corrosion occurs on both the inside and outside of any pipe and related structures ,corrosion is a natural process where metal electrochemically reacts with the environment and deteriorates over time. Without regular maintenance and monitoring, this can lead to leaks or even pipeline ruptures.in this work presents a numerical simulation using Abaqus software of peplines we compared the results with a small corrosion present 20% of area under fast pipe and without corrosion area were devolted to detection of frequencies and modes with two model of pipe, the goal to see the seven modes of pipe with and without corrosion

Keywords: *Corrosion,failure,damage,frequencies,the seven modes*

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DAMAGE ANALYSIS ON A CRACKED COMPOSITE HELICOPTER BLADE

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Abstract

The aim of this work is to study the behavior of a cracked helicopter blade, the cracked blade model by finite elements according to the mechanical characteristics of the material and aeroelastic loads is simulated, which allows to identify the aeroelastic stresses according to the rigidity of the fuselage. The control of the crack on the blade under aerodynamic loads is presented. Which allowed highlighting an indicator for monitoring and predicting damage in helicopter blades, the dynamic shock of impacts, clearly showed the variation of mechanical properties, natural frequency, rigidity and damping factor under the influence of crack propagation

Keywords: *blade, composite, crack, damage.*

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DYNAMIC BEHAVIOR OF ROTATING MACHINERY USING THE BOND GRAPH MODEL

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Abstract

This paper concerns the identification and evaluation of the dynamic behavior of rotating machines by bond graph, the developed model allows simulating some physical and aerodynamic phenomena. A finite element model has been developed to characterize the vibration behavior of the rotor of a rotating machine, this model allows to determine the instabilities and to extract the responses in transient regime, a dynamic unbalance is imposed on the structure in the presence of gyroscopic effects to numerically simulate the resonance, the bond graph model allows to diagnose the global state of the rotor through the resonance

Keywords: *bond graph, instability, finite elements, rotating machinery.*

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COMPARATIVE STUDY OF CUTTING FORCE IN THE HARD AND CONVENTIONAL TURNING OF 100CR6 STEEL

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Abstract

Cutting force is the important factor in determining the physical machining situation, from which the evolution of other factors can be predicted, notably cutting temperature, tool wear, machined surface roughness and consequently product quality. Variation in cutting parameters has an intensive influence on the evolution of cutting force during the turning operation. The present work aims to study the influence of cutting conditions, respectively cutting speed, feed rate and depth of cut, on the evolution of cutting force components Fa, Fr and Fv in hard and conventional turning, taking into account the machining of 100Cr6 bearing steel before and after hardening to 60 HRC with a CC650 ceramic insert cutting tool, based on a unifactorial expérimental design. Comparative processing of curves summarizing trends in numerical results has enabled us to determine the evolution of cutting force as a function of cutting conditions in hard and conventional turning. The various models expressing the relationship between machining parameters and cutting force components were determined. Finally, an analysis of the results was conducted, revealing that the depth of cut is the most significant factor influencing cutting force. Consequently, cutting force components are generally lower in hard turning compared to conventional processes.

Keywords: *Hard turning; Cutting parameters; Cutting force; 100Cr6; Ceramic insert.*

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EFFECT OF THE FORM THE AXIS ON SHRINK-FIT ASSEMBLY COHESION

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Abstract

One of the greatest mechanical assembly techniques is shrink-fit assembly because of its superior economics. All that is required is the axis and hub. It is used in many different industries, such as the production of cars, trains, and airplanes. The "interference" between the two cylinders is the result of the axis's inner diameter being larger than the hub's outer diameter in this action. There are three ways to accomplish this: first, by heating the outer cylinder to cause it to expand; second, by cooling the inner cylinder to cause it to contract; and third, by pressing the assembly to completion.. At the point where the two matched components meet, it generates frictional force and contact pressure. In this article, we study a comparison between two chrink-fit assemblies, one in the case of a full axis and the other in the case of a hollow axis, to see whether the form in the axis (cavitation) can have a positive effect or not, in simulation using the finite element method.

Keywords: *Interference, Form defect, Shrink-fit, Stresses, Plasticity*

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CALCULATING STRESSES AND STRAINS USING SIMPLIFIED EQUATIONS

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Abstract

Reduced body weight For many years, assemblies have been utilized to give wooden wheels a more durable running surface. The two components are often conical or cylindrical. Nowadays, shrink-fit is a cost-effective procedure that only requires making contact between two cylinders; no third parties are involved. It is used in many different industries, including as train wheels, oil and gas, aircraft, and automobiles. The inner cylinder's outer radius must be greater than the outer cylinder's inner radius in order to accomplish this action; this discrepancy is known as "interference," and it is significant in the assembly since it helps to raise the resistance of the whole thing. There are three methods for doing this: first, the outer cylinder is heated until it expands; second, the inner cylinder is cooled until it contracts; and third, the fitting is realized under a press. A contact pressure and friction force are produced at the interface between two identical cylindrical components when they are joined by pushing or shrinking one onto the other. This study examines a shrink-fit assembly consisting of two hollow cylinders, one of which is subject to internal pressure. After ignoring interference, we compare the outcomes of numerical simulations using the finite element method with the simplified equations for radial, hoop, and Von-Mises stress and strain. This is to show that when the interference is very tiny, simplified equations can be used in some circumstances.

Keywords: *Radial stress, Hoop stress, Strain, Interference, Shrink-fit.*

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PREDICTION OF PART MACHINING STABILITY USING A VARIABLE PITCH TOOL TAKING INTO ACCOUNT THE VARIATION OF DYNAMIC CHARACTERISTICS

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Abstract

During the milling operation, the machining system is affected by chatter resulting from the dynamic interaction between the workpiece and the tool, which can have detrimental effects on the cutting edges and the machined surface of the piece. Chatter occurs more frequently when the part is thin due to their low rigidity. This article studies the milling stability of Al 7075-T6 parts during milling taking into account the variation of dynamic characteristics and develops stability lobe diagrams and cutting forces, using a step tool variable. The Euler method is used to solve the equations of motion.

Keywords: *Stability lobe diagram • Variable pitch tool • Dynamic characteristics• Euler method*

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RBDO COMPARATIVE STUDY: ANALYZING RIA VS. PMA METHODOLOGIES IN MECHANICAL SYSTEMS

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Abstract

This study presents a comparative analysis of two well-recognized robust engineering approaches — the Reliability Index Approach (RIA) and the Performance Measure Approach (PMA) — applied to the optimization of Golinski speed reducers problem, a critical component frequently involved in optimization challenges within mechanical systems. These components, crucial in various mechanical systems, often face performance issues due to fluctuating conditions and uncertain parameters and factors. By integrating both RIA and PMA, this research aims to enhance the reliability and efficiency of speed reducers, while mitigating risks and improving system durability. The results indicate that for this benchmark, PMA outperforms RIA by a significant 40%. However, a key limitation of RIA is its sensitivity to the starting points of the algorithm, unlike PMA, which is much less affected by this factor. This highlights the need for further investigation into the influence of starting points and the non convergence issue on the effectiveness of both methods.

Keywords: *[RIA, PMA, Golinski Speed Reducer,RBDO, Mechanical Engineering]*

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INFLUENCE OF NODE NUMBER ON HEAT EQUATION SOLUTION : ACOMPARISON BETWEEN FINIT DIFFERENCE AND FINIT ELEMENT METHODS

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Abstract

This study investigates the impact of node number on the numerical solution of the heat equation using both the Finite Difference Method (FDM) and the Finite Element Method (FEM). The heat equation, a fundamental partial differential equation in thermal analysis, is solved under varying node densities to assess how the number of nodes influences solution accuracy, convergence, and computational efficiency in both methods. A comparative analysis is performed, highlighting the strengths and limitations of FDM and FEM in terms of precision and computational cost as the grid or mesh resolution increases. Results
show that while FDM offers simplicity and efficiency in structured grids, FEM provides greater flexibility for complex geometries but at the cost of higher computational demands. This study emphasizes the importance of selecting an appropriate node density and numerical method based on the specific requirements of the thermal problem being solved.

Keywords: *Numerical methods , Finit difference method , Finit element method , Heat equation*

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NUMERICAL SOLUTION OF THE AXISYMMETRIC INDENTATION PROBLEM FOR A MULTI-LAYERED ELASTIC MEDIUM

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Abstract

Contact mechanics being of great practical importance, it can be applied in various engineering sectors, such as roadways, airport runways, foundations, cylindrical mills, silos, and fuel oil tanks. Indeed, it interacts with mechanics, friction, and materials behavior. The Finite Element Method has been frequently used in solution of complex problems to simple sub-problems, which occur in solid mechanics, heat transfer and electrical systems, etc. In this context, a computer simulation method contact problems within the Finite Element Method based software called ABAQUS have been brought up for paper. A multi-layer partially supported on a rigid circular base is compressed along the upper surface by means of a rigid stamp is studied numerically. The layers are assumed to be homogeneous with a linear isotropic elastic behavior. It is assumed that the all contact surfaces are frictionless. Evaluation of the Von-Misses stress, normal stress and vertical displacement are determined. Additionally, we examine the influence of the layers thickness and the radius of the rigid base on these physical quantities.

Keywords: *Indentation, Multi-layer, Rigid base, Finite Element Method, ABAQUS.*

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FINITE ELEMENT STUDIES OF AXISYMMETRIC CONTACT PROBLEM FOR AN ELASTIC LAYER ON TWO RIGID BASES COMPRESSED BY A RIGID STAMP

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Abstract

Contact phenomena are abundant in everyday life and play a very important role in engineering structures and systems. These phenomena include friction, wear, adhesion and lubrication, among other things. They inherently complex and time dependent, taking place on the outer surfaces of parts and components and involving thermal, physical and chemical processes. The contact problems in solid mechanics involving an elastic layer lying on an elastic half-plane, elastic and rigid foundation have been very widely studied because of its possible application to a variety of structures of practical interest. Foundation grillages, pavements of highway and airfield, railways ballast, ball and roller bearings are some of the application areas of the contact mechanics. The numerical method is applied to the frictionless contact problem of an elastic layer partially reposing on a two rigid circular bases, and is indented along the upper surface with a rigid stamp. For this aim, two-dimensional analysis has been performed using Finite Element Method based software called ABAQUS. The distribution of the Von-Misses stress, the normal stress and the vertical displacement are obtained. Significant effect of the layer thickness on these physical quantities is demonstrated.

Keywords: *Contact mechanic, Elastic layer, Two rigid bases, Rigid stamp, Finite Element Method.*

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BOX-BEHNKEN OPTIMIZATION OF PARAMETERS INFLUENCING SURFACE STATE

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Abstract

The aim of this work is to optimize the geometric, metallurgical and mechanical properties, namely surface finish, wear resistance and surface hardening of mechanical parts made from AISI 1010 steel using the tribofinishing process.

With the application of box-Behnken experimental designs to model arithmetic mean roughness Ra and microhardness HV as a function of various influential factors, namely treatment time, frequency and amplitude.

Statistical analysis of the results obtained in numerical form (coefficient of determination R2, alpha level, Fisher's test, Student's F test), and graphically (contour plot, response surface and optimization diagram) using Minitab version 16 software helps us to analyze the influence of the above parameters and their degrees of influence.

Keywords: *Tribofinishing process, Roughness Ra, Wear, Micro hardness HV, Design of experiments*

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OPTIMIZATION OF SURFACE ROUGHNESS, TOOL WEAR AND MATERIAL REMOVAL RATE USING MCDM AND TAGUCHI MONO-OBJECTIVE OPTIMIZATION IN THE HARD TURNING PROCESS

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Abstract

Industrialists and researchers are primarily interested in increasing productivity, enhancing the durability of cutting tools, and improving the quality of machined surfaces. Our goal is to meet industrial requirements while maintaining a balance between increased production, machined surface quality, and cutting tool wear resistance. We carried out a study to evaluate the performance parameters Ra, VB, and MRR during hard turning of AISI 4140 steel, taking into account the cutting conditions and cutting tool material. The experiments are carried out following the Taguchi L9 design with four factors, namely cutting speed (Vc), feed rate (f), depth of cut (Doc), and cutting tool materials. We used the analysis of variance (ANOVA) to examine the relationship between the input parameters and the dependent output variables. Regression analysis was used to develop mathematical models of the different outputs. Then, an MCDM optimization based on the signal-to-noise of Taguchi, was used to determine the optimal cutting regimes that minimize Ra and VB and maximize MRR. According to the ANOVA, the most influential factors on Ra are (f) and (Vc), whereas for the wear VB, all factors are significant, with cutting velocity dominating. The optimization results maintained the following regimes for both MCDM methods: M1, Vc1 f1. The depth of cut varies, with ap being 0.1 mm and 0.2 mm. Whereas the Taguchi approach recommends the regimes (M2, Vc1, f1, ap3), (Vc1, f1 and ap1), and (Vc3, f3, ap3) for the minimization of Ra and VB and the maximization of MRR, respectively.

Keywords: *Hard machining, Ceramic, Wear, Roughness, MCDM Optimization, Taguchi*

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DESIGN AND DEVELOPMENT OF A NOVEL TESTING DEVICE FOR CONCRETE TENSILE STRENGTH

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Abstract

Tensile strength of concrete is an important parameter involved in the design and durability of concrete structures. The present paper is devoted to design and fabricate a novel testing device for determining the direct tensile strength of concrete. The testing device (called here in this work the load coverting device) was developed and fabricated for use with universal compression testing machines that are typically available in civil engineering laboratories worldwide. The concept involves converting compressive loads applied by the machine into tensile stresses on the specimen. In this study, an ordinary concrete mixture was used for preparation of specimens. The mix was made of cement, gravel, sand and water. In addition, indirect standard tensile tests (flexural and splitting tensile tests) were conducted to verify the reliability of the testing device. The results are quite encouraging and show that the tensile strengths obtained are close to those from splitting tests and lower than those from flexural tests.

Keywords: *Tensile strength, testing device, compression testing machine, indirect tensile tests.*

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TOPOLOGY OPTIMIZATION AND FATIGUE LIFE PREDICTION OF A DOUBLE-EDGED BLADE FOR A SINGLE-SHAFT SHREDDER.

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Abstract

This article presents a comprehensive study on the topology optimization and fatigue life prediction of a double-edged blade used in a single-shaft shredder. The objective is to enhance the performance and durability of the blade while reducing material usage. The analysis is conducted using the ANSYS finite element analysis software. Topology optimization is employed to determine the optimal distribution of material within the blade structure, with the aim of minimizing strain energy and increasing overall strength. Fatigue life prediction is a critical aspect of this study. By simulating the cyclic loading conditions that the blade is subjected to during shredding operations, the article provides insights into the expected fatigue life of the optimized blade designs. The results show that the topology-optimized blades maintain their structural integrity and fatigue resistance, indicating the feasibility of material savings without compromising performance. The combination of topology optimization and fatigue life prediction offers a valuable approach to designing cost-effective, high-performance shredder blades. The findings of this study can have a significant impact on the shredder manufacturing industry, as it demonstrates the potential for substantial material savings while ensuring product reliability.

Keywords: *Plastic Shredder Machine; Double Edged Blade; ANSYS Workbench; Static Analysis; Topology Optimization; Fatigue life.*

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CONTRIBUTION TO THE PROGNOSIS OF BEARING FAULTS THROUGH CYCLIC ANALYSIS OF THE REMAINING USEFUL LIFE (RUL)

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Abstract

Prognostics has been a major force in manufacturing preventive maintenance over the past few decades. It typically entails calculating mechanical systems' Time to Failure (TTF) or Remaining Useful Life (RUL). The analysis in prognosis may frequently be solely based on data (Trend Analysis). It has the dual advantages of being applicable in a wide range of systems and being reasonably accurate, but it also necessitates a large data set. The published works show that trend analysis is typically the most widely used prognostic approach, particularly for bearing fault.

Given the little amount of run-to-failure data and the fact that the Bearings' properties are appropriate for the development of a degradation model, we adopted the "Threshold Data" technique in this research. Furthermore, the goal of this work is to demonstrate that cyclic monitoring can accurately track degradation and estimate the RUL for the bearing defect while maintaining data integrity. To create a degradation model, first various filters are examined, and then Principal Component Analysis (PCA) and Model Fitting are used. In the end, we were able to calculate the bearing's RUL cyclically, demonstrating precise forecasts for every stage of its life till failure.

Keywords: *Prognosis, Preventive Maintenance, Remaining Useful Life , Bearings*

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IMPLICIT TIME INTEGRATION APPROACH FOR THE NONLINEAR DYNAMIC ANALYSIS OF 3D GEOMETRICALLY EXACT BEAM MODEL

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Abstract

In this work, we extended the schemes for 2D beams to 3D cases. This task is far from obvious because of the nature of rotations. In the proposed integration scheme, an exponential map with incremental rotation is used to update the rotation matrix where the angular velocities are updated in the same way as the translational velocities. This procedure provides a remarkable simplification in implementing a finite element code compared to previous approaches. In addition, the orthogonality of the rotation matrix at the midpoint is ensured which increases its accuracy. The main idea behind the construction of this new scheme is to apply the midpoint approximation scheme on kinematic variables and deformation quantities. This idea was first proposed by (Gams et al,2007) for the conservation scheme of a geometrically exact 2D beam. (Mamouri et al,2016) added dissipation to this scheme and recently (Chhang et al,2017) applied the same idea to a 2D co-rotating beam. Several numerical simulations are presented to illustrate the performance of overall stability and robustness of the proposed schemes.

Keywords: *geometrically exact beam, conserving energy, decay energy, Nonlinear dynamics, Cayley transformation, exponential map*

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ANALYSIS OF NATURAL FREQUENCIES IN FLUID-STRUCTURE INTERACTION: COUPLING IN A CYLINDRICAL PIPE UNDER LAMINAR FLOW CONDITIONS USING HAMILTON'S PRINCIPLE

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Abstract

We study the influence of the fluid on the structure in vibration between the fluid and the structure of a circular section cylinder, governed by the phenomenon of fluid-structure interaction in a conditioned flow of laminar and incompressible nature in the form of the macrostructure. These two phenomena are linked by the mechanical relationships of stresses according to displacements, modeled by a cylinder. The analysis of the vibrations of fluid-filled cylinders is studied with the limiting conditions of the fluid and the solid, with the coupling conditioned by its action-reaction force limits. The problem of the cylindrical pipe is formulated by deriving the deformation and kinetic energies of the vibrating cylinder and its fluid to obtain different natural frequencies. We use Hamilton's principle to transform the problem into the expression of the cylindrical differential equation, which gives three displacement functions in a system of partial differential equations in cylindrical coordinates of circular section, meeting the limiting conditions imposed at both ends. We apply the Navier-Stokes equation in cylindrical coordinates, with the fluid continuity equation, for the solid mechanical behavior equation of stresses in terms of displacement by strain. To obtain the results of natural frequencies, we use the Galerkin method for the solid and for the fluid with Galerkin-Time.

Keywords: *Fluid-Structure Interaction (FSI), Hierarchical Finite Element Method (HFEM), Natural Frequencies, Laminar Flow, Vibrational Analysis*

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TRANSFORMER FAULT DIAGNOSIS USING VIBRO-ACOUSTIC MONITORING

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Abstract

The electrical transformer is an essential and costly component of the electrical grid, both in terms of production and upkeep. Industries closely monitor variables that impact transformer condition and identify challenges in order to assure the uninterrupted distribution and transmission of electrical power. We propose a technique in this paper for keeping monitors on transformer conditions during an inter-turn short circuit fault. We examine the effects of vibrations caused by the movement of the transformer windings under high currents resulting from this kind of fault using simulations built on the COMSOL software. The analysis of the acoustic waves captured in the external environment of the transformer is the primary objective of the study. Monitoring changes in vibro-acoustic frequencies proves to be an effective method for detecting faults before they worsen and lead to transformer failure. The fault influences the vibrations' intensity, and the results indicate that the applied load also has an impact on vibro-acoustics. Between a functional transformer and one that has a defect, there is a noticeable difference in the intensity variation of the sound that propagates. When there is a fault, the defect causes the vibration rate to increase. These results point to a bright future for acoustic vibration sensing-based transformer diagnostic methods.

Keywords: *Transformer Diagnosis1, Vibro-acoustic Monitoring2, Inter-turn Short Circuit Fault3, COMSOL Simulation4.*

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STUDY OF THE EVOLUTION OF SPUR GEAR DEFECTS ON DYNAMIC BEHAVIOR

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Abstract

The importance of vibration analysis in industrial equipment maintenance is indisputable. This technique is crucial to ensuring the smooth operation of rotating machines, bearings, gears and other critical equipment. Vibration analysis can detect early signs of failure, helping maintenance teams to take preventive action, thereby reducing unplanned downtime and repair costs.

In our work, we used the vibration analysis method applied to spur gears under test, using two diagnostic and monitoring tools, with the aim of obtaining spalling along the entire length of the tooth and assessing the degree of deterioration.

Keywords: *vibration analysis; diagnosis; surveillance*

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SCRATCH TEST MULTILAYER FILM RESPONSE: UNDERSTANDING FAILURE MECHANISMS UNDER ABRASIVE CONTACT

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Abstract

In order to understand the behavior of thin films formed from multilayers of transition metals during abrasion contact, single-pass scratching tests at increasing loads were carried out on two TiN/CrN multilayer coatings with different numbers of interfaces, which were deposited by reactive magnetron sputtering. This study aims to comprehensively investigate the effects of multilayer architecture on the coating wear behavior. The scratch tests were performed with a Rockwell C diamond tip having a radius of 200 µm and a cone angle of 120°, using a "scratch tester Milinium 200", monitored by acoustic emission. The samples were scratch tested at an initial normal load of 1 N, which was gradually increased to a final load of 21 N at a loading ratio of 10 N/mm. The critical loads corresponding to damage mechanism evolutions and the scratch track morphologies were provided by load diagrams and validated by optical microscopy. The damage mechanisms on the multilayer coating scratch tracks were essentially identified as spallation and buckling modes. Indeed, a series of microscopic deformations and fracture mechanisms were observed and formed the overall material response of the coating/substrate system. As the scratching depth increases, tensile cracking in the scratch track makes progress to the radial and lateral crack's propagation and coating spallation. The coating with a high number of interfaces showed the highest critical loads, Lc1 ~ 4.3 N and Lc2 ~ 7.11 N, which is consistent with its improved mechanical properties. This demonstrates its good toughness compared to the coating deposited with fewer interfaces. Due to the better interaction of dislocations in the multilayers oriented along the (200) planes, cracking was stopped at the different interfaces (300 interfaces), and delamination occurred in the upper layers of the multilayer coatings.

Keywords: *Multilayer coating; Failure mechanisms; Scratch test; Toughness.*

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ANALYSIS OF NATURAL FREQUENCIES IN FLUID-STRUCTURE INTERACTION: COUPLING IN A CYLINDRICAL PIPE UNDER LAMINAR FLOW CONDITIONS USING HAMILTON'S PRINCIPLE

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Abstract

We study the influence of the fluid on the structure in vibration between the fluid and the structure of a circular section cylinder, governed by the phenomenon of fluid-structure interaction in a conditioned flow of laminar and incompressible nature in the form of the macrostructure. These two phenomena are linked by the mechanical relationships of stresses according to displacements, modeled by a cylinder. The analysis of the vibrations of fluid-filled cylinders is studied with the limiting conditions of the fluid and the solid, with the coupling conditioned by its action-reaction force limits. The problem of the cylindrical pipe is formulated by deriving the deformation and kinetic energies of the vibrating cylinder and its fluid to obtain different natural frequencies. We use Hamilton's principle to transform the problem into the expression of the cylindrical differential equation, which gives three displacement functions in a system of partial differential equations in cylindrical coordinates of circular section, meeting the limiting conditions imposed at both ends. We apply the Navier-Stokes equation in cylindrical coordinates, with the fluid continuity equation, for the solid mechanical behavior equation of stresses in terms of displacement by strain. To obtain the results of natural frequencies, we use the Galerkin method for the solid and for the fluid with Galerkin-Time.

Keywords: *Fluid-Structure Interaction (FSI), Hierarchical Finite Element Method (HFEM), Natural Frequencies, Laminar Flow, Vibrational Analysis*

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COMPARATIVE STUDY OF CIRCULAR AND ELLIPTICAL HYDRODYNAMIC BEARINGS WITH MISALIGNMENT EFFECT

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Abstract

This study numerically compares the performance of circular and elliptical hydrodynamic journal bearings in the presence of misalignment. A finite element method, applied to the Reynolds equation, was used to analyse the influence of variations in load, speed and misalignment angle on the main characteristics of these bearings. The results show that elliptical bearings are clearly superior to circular bearings under misalignment conditions. Specifically, the minimum film thickness of the elliptical bearings was approximately 10.56% greater than that of the circular bearings for the maximum misalignment tested. In addition, the maximum pressure of the elliptical bearings was 2.7% higher than that of the circular bearings under misalignment conditions, while under perfect alignment conditions it was 4.8% higher.

Keywords: *hydrodynamic bearing, circular bearing, elliptical bearing, misalignment*

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DESIGN PARAMETERS AND DYNAMIC ANALYSIS OF A NOVEL HIGH-PERFORMANCE TUNED MASS DAMPER WITH GROUNDED NEGATIVE STIFFNESS FOR VIBRATION CONTROL OF DAMPED PRIMARY SYSTEMS

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Abstract

In this present paper, a mini-max optimal design of a non-traditional Tuned Mass Damper with negative stiffness (NTNS-TMD) for damped primary structures is investigated to reduce high amplitudes in the resonant range of vibrations. The differential equation is formulated and the analytical solution of the system is derived. Using the principles of fixed-point theory, the closed-form solution for the optimal tuning coefficient is analytically obtained. Then, the optimal damping ratio and the optimal negative stiffness parameter of the proposed non-traditional TMD with negative stiffness are determined numerically by solving a set of nonlinear equations established using Chebyshev's equioscillation theorem. Extended simulations are conducted to examine the effectiveness of the optimally designed NTNS-TMD and the sensitivity of the optimal parameters. Finally, the vibration control performance of the proposed configuration is compared with those of two typical TMDs, which were presented by Liu and Pennestri, respectively. The comparison results demonstrate that the non-traditional TMD with negative stiffness significantly enhances vibration control by reducing the dynamic magnification response of damped primary structures and confining the normalized TMD stroke.

Keywords: *Non-Traditional TMD, Damped primary system, Dynamic response mitigation, Mini-Max Optimization, Negative stiffness, Stroke length*

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ANALYSIS OF THE VIBRATORY BEHAVIOR OF AN FGM BLADE USING THE FINITE ELEMENT METHOD

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Abstract

In this reason our work based on the choice of materials to ensure a long service life of turbine blades have been discussed. For a turbine blade, mechanical and thermal strength properties are required on the toughness and low-temperature side. To meet these advantages, new gradation designs in functional gradient material (FGM) with a UMM meshing method that presents a gradation properties such as mechanical strength according to the power law were also discussed. In this research, the analysis of an FGM blade under mechanical and vibratory loads was studied, in order to compare the maximum von Mises stresses for the different alloys and FGM and vibration modes. A fatigue analysis using the ABAQUS finite element code was carried out over the lifetime of the FGM blade

Keywords: *Keywords: Blade, FGM, Crack, Vibration, Meshing technique.*

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STUDY OF THE BEHAVIOUR OF THE BALLASTED VEHICLE-RAIL-TRACK INTERACTION

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Abstract

The railway sector is highly varied and sometimes a little complex, but it is not a mystery in itself. To obtain results, however, it is essential to have a good understanding of the interactions that govern it. However, vehicle-track-ballast interaction remains one of the most complex interactions.

To this end, in order to guarantee the stability and safety of railway infrastructure subjected to forces that vary over time. It is very important to understand the dynamic behaviour of the elements of the wheel-rail-undercarriage-sleeper system (wheel-rail-sole-sleeper system). This behaviour can be described using the equations of motion (time differential equations) of each element, taking into account the interactions between the different elements.

By combining the differential equations of each component, a general temporal equation is formulated to represent the model of the wheel-rail-sole-tie bar system subjected to vertical and lateral dynamic loads.

Due to the complexity of solving this general equation, it is transformed into a Fourier equation in the frequency domain, which facilitates the process of solving the problem of interaction between the wheel-rail-sole-sleeper system. The displacements, deformations and reactions of the sleeper to dynamic forces can also be determined.

Keywords: *Interaction -wheel- ballast track; Sole; sleeper; Dynamic loads; Reactions; displacements*

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COMPARATIVE FAULT DIAGNOSIS OF ROLLING ELEMENT BEARINGS USING EEMD-SVM AND DWPT-SVM: A STUDY ON ARTIFICIAL AND REAL DAMAGES

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Abstract

Accurate fault identification in rolling element bearings is essential for the reliability of rotating machinery. This study presents a comparative evaluation of two signal decomposition methods: Ensemble Empirical Mode Decomposition (EEMD) and Discrete Wavelet Packet Transform (DWPT), combined with Support Vector Machine (SVM) classification, and Principal Component Analysis (PCA) for dimensionality reduction, applied to vibration signals from a test rig. The dataset includes both artificial and real damages on the inner and outer rings of ball bearings. Bearings with eight rolling elements and similar geometrical sizes were used, ensuring minimal variations in characteristic kinematic frequencies.

Artificial damages were manually introduced using machining tools, while real damages were generated through an accelerated lifetime test apparatus. EEMD and DWPT were employed to decompose the vibration signals into relevant features, followed by PCA to reduce the dimensionality of the feature space and improve classification efficiency. These features were subsequently classified using an SVM model. A comprehensive comparison of the performance of the EEMD-SVM and DWPT-SVM models was conducted in terms of classification accuracy, highlighting their ability to detect and classify faults based on the signal characteristics of artificial and real bearing damages.

The results demonstrate that while both methods achieve high classification accuracy, the EEMD-SVM model outperforms DWPT-SVM in handling complex non-stationary signals, particularly for real damages. The integration of PCA further enhances the computational efficiency of the fault diagnosis process. This study provides a robust framework for bearing fault diagnosis and contributes to developing more reliable condition monitoring systems in industrial applications.

Keywords: *Bearing fault diagnosis, Ensemble Empirical Mode Decomposition (EEMD), Discrete Wavelet Packet Transform (DWPT), Principal Component Analysis (PCA), Support Vector Machine (SVM).*

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INFLUENCE OF MATERIAL AND GEOMETRIC PROPERTIES ON THE TRANSIENT RESPONSE OF TAPERED FGPM BEAMS

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Abstract

This work presents a transient analysis of a non-uniform tapered Functionally Graded Piezoelectric Material (FGPM) beam subjected to harmonic electrical loading. The equations of motion are derived using Timoshenko's beam theory and Hamilton's principle, with Rayleigh damping incorporated. A finite element model was developed, and the solution was obtained using the NEWMARK method via ANSYS software. The FGPM beam, modeled as a cantilever with the piezoelectric layer divided into ten independent actuators, was subjected to a parametric study to investigate the effects of geometric parameters (taper ratio α = 0.1, 0.3, 0.6 and polynomial degree N = 1, 3, 5) and material parameters (power law index n = 0, 1.5, 6) on its time-domain response. The results show that as the polynomial degree and taper ratio increase, the displacement response shifts to larger time values. Specifically, for α = 0.1, the tip displacement decreases with increasing polynomial degree, regardless of the power law index. For N = 5 and n = 0, the displacement amplitude decreases as α increases, whereas for n ≥ 1.5, the amplitude increases with α. Optimization results indicate the smallest displacement amplitude occurs with n = 0, α = 0.1, and N = 5, while the largest amplitude is observed with n = 0, α = 0.1, and N = 1. This model can be effectively applied to optimize unimorph actuators for active vibration control in practical systems.

Keywords: *Tapered beam, time domain analysis, FGPM, Finite element method, tip displacement*

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ACTIVE VIBRATION CONTROL OF A TAPERED FGPM UNIMORPH BEAM USING FEEDBACK CONTROLLER: FINITE ELEMENT MODELING AND OPTIMIZATION

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Abstract

This study focuses on the active vibration control of a FGPM (Functionally Graded Piezoelectric Material) unimorph tapered beam using a PID (Proportional-Integral-Derivative) controller. A finite element model of the beam was developed. We consider the structure as a clamped-free non-uniform tapered FGPM beam functioning as an actuator. The substructure consists of FGM layers, while the top layer is made of piezoelectric material. The equations of motion were derived based on Hamilton's principle, incorporating Rayleigh damping. The solution was obtained using the Newmark method. After introducing and validating the beam model, a feedback control system was implemented, utilizing a computational code developed in ANSYS APDL for parameter adjustment. To evaluate the effectiveness of different control strategies, the beam was subjected to a harmonic disturbance force applied to the piezoelectric patches and analyzed under various configurations of PID, PI (Proportional-Integral), and PD (Proportional-Derivative) controllers. The results demonstrated that both the PD and PID controllers provided superior vibration suppression compared to the PI controller, with amplitude reductions of 17.72% for both PD and PID, and 17.58% for PI. Further optimization of the PD controller parameters revealed that increasing the proportional gain (Kp) from 10000 to 78000 and the derivative gain (Kd) from 10 to 200 resulted in significant vibration reduction. Specifically, the transient response amplitude was reduced by 51.99% for Kp = 78000 and Kd = 200. The model offers a solid foundation for designing unimorph actuators for real-world applications, such as active vibration control in aerospace and mechanical systems.

Keywords: *FGPM; tapered beam; active vibration control; feedback controller; finite element modeling*

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PGD-TYPE MODEL REDUCTION FOR THE ANALYSIS OF AN ELLIPTICAL BORE JOURNAL BEARING

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Abstract

In this research, two studies are presented. The first is the development of the PGD (Proper Generalized Decomposition) model, one of the a priori reduced-order approximations that requires no prior knowledge of the solution and is based on the assumption of a distinct form of the unknown field variable. This model is applied to solve the Reynolds equation in order to obtain the pressure distribution on the elliptical bearing and its characteristic performances (load capacity, friction torque, friction coefficient). The current model was validated by comparing the pressure and film thickness with published literature results and the discretized model (FDM) with over-relaxation. The calculation program was performed using Matlab R2020a. The second part analyzes the effects of ellipticity variation and the eccentricity ratio on operating characteristics.

The results obtained demonstrate the performance of PGD in terms of computation time. In addition, the results show that increasing the ellipticity ratio leads to an increase in film thickness and pressure distribution, resulting in a reduction in load capacity and frictional torque while increasing the coefficient of friction. On the other hand, maximum pressure, load capacity, and frictional torque increase with increasing eccentricity ratio.

Keywords: *Proper generalized decomposition PGD, Elliptic Bore, journal Bearing, Reynolds equation, Hydrodynamic lubrication.*

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PGD-TYPE MODEL REDUCTION FOR THE ANALYSIS OF AN ELLIPTICAL BORE JOURNAL BEARING

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Abstract

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PGD-TYPE MODEL REDUCTION FOR THE ANALYSIS OF AN ELLIPTICAL BORE JOURNAL BEARING

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Abstract

In this research, two studies are presented. The first is the development of the PGD (Proper Generalized Decomposition) model, one of the a priori reduced-order approximations that requires no prior knowledge of the solution and is based on the assumption of a distinct form of the unknown field variable. This model is applied to solve the Reynolds equation in order to obtain the pressure distribution on the elliptical bearing and its characteristic performances (load capacity, friction torque, friction coefficient). The current model was validated by comparing the pressure and film thickness with published literature results and the discretized model (FDM) with over-relaxation. The calculation program was performed using Matlab R2020a. The second part analyzes the effects of ellipticity variation and the eccentricity ratio on operating characteristics.
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Keywords: *Proper generalized decomposition PGD, Elliptic Bore, journal Bearing, Reynolds equation, Hydrodynamic lubrication.*

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MAINTAINING THE INTEGRITY OF CARBON STEEL, X70 IN HYDROCHLORIC ACID MEDIUM USING ANIONIC SURFACTANTS AS CORROSION INHIBITORS

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Abstract

Carbon steels are widely used in various industries, particularly in the oil and gas sector. However, their performance is significantly compromised in acidic environments due to corrosion, which leads to substantial costs and poses risks to structural integrity. The corrosion process is particularly accelerated by strong acids, such as sulfuric and hydrochloric acids, resulting in material degradation and safety issues. Therefore, the implementation of effective long-term protective measures is essential. A common approach to mitigate corrosion is the use of corrosion inhibitors, which are favored for their effectiveness and ease of application. Among these, petroleum sulfonates (PS), classified as anionic surfactants, and are frequently employed due to their cost-effectiveness and performance in corrosion inhibition.

In this study, petroleum sulfonates (PS) were investigated as corrosion inhibitors for API5L, X70 carbon steel in a 1M hydrochloric acid solution at 30°C using weight loss measurements. These anionic surfactants were synthesized from petroleum products through sulfonation with sulfuric acid and characterized using spectroscopic analyses. The results indicated that 700 ppm of PS provided a corrosion inhibition efficiency of 69.76% after one hour of exposure. This study demonstrates the high effectiveness of petroleum-derived anionic surfactants in mitigating carbon steel corrosion in acidic environments.

Keywords: *Inhibition of corrosion, carbon steel, petroleum sulfonates, hydrochloric solution, weight loss.*

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ANALYSIS OF THE EFFECT OF GEOMETRIC MODIFICATIONS OF THE PLATE AND ADHESIVE ON THE MECHANICAL BEHAVIOR OF A SINGLE LAP JOINT

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Abstract

Since the development of new structural adhesives, their use has expanded to numerous applications across various industrial sectors, including aerospace, sports, civil engineering, and more. Adhesive bonding has rapidly evolved to compete with traditional assembly methods such as riveting, bolting, and welding, due to its advantages in terms of resistance under different loads, absence of stress concentration zones, ease of disassembly, and more. The strength of a bonded joint largely depends on the choice of adhesive in relation to the nature of the substrates and/or mechanical stresses. However, adhesives often exhibit high-stress concentration zones at their edges. The major challenge for researchers is to reduce these stress concentrations in those areas. Numerous approaches have been explored to address this issue through geometric or material optimization of the plate and the adhesive.

Our work aligns with this context, aiming to analyze, using the finite element method, the mechanical behavior of a single lap joint while proposing geometric modifications to the two substrates (such as plate tapering and adhesive fillet) to minimize high-stress concentrations in the adhesive joint, thereby enhancing the joint's strength. Through the analysis of different stresses within the adhesive joint, the results clearly demonstrate that the proposed geometric modifications are directly related to the overlap length. When the overlap length is well optimized, the modifications made to the plate and the adhesive result in a significant reduction of various stresses.

Keywords: *Plate tapering, Adhesive fillet, Overlap length, Finite elements, Mechanical behavior.*

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INFLUENCE OF MESH AND J INTEGRAL RADIUS ON STRESS INTENSITY FACTOR USING ABAQUS

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Abstract

The present work consists of studying the influence of the contour radius on the evaluation of the stress intensity factor (SIF) for Mode I and Mode II using ABAQUS, employing the J-integral method. To evaluate these integrals, ABAQUS defines the domain or contour in terms of rings of elements surrounding the crack tip. The first contour is normally located at the crack tip, and the following contours are generated as contours passing through the nearest neighboring elements, moving away from the crack tip. This study also examines the influence of mesh refinement on the stress intensity factor. The analysis was carried out using 8-node quadrilateral elements. The SIF evaluation is performed by examining the stress distribution upstream of the crack. The results obtained are then compared with those derived from analytical and semi-analytical formulas.

Keywords: *Crack, J-integral, Abaqus, FIC, Quadratic Element, mesh.*

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FAILURE ANALYSIS OF MULTISTORY RC/METAL FRAMES BASED ON HARDENING AND SOFTENING BEHAVIORS

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Abstract

In civil engineering and construction domains, the most widely used materials are perhaps reinforced concrete and steel. Moreover, most of the constructions in civil engineering are based on reinforced concrete (or metal) beams and columns. In order to provide crucial information and knowledge about the lifespan of such constructions, it may be very beneficial to study the behavior of reinforced concrete (or metal) beams and frames up until total failure. Before reaching complete failure, the limit load and the limit ductility constitute important data for such structure. A finite element beam formulation is presented in this paper for the analysis of 2D frame failure. The proposed model is capable of capturing the ductility limit and post-peak structural response of a collapsed structure brought on by a natural disaster like an earthquake or any other unintentional action. The model is based on a finite element curved Timoshenko beam enhanced with embedded discontinuity in rotation. The goal of this study is to present of an efficient tool that can be applicable for modelling of failure mechanism. The creation of mechanism is done by applying a geometrically linear analysis based on elasto-plastic law with linear isotropic hardening, such a constitutive relation describes the realistic behavior of steel beam in bending, combined with softening rigid-plastic law which is used to investigate the complete failure of structure. Such an analysis results in the creation of plastic hinges in a number of critical zones which causes the redistribution of actions and gravity loading and, as results, the structure is failed due to these softening plastic hinge leading to the creation of final failure mechanism that behaves like a Multi Body-System.

Keywords: *Softening plastic hinge, Hardening, Softening, Failure analysis, Embedded discontinuity.*

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CHARACTERIZATION OF A TERNARY ALLOY BY ULTRASONIC NON-DESTRUCTIVE TESTING

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Abstract

We are concerned to shape memory alloys (SMA) entrenched on copper such as copper-zinc-aluminum (CuZnAl).
The aim of this work is to characterize this ternary alloy at 8% weight of Al by means an ultrasonic non-destructive testing (NDT) method. The exploitation of this technique is used to seek for some important characteristics for the material, such as the elastic parameters namely the Young's modulus, the shear modulus and the Poisson's ratio.
The NDT technique is an ultrasonic ultrasound that drives the echoes coming from the front and rear faces of the sample to be displayed on a screen during the propagation of higher frequency and shorter duration vibration thru the material. In fact this method actuates the propagation velocities of longitudinal and transverse waves which are linked to the elastic parameters with theoretical relationships. Formerly, we determine the elastic parameters which depend on various heat processing that undergoes a sample of this alloy.
Thereafter, we study the shape memory effect that is based on a reversible martensitic structural transformation. In reality an optical microstructural characterization makes it possible to get optical micrographs which display the different microstructures of the sample in the martensitic state.
The development of ternary CuZnAl alloys was carried out with a view to improve the features of CuZn alloys. Hence, they show good physical properties and shape memory properties. These materials have mostly corrosion resistance and excellent electrical and thermal conductivity.

Keywords: *non-destructive ultrasonic testing, shape memory alloy, Young's modulus, shear modulus, ultrasonic waves.*

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EFFECT OF TORSIONAL LOADING ON A PENNY-SHAPED CRACK IN A FINITE ELASTIC MEDIUM

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Abstract

The objective of this work is to analyze an axisymmetric problem involving a penny-shaped crack embedded in a homogeneous material with finite thickness under torsion. The torsion is induced by a circular rigid disk attached to the upper surface, while the lower surface is fixed by an undeformable support. The crack is located within the homogeneous material. To address the problem, the Hankel transform was applied, reducing it to a system of dual integral equations, which were subsequently simplified into Fredholm integral equations of the second kind. These integral equations were solved numerically using the Gaussian quadrature rule. Dimensionless plots were generated to illustrate the effects of the material thickness, the distance between the support and the crack, and other key parameters on the stress intensity factor at the crack tip to predict the growth of the crack and avoid it. The results obtained show a strong correlation between the analytical solution and the numerical findings.

Keywords: *Penny-shaped crack, axisymmetric torsion, stress intensity factors, Fredholm integral equations*

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NUMERICAL SIMULATION OF AN EXPERIMENTAL CASE OF BEHAVIOR OF A REINFORCED CONCRETE FRAME

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Abstract

Numerical modelling is essential for understanding and predicting the response of structures to complex loading conditions, and accurately predicting the behaviour of reinforced concrete structures, particularly under cyclic or dynamic loading, remains a major challenge. To address this, many models have been developed to capture the non-linear behaviour of these structures, often using inelastic or fibre-based approaches. However, the implementation and validation of these models for practical applications in specific codes is a complex process.

This paper investigates the cyclic behaviour of a reinforced concrete frame using a special plastic hinge model, with the aid of a numerical simulation of an experimental test carried out on a reinforced concrete portal frame. The numerical results obtained are compared with the available experimental data and with Takeda's Tetra-linear model, which was also used by the authors of the experimental test. Although the proposed numerical model gives promising results, demonstrating the effectiveness of the proposed procedure, the study nevertheless highlights the importance of incorporating the effects of material degradation for more accurate predictions. This may contribute to the development of new numerical tools for the design of reinforced concrete structures in seismic zones, while improving their reliability and safety.

Keywords: *Behavior of reinforced concrete frame ; plastic hinge models ; Numerical simulation ; Finite elements*

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NUMERICAL SIMULATION OF PIPE DYNAMIC BEHAVIOR WITH CORROSION AREA.

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Abstract

Piping failures and damage are of ten the first sign of a corrosion problem,when pipeline corrosion is the oxidisation and electrochemical break down of the structure of a pipe,pipelline corrosion occurs on both the inside and outside of any pipe and related structures ,corrosion is a natural process where metal electrochemically reacts with the environment and deteriorates over time. Without regular maintenance and monitoring, this can lead to leaks or even pipeline ruptures.in this work presents a numerical simulation using Abaqus software of peplines we compared the results with a small corrosion present 20% of area under fast pipe and without corrosion area were devolted to detection of frequencies and modes with two model of pipe, the goal to see the seven modes of pipe with and without corrosion.

Keywords: *Corrosion,failure,damage,frequencies,the seven modes.*

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DAMAGE AND FAILURE IN FIBER REINFORCED COMPOSITES

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Abstract

Composites are defined as a multiphase and multi-scale material which consists of different materials in order to obtain desired properties that the individual constituent by themselves cannot attain. Composite materials can be tailored for various properties by appropriately choosing their components, their proportions, their distributions, their morphologies, as well as the structure and composition of the interface between components.

They are used in various fields such as aeronautics, aerospace, energy and other industries. They are characterized by their high strength/weight ratio and stiffness/weight ratio

Characterization and the modeling of this type of material can be done at different scales or by establishing a direct link by homogenization between them. In fact, there is no single mechanism but several types of damage different in their nature and their mode of development. On the microscopic scale: adhesion breaks between fibers and the matrix (fibre/matrix decohesion) or porosities. On the mesoscopic scale, or scale of the ply, transverse intralaminar cracks are observed (perpendicular to the direction of stress) or longitudinal (in the direction of application of the force) and ruptures of fibers at the extreme stage of material ruin. On the macroscopic scale, we observe the delamination phenomenon which corresponds to a local separation between two layers linked to a significant concentration of shear stresses generally starting at the edges free from the structure.

The various damages occurring to composite materials through the different components and under various stresses, were the subject of observations and studies through the application of the resistance of the materials, the linear and non-linear mechanics of rupture, micro-mechanics, MEF.

For this it is worth mentioning that there are different rupture criteria such as the Hashin criterion applied to this case study of stress evaluation for a GFRP rectangular plate, provided with a hole and subjected to traction uniaxial with abaqus 6.14.5

Keywords: *Composites, delamination, matrix, fibre, ply, Hashin*

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STEAM GENERATOR BEHAVIOR DURING TUBE RUPTURE ACCIDENT IN INTEGRATED PRESSURIZED REACTOR

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Abstract

The increasing demand for energy and the need for sustainable solutions have driven the development of advanced nuclear technologies. To address these challenges, small and medium modular reactors including the integrated Pressurized Water Reactors (iPWRs) have attracted significant attention due to their innovative designs that enhance safety margins. These advanced features enable the safe, clean, and reliable use of nuclear energy for a variety of applications, including electricity generation, district heating, desalination, hydrogen production, and various process heat applications. This compact design of the reactor integrates the steam generator and pressurizer within a single vessel, thereby boosting operational efficiency and reliability by utilizing natural coolant circulation, where the cooling process produces steam within the helicoiled tubes.
This study uses the RELAP5/MOD3.4 code to investigate the steam generator behavior in the NuScale Small Modular Reactor (SMR) during potential tube rupture accidents. The model represents the main reactor components, including the core as the primary heat source, the steam generator, and the pressurizer. The simulation examines a tube rupture in the steam generator to determine if the natural circulation cooling would be affected and if secondary coolant could rise to dangerous levels, potentially causing system failures. The obtained results demonstrate the model's ability to reproduce steady-state conditions. Furthermore, the transient tube rupture analysis showed that despite the rapid development of instabilities and oscillations on both the primary and secondary sides, the natural circulation flow remained uninterrupted, demonstrating the system's robustness and confirming its safety after the accident

Keywords: *Integrated Reactor, RELAP5, SMR, Natural Circulation, Steam Generator*

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ANALYSIS OF FLUID-STRUCTURE INTERACTION UNDER CONVECTIVE FLOW

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Abstract

In many industrial processes, the control of thermoconvectives flows is essential to protect equipment from damage during operation. To address this, a new approach has recently emerged, utilizing cavities equipped with flexible fins or membranes to regulate these flows. This study focuses on analyzing the dynamics of thermoconvectives flows induced by buoyancy forces, through a numerical study of the interaction between a fluid and a flexible structure using a fluid-structure interaction (FSI) model. The Navier-Stokes equations are discretized using finite volume method in the ALE formulation, while the structural equation is discretized with finite element method. The study domain consists of a square cavity with a flexible, adiabatic membrane, that deforms elastically due to FSI. Inside the cavity, a rigid plate held at a high temperature, positioned near the flexible membrane, which induces convective currents due to the thermal gradient [Figure 01]. This study investigates the influence of varying the Rayleigh number (Ra), which quantifies the balance between buoyancy and viscous forces, and the membrane's elastic modulus (E), which dictates its resistance to deformation. By varying these parameters, we analyze how different flow regimes and membrane stiffness levels affect the overall heat transfer and flow structure

Keywords: *natural convection; flexible wall; fluid-structure interaction; numerical analysis*

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HYBRID ENERGY SYSTEMS FOR ISOLATED REGIONS: INTEGRATING SOLAR POWER AND MICROREACTORS WITH ROCK-BASED HEAT STORAGE IN SOUTHERN ALGERIA

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Abstract

This study investigates the hybridization of solar power stations with nuclear microreactors for electricity production in isolated regions of southern Algeria. By integrating a rock-based packed bed for heat storage, the system effectively addresses the challenges of energy intermittency inherent in solar power, thereby enhancing the reliability and stability of the power supply in these remote areas. The research delves into the technical and operational synergies between solar energy and nuclear microreactors, highlighting their combined potential to deliver continuous, sustainable energy even in the absence of sunlight. The analysis extends to the system's design considerations and environmental impact, offering a comprehensive overview of its applicability. The results demonstrate that the hybrid system not only provides a robust and resilient energy solution for isolated regions but also plays a crucial role in reducing carbon emissions, optimizing energy efficiency, and promoting long- term energy independence. This innovative approach presents a scalable and viable model for other regions facing similar energy access challenges, paving the way for sustainable development in remote areas.

Keywords: *nuclear, solar, hybrid energy, micro reactor*

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DOUBLE-DIFFUSIVE CONVECTION OF NON-NEWTONIAN POWER-LAW FLUIDS IN A VERTICAL POROUS LAYER

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Abstract

This paper presents a numerical study of Double-Diffusive convection within a vertical porous medium saturated by a non-Newtonian fluid. The power-law model is utilized for modelling the behavior of the flow in the porous layer. The long side of the cavity experience thermal and solutal flux rates, whereas the other walls are impermeable and thermally isolated. The relevant factors that govern the problem being investigated are the Rayleigh number, R_T, the power-law index, n, the cavity aspect ratio, A, the Lewis number, Le, and the buoyancy ratio, N. A semi-analytical solution, valid for an infinite layer (A>>1), is derived on the basis of the parallel flow approximation. It is that the power-law index, n, have a strong influence on the strength of the intensity of flow, Ψ_0, the heat transfer rate, Nu, and the mass transfer rate, Sh, within the enclosure. A good agreement is found between the predictions of the parallel flow approximation and the numerical results obtained by solving the full governing equations.

Keywords: *Double-diffusive convection, power-law fluids, vertical porous layer, parallel flow*

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THE EFFECT OF THE INCLINATION OF AN OPTIMIZED TUBE WITH Y-SHAPED FINS ON THE MELTING PROCESS OF THERMAL STORAGE UNITS WITHIN A MODIFIED SHELL ENCLOSURE

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Abstract

Thermal energy storage is crucial for utilizing thermal energy sources like waste heat and solar energy. The development of latent heat storage systems is crucial for the successful application of thermal energy, as it is an efficient storage approach. This study investigates the thermal properties of a shell-and-tube latent energy storage system using phase change material (PCM). The system has Y-shaped fins placed within an octagonal-shaped shell. The enthalpy-porosity approach was used to analyze the performance of a system that included nano-enhanced paraffin wax as a phase change material (PCM). The system assessment indices used were the PCM temperature melted fraction, as well as the Nusselt and Bejan numbers. A sensitivity analysis was done to find out how the amount of copper nanoparticles (NPs), the angle of the tube's orientation, and its eccentricity affected the system's performance. The obtained results demonstrate that between the studied parameters, Changing the tube inclination angle effect on system characteristics; in the case of the 60◦ tube inclination angle (denoted by case 3), the melting time was reduced by 23 % compared to the base case. Changing the tube inclination angle show a significant effect on the Be number; using the case of 60◦ tube inclination angle and NP concentration of 8 % shows a slight improvement of temperature and melted fraction was reduced by 24 % It also led to the lowest decrease in the average Bejan.

Keywords: *[Latent heat storage shell and tube, octagonal-shaped shell, tube inclination angle, nanoparticle, Bejan number, thermal energy storage]*

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LAMINAR NATURAL CONVECTION IN LATERALLY AND BOTTOM HEATED, THE UPPERCUT COOLED IN VERTICAL CYLINDRICAL CAVITY: APPLICATION TO LIQUIDE HYDROGÈNE.

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Abstract

Numerical simulation of laminar natural convection in a cylindrical cavity is presented. The cavity is subjected to a lateral flow and from below has a uniform heat flux density, cooled at the top of the upper surface. The influence of the characteristic parameters of the steady-state solution problem is analyzed (10+4<=Ra<=10+6, Pr=1.29, 0.5<=AR<=2.0). The numerical model used is the finite volume model.

Keywords: *Solar energy- Hydrogen storage- Liquid hydrogen- Natural convection- Cylindrical cavity- Finite volume method*

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COMPARATIVE NUMERICAL STUDY UNDER MATLAB AND ANSYS-FLUENT OF THE EFFECT OF G-SPACING ON TURBULENT FLOW AROUND TWO VERTICAL SQUARE OBSTACLES

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Abstract

This study focused on the analysis of the behavior of turbulent flow around two square obstacles at a Reynolds number equal to 22000 and for different spacings between these two obstacles in unsteady regime in two-dimensional geometries. The study successfully achieved all its objectives by performing simulations under FEATool-MATLAB and ANSYS-Fluent by drawing several conclusions. The study revealed that the spacing G significantly influenced the fluid flow around the two two-dimensional obstacles. The main objective in this study is to compare the results obtained in the two CFD software: ANSYS-Fluent and FEATool, the study analyzed the velocity contours, revealing that the simulation under ANSYS-Fluent or under FEATool is similar.

Keywords: *CFD; Obstacle; Turbulent Flow; FEATool; ANSYS-Fluent; Reynolds Number*

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NUMERICAL ANALYSIS ON HEAT TRANSFER IMPROVEMENT IN A 2D TRAPEZOIDAL CORRUGATED PIPE OF A ROTARY CEMENT KILN

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Abstract

The need for increased efficiency has sparked a renewed interest in finding ways to improve heat transfer in rotary kilns. Among the various methods investigated, corrugated surface geometry has shown promise for improving heat transfer in rotary cement kilns. Rotary kilns are widely used in a variety of industries, including cement production. This study aims to improve the thermal performance of a rotary kiln duct by incorporating trapezoidal grooves into its outer wall. Four trapezoidal grooves with depth-to-diameter ratios (h/D) of 0 to 0.15 were created. The Reynolds Averaged Navier-Stokes (RANS) equations for two-dimensional steady-state flow are used in the study, with the finite volume method (FVM) implemented in FLUENT. Several RANS turbulence models were used, including k-ε standard, k-ε Realizable, k-ω SST, and k-ε RNG. The k-ε Realizable model validated the CFD results. Numerical results show that increasing groove depth lowers the outer wall temperature of the rotary kiln compared to smooth walls and yields the highest Nusselt number, particularly for grooves with h/D = 0.1 and 0.15.

Keywords: *CFD, forced convection, Nusselt number, k-ε Realizable Model; Rotary Cement Kiln, trapezoidal corrugated pipe*

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INFLUENCE OF ENVIRONMENTAL EFFECTIVE ALBEDO ON PERC+ BIFACIAL SOLAR CELLS PERFORMANCE

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Abstract

Ever since its initial release by ISFH and SolarWorld in 2015, the PERC+ cell concept has garnered swift adoption from numerous solar cell manufacturers across the globe. This rapid industrial uptake is attributed to the remarkably similar process technology shared between bifacial PERC+ cells and monofacial PERC cells, both of which are increasingly becoming standard in the PV industry. This study focuses on analyzing the performance variation of PERC+ cells, including short-circuit current density (Jsc), open-circuit voltage (Voc), fill factor (FF), and output power (Pout) in relation to the real albedos of typical surfaces. The simulation was conducted using PC2D, a solar cell device simulator that models two-dimensional effects entirely within a Microsoft Excel spreadsheet and allows for modeling bifacial cells with simultaneous illumination of both surfaces. Consequently, the simulator can represent the equivalent characteristic J - V of the PERC+ cells. The results demonstrated a significant increase in PERC+ cell performance; for example, output power reaching from 24.92 mW/cm2 for green grass to 35.56 mW/cm2 for snow-covered surfaces. Furthermore, the study highlighted strong linearity between all four parameters (Jsc,Voc, FF, Pout) and effective albedo. This suggests that these parameters can be predicted for various effective albedos of current surfaces without simulating the PERC+ solar cell.

Keywords: *Bifacial solar cells . PERC+ . Output power . Albedo . Efficiency . PC2D*

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TEMPERATURE AND CONCENTRATION EFFECTS ON RHEOLOGICAL BEHAVIOR OF XANTHAN DRAG REDUCTION AND INHIBITORS CORROSION POLYMERS SOLUTION

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Abstract

In this study, the rheological characteristics of Xanthan polymer dilute solution were analyzed. The concentrations used in this study ranged from 0.4 % to 0.8%. The test temperatures ranged between 293 and 333 K. The shear rate range was from 0.8 and 1200 s−1. Rheological measurements were performed on a rotational rheometer model MRC302e. The solution rheology was affected by shear rate, polymer concentration, and testing temperature. The results obtained show that these polymer solutions; already known to drag reduction and corrosion inhibitor; exhibits shear-thinning behavior where viscosity is inversely proportional to temperature. This type of result has already been observed in the literature and that of the Hatchel Berkley model whose stresses increase nonlinearly with the shear rate, thus presenting a good reduction in friction at a high temperature of 60 and at low concentration.

Keywords: *polymer, rheometer, shear stresses, shear rate, temperature, shear-thinning, drag reduction reducer, concentration, temperature.*

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NUMERICAL STUDY OF THE EFFECT OF COMBUSTION CHAMBER GEOMETRY ON THE PERFORMANCE AND EMISSIONS OF A NATURAL GAS / DIESEL DUAL FUEL ENGINE

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Abstract

Increasing emissions of unburned hydrocarbons (HC) and carbon monoxide (CO) remain a challenge for dual-fuel engines. To remedy, numerous works have been reported on variation of fuel properties and engine-operating parameters for dual-fuel operation improvement. However, very few works have been dedicated to basic engine conception modification. The aim of this work is to develop a numerical modeling tool to study the influence of combustion chamber geometry on combustion quality. A 3D numerical simulation has been developed using CONVERGE CFD software with various mesh control techniques including embedding and Adaptive Mesh Refinement (AMR). The study includes simulations for different piston shapes, in order to determine the appropriate shape for achieving the best air/fuel mixture. combustion pressure and net heat release rate (HRR) generated from the simulations are compared to the corresponding experimental results. Additionally, efficiency, NOx, HC and CO emissions results are presented and discussed.

Keywords: *diesel engine, alternative fuel, exhaust emissions, dual-fuel, 3D CFD model.*

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ANALYSIS AND SIMULATION OF SINGLE AND TRIPLE-JUNCTION INGAP/GAAS/GE SOLAR CELLS FOR SPACE APPLICATIONS

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Abstract

The space industry is beginning to adopt multi-junction solar cells, composed of III-V semiconductor materials, capable of absorbing a broader portion of the solar spectrum. As part of the development of a triple-junction InGaP/GaAs/Ge solar cell, we first conducted simulations on three single-junction solar cells: InGaP, GaAs, and Ge, achieving efficiencies of 15,89%, 19,57%, and 5,15 %, respectively. Then, to improve efficiency, we performed a numerical simulation of the triple-junction InGaP/GaAs/Ge solar cell by stacking these three cells, resulting in a high efficiency of 30,30 %. The aim of this study is to optimize the efficiency of triple-junction InGaP/GaAs/Ge solar cells through numerical simulations and to analyze the impact of the space environment (protons, electrons) on their performance.

Keywords: *[InGaP/GaAs/Ge solar cells; efficiencies, proton; electrons, fluence, energy]*

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HALF-METALLIC FERROMAGNETIC,STRUCTURAL, DYNAMIC, ANDTHERMODYNAMIC PROPERTIES OF A FULL HEUSLER COMPOUND MN2OSSB: AB INITIO STUDY.

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Abstract

This paper presents a thorough investigation of the structural, electronic, magnetic, thermodynamic, and phonon properties of Mn_2OsSb, utilizing first-principles calculations grounded in density functional theory (DFT). Our findings indicate that this compound exhibits enhanced stability in the Hg_2CuTi structure, with the ferromagnetic (FM) ground state being energetically favorable, characterized by a substantial magnetic moment of 3.00
μB. Moreover, our analysis of the spin-polarized electronic properties, including band structures and densities of states, reveals that Mn_2OsSb displays a complete half metallic character when assessed using the generalized gradient approximation (GGA). In addition,
we employed the phononpy code to calculate key thermodynamic parameters such as Helmholtz free energy (F), heat capacity (Cv), and entropy (S), providing a comprehensive
understanding of the material's thermal properties. Finally, our investigation into the dynamic properties indicates that the inverse cubic phase (XA) of Mn_2OsSb is the most stable configuration among those considered. This insight is crucial for future research and
development, highlighting the potential of Mn_2OsSb in various technological applications like spintronic and energy storage

Keywords: *DFT , FP-Lapw+lo ,Half metallic,Thermodynamic, Dynamic, Ferromagnetism*

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ANALYTICAL STUDY OF CAPILLARY EFFECTS ON THE STABILITY OF FLUID INTERFACES IN KELVIN-HELMOLTZ INSTABILITY

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Abstract

The Kelvin-Helmholtz instability (KHI) commonly arises at the interface between two fluids with different velocities and densities, leading to complex wave dynamics and potential mixing. In this study, we analytically investigate the impact of surface tension on the evolution and stability characteristics of KHI. Using linear stability analysis, we derive and analyze dispersion relations that incorporate surface tension as a stabilizing force at the fluid interface. The results demonstrate that surface tension significantly affects the growth rate of the instability, particularly at short wavelengths, by suppressing perturbations that would otherwise amplify rapidly in its absence. Furthermore, we identify critical wave numbers at which surface tension begins to influence instability suppression and compare these thresholds with traditional KHI growth rates without surface tension. Our findings provide deeper insights into the role of capillarity in fluid interface stability, highlighting conditions under which surface tension can either delay or completely suppress the onset of KHI. This analytical approach enhances understanding of capillary effects in natural and industrial applications, such as in oceanographyand multiphase flows in engineering systems.

Keywords: *Kelvin-Helmoltz instability , Geophysical fluid dynamics , stratification*

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A NUMERICAL ANALYSIS OF THE MELTING PROCESS IN A STORAGE CAVITY WITH PARTIAL INTEGRATION OF METAL FOAM /NEPCM COMPOSITE: KITE-SHAPED FOAM FILLING

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Abstract

Despite technological advances, the low thermal performance of storage systems still limits their industrial application and commercialization. Designing cost-effective solutions remains a challenge, but the combination of phase change material, nanoparticles and metal foams appears to be a promising solution due to the high thermal conductivity of metal foams. This study presents a numerical analysis of melting in a storage cavity using kite-shaped aluminum foam and a phase change material reinforced with silver nanoparticles. A finite volume method based on the enthalpy-porosity technique was adopted for the numerical simulations. The impact of nanoparticle volume fractions on thermal and economic performance was investigated. The results show that the melting time and energy stored decreased by 5.1% and 3.8%, respectively, for ϕ = 2%, and by 7.8% and 7.6% for ϕ = 4%. Additionally, the 2% volume fraction proves to be the optimal configuration in terms of both thermal and economic performance.

Keywords: *PCM, Metal Foam, Nanoparticles, Melting performance, Natural convection.*

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CONFINED INTERDISC FLOWS

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Abstract

The present work concerns the numerical study of axisymmetric flows, of a viscous and incompressible fluid, generated by rotating the end disks of a cylindrical or truncated conical cavity. The numerical simulation has revealed various secondary flow structures, due to the combined effects of the rotating and/or stationary boundaries, whose nature and number depend on the physical parameters Re=ΩbR20b (the Reynolds number), S= Ωt/ Ωb, So = Ωt/ Ωb (the rotation ratios) and on the radius ratio of the enclosure a= R2/ R1 .

Counter-rotation (So <0) generates counter-rotating cell structures separated by stagnation lines which do not coincide with the transition layers. For a given couple of parameters, the co-rotation (So >0) leads to the formation of a core rotating as a solid body.

In the case of a cylindrical cavity whose aspect ratio a≥1.48, the study reveals the occurrence of axisymetric bubbles, in the vicinity of the rotating axes, characterised by a stagnation point and an inverse flow (vortex breakdown). As a tentative control strategy, it appears that a weak counter-rotation suppresses the bubbles while the co-rotation, even for weak rotation ratios, enhances their appearance.

Keywords: *Annular space/Differential rotation /Axial bubbles / radial temperature gradient.*

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CONFINED INTERDISC FLOWS

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Abstract

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Keywords: *Annular space/Differential rotation /Axial bubbles / radial temperature gradient.*

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DRX,MEB,IR AND TG OF NANOSTRUCTURED PBO PREPARED FROM SPENT LEAD ACID BATTERY NEGATIVE PLATE (WASTE RECYCLING)

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Abstract

Abstract: Early, millions of lead acid batteries (LABs) are thrown after their failure. They constitute a source of contamination of the environment and a great attaint for the human health. Many processes, either pyrometallurgical or hydrometallurgical, have been developed to produce metallic lead from the spent LABs. However, pyrometallurgical routes require high temperature (around 1000 °C), which not only consume huge amounts of energy but also easily produce SO2 and lead dust if the desulfation is not fully completed, bringing secondary contamination to the environment [1-3].

The aim of this work was the synthesis, characterization and the reuse of nanostructured PbO obtained from spent materials negative lead acid batteries.

The processes of synthesis comprise desulfation, and calcination. At each stage of the above process, the chemical composition and the morphology of the obtained materials was studied by X-Ray diffraction, scanning electronic microscopy SEM, IR and thermogravimetry.

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Keywords: *Solvothermal, nanostructured PbO , Lead acid battery,*

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SIMULATION AND OPTIMIZATION OF SR_3SBI_3-BASED PEROVSKITE SOLAR CELLS WITH ZNO, ZNS, AND ZNSE ELECTRON TRANSPORT LAYERS: A SCAPS-1D STUDY.

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Abstract

In this work, we simulate and optimize Sr_3SbI_3-based perovskite solar cells using SCAPS-1D, focusing on the influence of three electron transport layers (ETLs): ZnO, ZnS, and ZnSe. Key parameters such as power conversion efficiency (PCE), open-circuit voltage (Voc), short-circuit current density (Jsc), and fill factor (FF) were evaluated for different ETL thicknesses and temperatures. At an ETL thickness of 0.03 µm, the highest PCE was observed with ZnO (18.61%), followed by ZnS (18.17%) and ZnSe (17.59%). As the thickness of the ETL increased, notable improvements in cell efficiency were observed, with ZnO reaching a maximum PCE of 19.77% at 0.075 µm. However, temperature variations negatively impacted the performance of all cells. For ZnO, the PCE dropped from 19.77% at 300 K to 17.75% at 360 K. Similar trends were observed for ZnS and ZnSe, with ZnS exhibiting a reduction in PCE from 18.21% at 300 K to 16.90% at 360 K, and ZnSe from 17.20% to 15.35%. The study highlights the impact of ETL selection and operating temperature on the performance of Sr_3SbI_3-based solar cells, providing insights for optimizing these devices in varying environmental conditions.

Keywords: *Sr_3SbI_3 perovskite, SCAPS-1D, solar cells, electron transport layer.*

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NUMERICAL STUDY OF THE EFFECT OF USING TWISTED TAPE AND A NANOFLUID ON THE THERMAL PERFORMANCE OF A CYLINDRICAL-PARABOLIC COLLECTOR

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Abstract

Cylindro-Parabolic Collector (CPC) is a solar energy technology known for its established role in concentrated solar power systems. Ongoing research aims to improve its thermal efficiency by exploring modifications in the geometry of the absorber tube and using innovative heat transfer fluids. The main objective of this work is to evaluate the combined effects of modifying the absorber tube geometry and using advanced heat transfer fluids on the thermal performance of CPCs. The absorber tube design incorporates twisted tape inserts, which act as turbulators to enhance heat transfer. The heat transfer fluids used include Syltherm 800, a synthetic heat transfer fluid, and Syltherm 800+Cu, a nanofluid that adds copper nanoparticles (φ=1-4%) improved thermal properties. The performance of a collector with a twisted tape turbulator (CTT) is compared with that of a plain collector tube (PC) by calculating the Nusselt number (Nu) and outlet temperature. The findings results indicate a significant enhancement in thermo-hydraulic performance with the twisted tape turbulator and Syltherm 800+Cu nanofluid combination. The twisted tape increases turbulence, improving heat transfer, while the nanofluid enhances the thermal conductivity of the system.

Keywords: *Parabolic trough collectors, Twisted tape, nanofluid, heat transfer enhancement.*

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STUDY OF SOLAR CELLS OF DIFFERENT SEMICONDUCTOR MATERIALS

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Abstract

The work presented aims to improve the efficiency of photovoltaic solar cells using three types of materials Silicon (Si), Gallium Arsenide (GaAs) and Gallium Phosphide (InP). We explained the essential physical parameters used in the simulation by the PC1D calculation code, as well as the model of the equations introduced in the calculations and the obtained results of the characteristics of a solar cell composed of different semiconductor materials: Si, GaAs and InP. To know what are the factors that influence these characteristics, we also study the component in its material aspect, the PC1D calculation code makes it possible to analyze the transport mechanisms of the load carriers (electrons and holes) by solving the transport equations and subsequently generate the various curves and mainly the Current-Voltage (I-V) characteristic. It has a user-friendly interface to control many parameters related to equations and the external conditions. The calculation of the voltage current is done in stages where we define the structure and the data of the different semiconductor materials of the cells, specifying the zone of the transmitter through the doping used, act on the parameters of the solar radiation and excite the cell with a series of polarization to generate the (I-V) curve for solar cells textured and without texturization. From the curve (I-V) it was possible to calculate mainly the cells efficiency which enabled the evaluation of the quality of the cells.

Keywords: *Solar Cell, Efficiency , I-V Characteristic, PC1D , Semiconductor*

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PERFORMANCE OF A HYBRID AIR SOLAR COLLECTOR

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Abstract

In this present work, COMSOL Multiphysics software was used to numerically study the thermal parameters of a PVT hybrid solar panel using air as the heat transfer fluid. In order to properly monitor the temperature variations of the cell and the air at the outlet of the channel, as well as to determine the thermal and electrical efficiencies of the solar panel. The experimental results of a solar collector assembly made by Tiwari during a day in July 2004 in India were used to carry out a numerical simulation. It was found that the electrical efficiency of the solar collector was affected by the cell's temperature.The channel outlet's air temperature increases, which results in an increase in useful energy, which leads to an increase in thermal efficiency because they are directly linked. The yield was observed to be the highest at 1 p.m. The panel's upper surface made of glass has the highest temperature, surpassing 65°C. The temperature of the air at the outlet of the channel went up with a deviation that can go as high as 30°C as compared to the air temperature at the channel's entrance. The results revealed that the solar panel's surface temperature reached its highest point at the outlet.

Keywords: *Hybrid solar panel PVT, Air channel, Thermal efficiency, Cell temperature, COMSOL multiphysics.*

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NUMERICAL ANALYSIS OF THE EFFECT OF THE AIRFOIL TYPE AND THE BLADE NUMBER ON WIND TURBINE PERFORMANCES

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Abstract

With the growing global demand for renewable energy, improving the efficiency and longevity of wind turbines is crucial. Wind farms not only provide a viable solution for future energy needs but also contribute significantly to mitigating climate change by reducing reliance on fossil fuels. As air temperature increases throughout the day, wind speeds rise due to the temperature gradients formed. Wind is harnessed to generate electricity by transforming the kinetic energy of moving air into electrical energy. The blades of wind turbines are considered the most vital and expensive parts of the wind system. Therefore, acquiring a comprehensive understanding of blade behavior is essential. In our work, we focused on analyzing the effect of blade type and their number on the performance of a small horizontal axis wind turbine (HAWT). Based on the Blade Element Momentum (BEM) method, simulations were conducted using blades with different aerodynamic airfoils such as NACA3712 and SG6043, and varying number of blades. The simulations were carried out using Qblade software. Several variations of wind speeds ranging from 1 m/s to 10 m/s were generated for the different airfoils. Through this study, we were able to highlight the effect of profile type and the number of blades on the performance of a horizontal wind turbine, and these parameters are crucial for optimizing the efficiency of the wind system.

Keywords: *Small HAWT, airfoil, Qblade, wind energy, aerodynamic performance*

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SIMULATION OF RADIATIVE TRANSFERS IN SEMI-TRANSPARENT LAYERS OF PHOTOVOLTAIC MODULES USING THE DISCRETE ORDINATES METHOD

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Abstract

The increasing demand for renewable energy has heightened interest in optimizing photovoltaic module efficiency. A crucial aspect of this optimization involves understanding the radiative transfer processes occurring within semi-transparent layers of PV modules. Photovoltaic modules are composed of multiple layers, including protective glass, anti-reflective coatings, and semiconductor materials. Each layer's optical properties significantly influence how sunlight is absorbed, reflected, or transmitted. By accurately modeling these interactions, we can improve the design and performance of PV systems. This presentation explores the use of the Discrete Ordinates Method implemented in Fluent to simulate these transfers, providing insights into enhancing energy conversion efficiency. The DOM is a numerical technique that discretizes the angular domain into a finite set of directions, allowing for detailed analysis of radiative heat transfer in semi-transparent media. Using Fluent, we first define the geometric and optical characteristics of each layer, including material thickness, refractive index, and absorption coefficients. The radiative transfer equations are then solved across a meshed geometry, facilitating the computation of light intensity and energy distribution throughout the module. The present study focuses on the study of the degradation of photovoltaic modules and the impact of environmental factors such as dust on their performance, providing valuable insights for the photovoltaic industry. The results show that photovoltaic modules without cleaning can experience a degradation of their output power by up to 70% of their initial value.

The application of the Discrete Ordinates Method in Fluent for simulating radiative transfers in PV modules represents a significant advancement in solar technology research. By leveraging this simulation technique, we can develop more efficient photovoltaic systems, ultimately contributing to the broader goal of increasing renewable energy adoption.

Keywords: *Photovoltaic module, simulation, transmissivity, environmental factors, efficiency loss*

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HEAT TRANSFER OF NANOFLUID IN A CYLINDRICAL ENCLOSURE UNDER THE INFLUENCE OF A MAGNETIC FIELD

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Abstract

This numerical study focuses on the flow of an Al_2O_3-water nanofluid driven by a rotating disk at the bottom of a cylindrical enclosure subjected to an axial temperature gradient and an
external magnetic field. The finite volume method is used to solve the system of equations governing the magnetohydrodynamic flow, and the SIMPLER algorithm is employed to ensure the coupling of velocity and pressure. The FORTRAN language developed a computational code to simulate the two-dimensional flow with heat transfer
The effects of the Richardson number (Ri), the Hartmann number (Ha), and the nanoparticle volume fraction (ϕ) on the flow and heat transfer are studied in detail. The results
reveal that, in all cases, in the absence of a magnetic field, the average Nusselt number ($\overline{Nu}$)
increases with the increase in the Richardson number (Ri) and the nanoparticle volume fraction (ϕ). However, in the presence of a magnetic field, the average Nusselt number decreases as the Hartmann number increases.

Keywords: *Convection 1 , Nanofluid 2 , Magnetic field 3 , Cylindrical enclosure 4 , Rotating disc 5 .*

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CORRUGATED ABSORBER PLATE PARAMETER EFFECT IN SOLAR AIR HEATER

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Abstract

A detailed numerical investigation of two-dimensional solar air heater (SAH) having corrugated absorber plate was performed in this study using CFD techniques. The main objective is the improvement of the heat transfer rate and the determination of the optimum corrugation characterization that provides high thermo-hydraulic performance for the adopted SAH. Mainly, the effect of the corrugated height ratio e/D and the corrugated pitch ratio P/e, for several values of Reynolds number are investigated. Results showed that the maximum value of Nusselt number is obtained for P/e = 7.14 and e/D = 0.166 with a gain (do you mean heat gain?) of about 37.31 % compared to the smooth duct for Re = 18,000. The friction factor increases with decreasing P/e ratio and increasing e/D ratio. The highest value is obtained for P/e = 7.16 and e/D = 0.166. The optimum value of thermos-hydraulic performance parameter (THPP) could be obtained for P/e = 16.66 and e/D = 0.0656.

Keywords: *Solar air heater, Corrugated plate, Heat transfer, Thermo-Hydraulic Performance*

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COMPARATIVE STUDY OF PID TUNING METHODS FOR DC MOTOR SPEED CONTROL

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Abstract

PID controllers are widely used in many control industrial applications and there are many methods for tuning parameters which provide good performance. In this study, Ziegler Nichols tuning rule and its modified version known as Cohen Coon method are used to control the Direct Current (DC) motor speed. PID synthesis methods based on Internal Model Control (IMC) with both integer and non-integer filters are also proposed. Comparative study between these control schemes from the point of view of characteristics and performance is carried out. The obtained simulation results have shown that these methods provide good performance for DC motor speed from the point of view of set-point tracking and torque load compensation.

Keywords: *DC motor, PID controller, Ziegler Nichols, IMC structure, Bode's ideal transfer function, Cohen Coon method.*

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PARAMETRIC STUDY OF GAS TURBINE POWER PLANT FOR THE CASE OF STOICHIOMETRIC AND NON-STOICHIOMETRIC COMBUSTION

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Abstract

The present work involves the parametric study of a gas turbine power plant for the electricity production. Two cycles of the power plant are studied (Brayton cycle and regeneration cycle). Also, two types of combustion are considered in this study: stoichiometric combustion (without excess air) and non-stoichiometric combustion (with excess air). The methane gas (CH4) was used as the fuel of the combustion process. The influence of the parameters that affect on the work of the gas turbine power station such as, ambient temperature, excess air and heat exchanger efficiency are shown and analyzed. The results show that higher ambient temperatures lead to an increase in the combustion temperature and a reduction in the net mechanical output power. Increasing excess air reduces the values of the mechanical output power and the combustion temperature. It was also found that the enhancement of the heat exchanger efficiency improves significantly the efficiency of the power station and increases the combustion temperature.

Keywords: *Keywords: gas turbine, combustion, excess air, Brayton cycle, regeneration*

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DESIGN, ANALYSIS, AND SIMULATION OF A COMPLIANT LEVER MECHANISM FOR PIEZOELECTRIC-DRIVEN MICROPOSITIONING.

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Abstract

This paper introduces a new, streamlined lever-based amplification system designed to enhance precision and control in piezoelectric applications. Unlike traditional multi-lever designs, our approach utilizes a single strategically designed lever with compact, streamlined arms. This innovative design achieves a substantial amplification ratio while maintaining a compact, parallelepiped-shaped structure (54.5 mm x 23.3 mm x 10 mm), making it ideal for various micropositioningitasks.

The proposed mechanism delivers a maximum output displacement of 1102.7 µm for an input displacement of 50 µm from the piezoelectric (PZT) actuator. Finite element simulations conducted using ANSYS Workbench ensured optimal performance by maintaining stress levels well below the yield strength (327.95 MPa) of the selected material (7075 T6 aluminum alloy).

The primary innovation of this work lies in the single lever mechanism, which significantly reduces the size and complexity compared to conventional designs. This innovative approach has the potential to drive advancements in precision engineering and robotics applications that demand high amplification and precise control.

Keywords: *Piezoelectric actuator, Compliant mechanisms, Flexure hinge, Displacement amplification mechanism, finite element analysis;*

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EVALUATION OF THE BEST-CASE QUALITY IN GROUP SHEDULING FOR JOB SHOP PROBLEM WITH IDENTICAL PROCESSING TIMES

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Abstract

The job shop scheduling problem with identical processing times $J_m \mid p_i = p \mid C_{max}$ is an NP-hard problem often tackled using either predictive or reactive methods. Predictive methods, like discrete optimization or heuristics, focus on finding feasible or optimal solutions that satisfy constraints and minimize an objective function, while reactive methods adjust predictive schedules in real time in order to handle uncertainties that occur, such as uncertain processing times, availability issues, or urgent tasks. To combine the strengths of both approaches several proactive-reactive approaches, have been developed the last few years, and the group scheduling method is one of the most extensively studied approach. A group sequencing is a schedule that introduces sequential flexibility, by defining a partial order between operations to perform on machines (group of permutable operations). The resulting flexible solution characterizes a family of schedules without listing them individually. An interesting characteristic of this method is its flexibility, which is valuable by measuring the number of groups. In this article, we focus on improving the best-case scenario in group scheduling, for evaluating the performance of a schedule before its real-time execution, and to aid decision-making during the execution process. Considering the job shop scheduling with identical processing times, and we propose a new lower bound, corresponding to the best performance of the groups of permutable operations. Computational experiments were conducted on standard benchmark instances, showing superior results of our proposed bound, compared to known existing bounds. The proposed method provides a more effective way to handle uncertainties and improves scheduling performance while maintaining flexibility during execution.

Keywords: *Job shop scheduling, identical processing times, group scheduling, sequential flexibility, best-case quality.*

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EFFECT OF THE HEATING AND AIR CONDITIONING SYSTEM ON THE POWER CONSUMPTION OF FUEL CELL ELECTRIC VEHICLE

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Abstract

Currently, automotive technology is moving steadily towards new technologies because of the rapid depletion of fossil fuels and climate challenges caused by the transport. For road transport sector, the fuel cell electric vehicle is one of the promising solutions advocated by car manufacturers and research organizations to replace gradually conventional vehicles. Moreover, one of the main problems to consider is how to maintain a good climate in the vehicle compartment to provide simultaneously security and a comfortable microclimate for passengers and ensure optimal performance for energy storage system. This communication aims for numerical simulation of the influence of air conditioning system on the energy performance of a fuel cell electric vehicle using MATLAB environment. The vehicle propulsion is ensured by two asynchronous wheel motors powered by a hybrid power source consists of a PEM fuel cell and a Li-ion battery. The air conditioning system comprises a reversible heat pump operating with a brushless synchronous compressor. The simulations shows that the power needed to operate the air conditioning system depends on the thermal load and it's responsible for 8% of total consumption of the vehicle. It was also shown that the storage system has good performance and gives good dynamic characteristics simultaneously for the traction chain system and the air conditioning system.

Keywords: *electric vehicles, fuel cell, thermal comfort, Li-ion Battery, automobile air conditioning, SOC*

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DEVELOPMENT OF SCREEN-PRINTED GRAPHITE ELECTRODES MODIFIED WITH PLATINUM AND NICKEL NANOPARTICLES FOR THE SIMULTANEOUS QUANTIFICATION OF VITAMIN C AND ACETAMINOPHEN IN PHARMACEUTICAL SAMPLES

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Abstract

Acetaminophen (APAP), commonly known as paracetamol, is a widely used pain reliever and fever reducer. However, its overuse can lead to toxic metabolites that harm liver and kidney function. Ascorbic acid (AA), or vitamin C, is a water-soluble vitamin with antioxidant properties, commonly used to treat conditions like colds and infertility. Combination drugs containing both APAP and AA are often prescribed, making their simultaneous detection crucial for ensuring pharmaceutical quality and patient safety.

This study presents a novel electrochemical method for the simultaneous detection of APAP and AA using screen-printed electrodes (SPEs) modified with platinum and nickel nanoparticles (Pt-Ni NPs). The Pt-Ni NPs were electrodeposited onto the SPEs to improve their electrochemical performance. Structural and morphological analyses were performed using techniques such as FE-SEM, TEM, EDX, XRD, and AFM. Differential pulse voltammetry was used to quantify both APAP and AA under optimized conditions.

The sensor demonstrated a linear detection range of 10 to 1800 µM for AA and 1.0 to 200 µM for APAP, with detection limits of 7.0 µM for AA and 0.66 µM for APAP. It showed excellent reproducibility, recovery, long-term stability, and resistance to interference, making it a reliable tool for quantifying APAP and AA in pharmaceutical formulations. This approach offers a promising solution for monitoring the safety and quality of pharmaceutical products containing these compounds.

Keywords: *Keywords : Acetaminophen, vitamin C, Pt–Ni nanoparticles, SPE, electrochemical sensor.*

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SOME USES OF RECYCLED GRANITE IN CEMENT AND MORTAR: REVIEW

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Abstract

Recovery of waste granite in cement as supplementary cementitious materials has become an opportunity. Some advantages are granite waste recycling, consumption reduction of natural resources and improvement of cement properties. This paper presents a review on addition of recycled granite waste to the cement and effect on their properties. Some international researches were selected from scientific peer-reviewed journals. The important items analyzed were granite characteristics, recycling methods and cement performance. The last item includes physical and mechanical properties. Although the granite negatively affected some properties, this paper focuses on the variables that mitigate these effects. As conclusion, application of granite waste would be useful on both, technical and environmental dimensions and this paper could be used as a helpful tool for studying and designing concrete composites with granite.

Keywords: *Recycled granite; supplementary cementitious materials; Mechanical properties; Physical properties; Durability properties*

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PARAMETERS INFLUENCING THE DUCTILITY OF REINFORCED CONCRETE BEAMS

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Abstract

The finite element method is a powerful tool for analyzing various types of structures, thanks to the development of computer tools and models of the nonlinear behavior of materials. The aim is to develop computer tools for finite element modelling of the nonlinear behavior, both locally (bent sections) and globally (whole elements), of reinforced concrete structures subjected to increasing loading up to failure in bending. The application of these analysis tools enabled us to compare our numerical results with the experimental data obtained by Mazars. The comparison of these results proved satisfactory, validating our approach. A parametric study was carried out on the influence of various parameters on the local and global ductility of the Mazars beam, namely the compressive strength of the concrete and the percentage of longitudinal reinforcement. The following remarks were drawn from this study: The maximum moment and the maximum breaking load capacity increase with the increase in the percentage of longitudinal reinforcement and the compressive strength of the concrete. Local ductility increases by 32% as a function of the percentage of longitudinal reinforcement ω up to the value ω = 1%, then decreases for a heavily reinforced section. For ω = 1%, the section showed sufficiently ductile behavior (μD = 3.77). For ω = 0.5 the beam showed sufficiently ductile global behavior (μD = 4.83). Beyond this value, the ductility decreases for excess reinforcement. Local and global ductility increase by around 29% and 5%, respectively, as a function of the compressive strength of the concrete.

Keywords: *Keywords: Modulization, Ductility, Simulation, Analys, nonlinear*

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DETERMINING THE OPTIMAL VARIANT FOR A ROAD PROJECT BY COMBINING THE BIM TOOL WITH THE TOPSIS AND ELECTRE III METHODS.

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Abstract

Traditional methods of road infrastructure design and planning are often a source of wasted time, additional costs, delays and errors. Building information modeling (BIM) represents a significant technological advance in the construction sector, offering substantial benefits throughout the project lifecycle and reducing design errors in road infrastructure projects. However, major improvements are still needed in the field of road and motorway infrastructure. A central objective is to facilitate data exchange and collaboration on these projects.

During the preliminary design phase, the selection of variants is a crucial step. This stage is decisive in assessing the viability and feasibility of the different variants, and in preparing the project for the next, more detailed phase. It's in this context that the main aim of this research is to identify the optimum road alignment to replace a flood-prone section of the CW 60, linking the town of Sidi Belattar to the RN 90, at the Chelif river. This section was chosen as a case study for digital experimentation.

A comparative analysis was carried out by projecting the different variants using 2D mapping and the INFRAWORKS 3D tool. The variants were ranked using two multi-criteria analysis methods, TOPSIS and ELECTRE III. The results of the ranking were consistent, recommending variant 2 to replace the vulnerable section.

Keywords: *BIM, Road, Flood, InfraWorks, Topsis, Electre III.*

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SENSITIVITY OF ULTRASONIC VELOCITY AND MECHANICAL STRENGTH OF EARTH BRICKS TO QUICKLIME AND DATE PALM FIBERS DOSAGES

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Abstract

Earth building is a key part of eco-friendly construction, offering several advantages, including reduced environmental impact, energy efficiency, and the use of natural, locally sourced materials like clay and sand. It provides excellent insulation, regulates indoor temperatures, and creates healthier, more sustainable living spaces while minimizing waste and carbon emissions. However, they face durability and strength challenges due to moisture sensitivity, which can lead to severe deterioration. The incorporation of stabilizers and natural plant fibers helps to overcome these limitations, yet the environmental impact of chemical stabilizers makes their use debatable. This study focuses on lime, an eco-friendly, carbon-neutral material; given that around 15.59% of annual CO_2 absorption comes from lime produced in previous decades, this material has the potential to reduce the carbon footprint of its production process. In order to improve understanding of the behavior of earth bricks, the influence of different dosages of quicklime and date palm fibers on ultrasonic velocity and mechanical strength was investigated. The outcomes indicate that the presence of quicklime and fibers affected the ultrasonic velocity and strength of the samples. Notably, a significant correlation was found between these two characteristics, allowing ultrasonic testing to provide insight into the internal structure and overall strength of the earth bricks.

Keywords: *Stabilization, Earth bricks, date palm fibers, Mechanical strength, Ultrasonic velocity*

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INFLUENCE OF SOIL TYPE ON THE SEISMIC PERFORMANCE OF A REINFORCED CONCRETE STRUCTURE

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Abstract

The aim of this work is to demonstrate the influence of soil type and site location on the seismic performance of a reinforced concrete residential structure located in Tissemsilt. The structure falls under usage group 2 and is situated in a moderate seismicity zone (IIa). This study follows the Algerian seismic codes (RPA99 / 2003 version) and concludes that the type, nature, stiffness, and aggressiveness of the soil play a crucial role. The site and soil conditions affect the choice of foundation type. Therefore, the modification of seismic action is reflected in the shape of the response spectrum. It is essential to understand the nature of the foundation soil before selecting the appropriate response spectrum for calculations. The soil characteristics, described by wave propagation speed, significantly influence the dynamic response of structures.

Keywords: *Seismic performance, Structure, Soil, Stiffness, Response Spectrum.*

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SIMPLIFIED RHEOLOGICAL CHARACTERIZATION OF SELF-COMPACTING CONCRETE

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Abstract

Several previous studies have shown that tests using concrete rheometers can be used to analyze the intrinsic properties of fresh concrete, such as yield stress and plastic viscosity. The objective of this study is to propose a rheological model for self-compacting concrete at reduced scale, in which a four-bladed rotating device is immersed at a controlled speed. The concrete is subjected to shear through the rotation of this device. This model allows us to describe the rheological behavior of concrete (at full scale) and to determine its intrinsic parameters, namely yield stress and plastic viscosity. The validation of this approach was established by formulating six (06) self-compacting concretes (SCC) (at full scale). The intrinsic rheological parameters (yield stress and viscosity) obtained from their reduced-scale concretes confirm their self-compactability, referencing the rheological results of self-compacting concretes provided by three other internationally recognized rheometers. The results also demonstrated a very strong correlation between the slump flow of these six (06) full-scale SCCs and the yield stress of their reduced-scale concretes on one hand, and between sieve stability and plastic viscosity on the other. The advantage of this approach is to limit the burdensomeness and the complexity of studies on full-scale concrete and reduce the time required to obtain appropriate results. In conclusion, this model of reduced-scale concrete, in which a rotating device operates at a controlled speed, is capable of describing the rheological behavior of fluid concrete such as self-compacting concrete and providing its intrinsic parameters, namely yield stress and plastic viscosity.

Keywords: *Rheology, yield stress, plastic viscosity, self-compacting concrete, modeling, rheometer.*

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INVESTIGATING THE IMPACT OF RECYCLED POLYESTER FIBERS ON THE PROPERTIES OF SAND CONCRETE

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Abstract

Increasing CO2 emissions and environmental damage caused by liquid and solid waste are forcing researchers in their field to find creative solutions. In civil engineering, the non-biodegradable nature of synthetic waste fibers is being extensively studied to highlight their potential for recycling. This research focuses on investigating the use of discarded Waste Polyester Fibers (WPF) obtained from cobblers to strengthen sand concrete. The WPF had a diameter of 1 mm and were cut into lengths ranging from 10 to 15 mm. They were incorporated into the sand concrete at proportions of 1%, 1.5%, and 2% by mass. The effects of these fibers on the fresh and hardened states of the sand concrete were examined over periods of 3, 7, and 28 days. The results show that workability and density decreased after adding WFP to the mix. Compressive strength decreased by 23.25% at 2%, while flexural tensile strength showed a significant improvement, reaching a peak of 127% at 1.5%. Similarly, splitting tensile strength increased by 56% at 2% fibres content. These results confirm that WPF improve the tensile strength of sand concrete. However, it is important to accurately determine the fiber dosage in order to obtain optimal properties.

Keywords: *Sand concrete, Waste Polyester fiber, fresh states, and hardened states*

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EFFET DE LA GEOMETRIE ET L'HYBRIDATION DES FIBRES METALLIQUES SUR LES PROPRIETES PHYSICO CHIMIQUES DU BETON

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Abstract

This research work examines an experimental study aimed at studying the effect of the geometry an hybridization of metal and polypropylene fibers on the physicomechanical behavior of concrete as well as their flexional behavior.
Seven concrete formulations were studies, a control concrete, three formulations reinforced with a single type of fiber (corrugated metal fiber, hooked metal fiber, polypropylene fiber) and three formulations with hybrid fiber reinforcement.
The results obtained show that the mechanical behavior of fiber reinforced concrete with respect to compressive strength and deformability are significantly improved and present a very significant gain.
Geometry, shape and fiber type are important factors for improving the flexural behavior and deformability of concrete.

Keywords: *Fiber reinforced concrete. Corrugated metal fibers. Attached metal fibers. Polypropylene fibers. Mechanical behavior.*

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EFFET DE LA GEOMETRIE ET L'HYBRIDATION DES FIBRES METALLIQUES SUR LES PROPRIETES PHYSICO CHIMIQUES DU BETON

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Abstract

This research work examines an experimental study aimed at studying the effect of the geometry an hybridization of metal and polypropylene fibers on the physicomechanical behavior of concrete as well as their flexional behavior.
Seven concrete formulations were studies, a control concrete, three formulations reinforced with a single type of fiber (corrugated metal fiber, hooked metal fiber, polypropylene fiber) and three formulations with hybrid fiber reinforcement.
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Geometry, shape and fiber type are important factors for improving the flexural behavior and deformability of concrete.

Keywords: *Fiber reinforced concrete. Corrugated metal fibers. Attached metal fibers. Polypropylene fibers. Mechanical behavior*

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UREA DEWAXING OF HEAVY ATMOSPHERIC GASOIL IN THE PRESENCE OF DIFFERENT ACTIVATORS

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Abstract

The urea dewaxing process is used to remove paraffinic hydrocarbons contained in kerosene, gasoil and light oils in order to obtain a low pour point product and soft paraffin. In this study, a heavy atmospheric gasoil having a distillation range of 323–372°C was dewaxed by urea in the presence of different activators, namely methanol, ethanol and acetone. The role of the activator is to accelerate the formation of the adduct (urea-paraffin complex) by creating a homogeneous solution of urea and paraffin. All experiments were carried out under the same operating conditions using petroleum ether as solvent. The formation of the complex required 40 min of stirring at 35°C. The complex was then separated from the liquid phase by vacuum filtration. The decomposition of the complex with water heated to 80°C allowed the recovery of the paraffin, while the dewaxed gasoil was recovered by simple distillation. The results showed that the quantities of paraffins obtained depend on the activator used, they increase in the order acetone < ethanol < methanol. The pour points of the raw material and dewaxed gasoils were measured by the ASTM D97 standard test method. The dewaxing process in the presence of methanol lowered the pour point of heavy gasoil from +3°C to -24°C. The pour points of dewaxed gasoils in the presence of ethanol and acetone are -18°C and -15°C, respectively. The use of methanol led to obtaining the greatest amount of paraffin and the lowest pour point.

Keywords: *Urea dewaxing, Heavy atmospheric gasoil, Activators, Pour point, Soft paraffin*

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FORMULATION OF A SELF-COMPACTING CONCRETE BASED ON MARBLE FROM THE OPTIMIZATION OF THE PASTE

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Abstract

The aim of this work is to formulate a self-compacting concrete (SCC) through the optimization of its paste. To valorize industrial by-product waste, we utilized marble powder as a substitution and as an additive relative to the weight of the cement. Several cement pastes were formulated, varying the amount of marble as well as its fineness. Four (04) formulation groups were created with an addition of 10% marble, using two different fineness levels, including a control paste and three pastes with cement substitution of 10%, 20%, and 30% marble. For each group, we varied the dosage of the admixture from 0.8% to 2% relative to the mass of the binder, resulting in a total of 56 formulations studied. The optimized paste formulation corresponds to the maximum fluidity of the pastes, determined from tests conducted with a mini-cone by measuring the spread diameter. The results obtained showed that incorporating marble powder into the cement paste improves the rheological properties. We also noted that the optimized paste composition for both fineness levels corresponds to a 30% marble content, with 10% as an additive and 20% as a substitution for the cement, and an admixture dosage of 1.4%. The method of optimizing the paste to formulate self-compacting concrete proves relevant, as the required fresh state characteristics of self-compacting concrete were achieved directly (without trial and error).

Keywords: *Self-compacting concrete, marble, fineness, fluidity, optimization, cementitious paste.*

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ENHANCING CLAY SOIL PROPERTIES WITH CHEMICALLY TREATED PALM LEAF POWDER: AN EXPERIMENTAL AND STATISTICAL APPROACH

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Abstract

The utilization of natural fibers presents a promising approach to mitigate the environmental impact of textile production, given their renewable and biodegradable nature. In this study, we seek to exploit the abandoned residues of Washingtonia filifera (WF) palms, commonly found in northern Algeria, which generates significant waste as its leaves are often discarded without value. We investigate the potential of WF palm leaves, processed into powder (WFP), to enhance the properties of clayey soil. The leaves were chemically treated with sodium hydroxide at concentrations of 3%, 6%, and 9% to improve their mechanical characteristics. Unconfined compression tests were conducted on clay samples incorporating varying percentages of WFP (0.5%, 1%, 1.5%, 2%, and 2.5% by weight). Four parameters were assessed: unconfined compressive strength (UCS), ductility ratio (DR), elastic modulus (E50), and energy absorption capacity (CAE) to evaluate the enhancement of ductility in the treated soil. The effect of experimental parameters was determined by using the statistical tool analysis of variance (ANOVA). In addition, the experimental results was modeled using response surface method (RSM) to find the optimal addition of 2% WFP and 3% NaOH, which is in agreement with the experimental results.

Keywords: *Clayey soil, Chemical treatment, Unconfined compression strength, RSM, Optimizing.*

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THE INFLUENCE OF STABILIZERS' CONTENT ON THE SWELLING AND WATER ABSORPTION PROPERTIES OF EARTH CONCRETE

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Abstract

Swelling and water absorption are significant issues in earthen construction, affecting both durability and structural integrity. Earthen materials, such as adobe and rammed earth, are naturally porous and can absorb moisture, leading to swelling and potential structural damage over time. This moisture uptake can result in cracking, deformation, and a decrease in load-bearing capacity, ultimately compromising the longevity of the structure. Effective stabilization techniques, such as the addition of binders, are essential for mitigating these issues, enhancing the resilience of earthen construction in various environmental conditions. This investigation aims to contribute to addressing swelling and water absorption, which are crucial for ensuring the sustainability and reliability of earthen buildings, by examining the changes in these properties with varying binder (cement and quicklime) contents. The main results reveal that stabilization positively affects both swelling and water absorption, enhancing the resistance of earth concrete samples to water by reducing these properties.

Keywords: *Stabilization, Earth concrete, Swelling, Water absorption*

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INSTABILITE DES POUTRES MÉTALLIQUES BI-SYMETRIQUES MAINTENUES LATERALEMENT CONTRE LE GAUCHISSEMENT ET LA ROTATION.

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Abstract

In this study, the results of theoretical investigations into the instability phenomenon of lateral torsional buckling of bi-symmetrical rolled steel I-beams are presented. These beams are restrained and held laterally and elastically against warping and rotation in the plane of lateral torsional buckling at the end nodes or supports. For this purpose, an analytical model was proposed to provide the critical loads and subsequently the critical moments of lateral torsional buckling. This model is based on the principle of total potential energy realised in the context of linear elastic behaviour. The differential equilibrium equations are established using Galerkin's method, then the tangential stiffness matrix is calculated to determine the critical loads. The critical moments are calculated using programs that enable the numerical calculations to be carried out. The values of critical moments determined using these programmes were compared with the values obtained using the LTBeam (FEM) software. Using these numerical examples, very good agreement was found between the results. Detailed calculations were carried out accordingly for different values of the fixity index against buckling and against rotation in the plane of lateral torsional buckling.

Keywords: *Instability, critical load; Lateral restraint ; Warping; Torsion; The energy method.*

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OPTIMIZATION OF GEOMETRIC PARAMETERS INFLUENCING THE BEARING CAPACITY OF A STRIP FOOTING ABOVE TWIN CIRCULAR VOIDS USING RESPONSE SURFACE METHODOLOGY

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Abstract

Underground excavations are essential in several fields, such as tunnel construction, mining, and the development of underground infrastructure. This study examines the potential of the response surface methodology (RSM) to optimize the location and dimensions of underground excavations. This methodology is used to predict the bearing capacity of strip footings located above circle excavation and to optimize their geometric parameters, including the excavations depth (Y), the distance between excavations(X), and the excavations diameter (D). The influence of the geometric parameters on the behavior of the footing and the location of the cavities as will be also studied.The aim of this work is to optimize both the location and dimensions of underground excavations by numerically assessing the bearing capacity of the footings situated above these excavations. To achieve this, the response surface methodology (RSM) will be applied. The numerical modeling of the problem will be conducted using the Plaxis 2D software, based on the finite element method. Numerical design of experiments will also be developed for modeling, taking into account the geometric parameters of the excavations. The response surface methodology (RSM) will be used to develop mathematical models linking input (Y, X, D) and output parameters (qu) for future optimizations. Finally, these models will be combined with an optimization technique to enhance the geometric dimensions and positioning of the excavations.

Keywords: *Bearing Capacity, Optimization, RSM, Underground Excavation, Plaxis.*

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OPTIMIZATION OF GEOMETRIC PARAMETERS INFLUENCING THE BEARING CAPACITY OF A STRIP FOOTING ABOVE TWIN CIRCULAR VOIDS USING RESPONSE SURFACE METHODOLOGY

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Abstract

Underground excavations are essential in several fields, such as tunnel construction, mining, and the development of underground infrastructure. This study examines the potential of the response surface methodology (RSM) to optimize the location and dimensions of underground excavations. This methodology is used to predict the bearing capacity of strip footings located above circle excavation and to optimize their geometric parameters, including the excavations depth (Y), the distance between excavations(X), and the excavations diameter (D). The influence of the geometric parameters on the behavior of the footing and the location of the cavities as will be also studied.The aim of this work is to optimize both the location and dimensions of underground excavations by numerically assessing the bearing capacity of the footings situated above these excavations. To achieve this, the response surface methodology (RSM) will be applied. The numerical modeling of the problem will be conducted using the Plaxis 2D software, based on the finite element method. Numerical design of experiments will also be developed for modeling, taking into account the geometric parameters of the excavations. The response surface methodology (RSM) will be used to develop mathematical models linking input (Y, X, D) and output parameters (qu) for future optimizations. Finally, these models will be combined with an optimization technique to enhance the geometric dimensions and positioning of the excavations

Keywords: *Bearing Capacity, Optimization, RSM, Underground Excavation, Plaxis.*

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IN-VITRO DISSOLUTION STUDY OF A TRANSDERMAL DRUG FILM BASED ON HYDROCHLOROTHIAZIDE

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Abstract

Bioadhesive polymers have a significant role in the development of drug delivery systems and medical devices. Bioadhesion refers to the ability of certain materials, particularly polymers, to adhere to a biological surfaces such as skin, mucous membranes, or specific tissues. This property is exploited to enhance therapeutic efficacy by prolonging the contact time of the device or drug with the target surface.

The aim of this research is to design a medicated film based on an antihypertensive agent, hydrochlorothiazide, using a combination of bioadhesive polymers for transdermal administration. The films were prepared according to a matrix of trials (F1 to F6) using the solvent casting technique. Physicochemical and biopharmaceutical evaluations of the prepared transdermal films were performed through various characterizations such as physical appearance, thickness measurement, mass uniformity, content uniformity, and in vitro drug release. The results demonstrated that the incorporation of CMC and PVP K30 into the film formulation had a significant impact on the physicochemical and pharmacokinetic properties of hydrochlorothiazide. Specifically, in the F4 formulation, the influence of the three polymers HEC, CMC, and PVP K30 at minimal concentration was well observed. This effect resulted in a notable reduction in the dissolution rate, with it not exceeding 60% after 8 hours, compared to 80% for hydrochlorothiazide alone.

This approach offers promising improvements in transdermal systems, addressing the needs of hypertensive patients by reducing dosing frequency and optimizing drug bioavailability. Further research is required to refine the formulation and assess its in vivo performance.

Keywords: *Bioadhesive polymers, transdermal film, hydrochlorothiazide, In vitro dissolution*

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ASSESSMENT THE MECHANICAL AND THERMAL BEHAVIOR OF RECYCLED WASTE BASED-CONCRETE

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Abstract

Fiber-reinforced concretes derived from the recycling industry possess very satisfactory intrinsic mechanical properties at ambient temperature. However, their behavior under extreme conditions, such as fires, still raises several questions. The objective of this research is to study the behavior of fiber-reinforced concrete at high temperatures, as well as the impact of temperature evolution on their mechanical properties, by evaluating residual mass loss and residual strength.

The concretes were subjected to different heating and cooling cycles up to maximum temperatures of 600°C and 800°C after a 28-day curing period. This study revealed that the residual strength of fiber-reinforced concretes from the recycling industry significantly decreased when exposed to high temperatures compared to concretes not subjected to such conditions. At all examined temperatures, metallic fiber concretes demonstrated significantly higher strength compared to polypropylene fiber and mixed fiber concretes. At 800°C, mixed fiber concretes showed spalling areas, while metallic and polypropylene fiber concretes developed networks of microcracks without spalling.

Keywords: *Concrete, Temperature, polypropylene fibers, metallic fibers, strength.*

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INTELLIGENT CONTROL STRATEGY FOR MITIGATING SEISMIC VIBRATIONS IN STRUCTURES

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Abstract

The increasing need to minimize undesirable vibrations in structures has spurred the development of intelligent active control strategies aimed at reducing seismic responses. Among the key structural parameters, peak inter-story drifts and total drift responses are particularly significant due to their impact on building integrity, occupant safety, and potential damage reduction during earthquakes. Therefore, mitigating inter-story drift is crucial. Our research focuses on deploying an Active Mass Damper (AMD) system, controlled by an advanced neuro-controller, to significantly reduce seismic impacts on a five-story building. The performance of the AMD system is compared to that of a conventional Passive Tuned Mass Damper (TMD) system. Simulations using historical earthquake data, including Northridge far fault, Chi-Chi near fault without pulse, and Loma Prieta near fault with pulse, demonstrate that the AMD system is more effective in minimizing critical structural responses, such as peak and total inter-story drifts. These results emphasize the advantages of incorporating intelligent control systems to enhance building resilience against earthquakes.

Keywords: *Intelligent control, Neuro-controller, AMD, Seismic response.*

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ARTIFICIAL NEURAL NETWORKS FOR PREDICTING COMPRESSIVE STRENGTH IN SLAG-BASED CONCRETE

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Abstract

The incorporation of slag into cement is commonly used to improve its physical and mechanical properties. Consequently, the use of artificial neural network (ANN) technology has become increasingly advantageous and essential for predicting the compressive strength (CS) of concrete. To achieve this, a prediction model was developed using a dataset collected from various research experiments. By evaluating the factors influencing the mechanical properties studied, the model demonstrated excellent performance in learning, testing, and validation, with an impressive correlation of 98% and a mean squared error of 0.019. A parametric analysis and comparison of the predicted values with experimental results from other studies further confirmed the model's effectiveness, indicating its reliability for predicting the CS of slag-based concrete.

Keywords: *Slag concrete, Artificial neural networks, Correlation, Compressive strength, predictive modeling.*

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SEISMIC RESPONSE OF STRUCTURES SUBJECTED TO NEAR FIELD EARTHQUAKES

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Abstract

Ground motions are categorized as near-fault or far-fault based on their distance from the epicenter and their motion characteristics. The near-fault zone is generally defined as being within 20 km of the ruptured fault, though this definition can vary depending on site-specific factors and ground motion characteristics. A distinct feature of near-fault ground motions is the presence of a high-intensity pulse early in the movement, which is clearly visible in velocity time history. These motions are typically more intense than other ground motions recorded during the same seismic event under similar conditions, as their proximity to the seismic source limits the attenuation of energy. This study aims to assess how structures with different dynamic characteristics respond to near-fault ground motions.

Keywords: *Earthquakes; far-fault; near-fault; ground motion; response spectrum*

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A BIBIOGRAPHIC ANALYSIS OF THE CONCRTE CREEP FOR MODELING THE BEHAVIOR OF THE REINFORCED CONCRTE STRUCTURES

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Abstract

Nonlinear analysis has been widely used to study the behaviour of the reinforced concrete structures until failure. Research in industry and science aims to extend forward the use of nonlinear calculation of the reinforced concrete structures, taking into account the concrete creep for structural parts such as columns. In the literature research we find some research's on this subject and the results are reported in several communications and publications.

This paper explores the different synthesis methods of the concrete creep in the nonlinear analysis of the reinforced concrete structures. For selecting a suitable creep model, we consider the the nonlinear method analysis describing the behavior of the reinforced concrete structures.

The developed software existing has been established by using the approach of the beam elements representing the structure response by two nodes, the calculations are carried out iteratevely, the stiffness matrix is determined as a fonction of loading, which is turn for the determination of the distribution of the internal forces. This calculation is based an iterative process.

Finally this study aims to contribute and provide guidance for introducing in development fortran of the existing developed software the effects of the concrete creep for modeling of the reinforced concrete structures

Keywords: *Creep, concrete, stiffness matrix, structures, loading*

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DETERMINING THE OPTIMAL VARIANT FOR A ROAD PROJECT BY COMBINING THE BIM TOOL WITH THE TOPSIS AND ELECTRE III METHODS.

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Abstract

Traditional methods of road infrastructure design and planning are often a source of wasted time, additional costs, delays and errors. Building information modeling (BIM) represents a significant technological advance in the construction sector, offering substantial benefits throughout the project lifecycle and reducing design errors in road infrastructure projects. However, major improvements are still needed in the field of road and motorway infrastructure. A central objective is to facilitate data exchange and collaboration on these projects.

During the preliminary design phase, the selection of variants is a crucial step. This stage is decisive in assessing the viability and feasibility of the different variants, and in preparing the project for the next, more detailed phase. It's in this context that the main aim of this research is to identify the optimum road alignment to replace a flood-prone section of the CW 60, linking the town of Sidi Belattar to the RN 90, at the Chelif river. This section was chosen as a case study for digital experimentation.

A comparative analysis was carried out by projecting the different variants using 2D mapping and the INFRAWORKS 3D tool. The variants were ranked using two multi-criteria analysis methods, TOPSIS and ELECTRE III. The results of the ranking were consistent, recommending variant 2 to replace the vulnerable section.

Keywords: *BIM, Road, Flood, InfraWorks, Topsis, Electre III.*

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SEISMIC VULNERABILITY OF MASONRY STRUCTURES (TIZI-OUZOU CITY)

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Abstract

Seismic vulnerability expresses the response of structures to earthquakes. Understanding the seismic behavior of an existing structure requires knowledge of its specific structural features, the materials it is made of, and the calculation codes used. However, a building stock typically includes structures that are little understood and difficult to analyze; such as the unreinforced masonry structures that comprise much of the city of Tizi-Ouzou.

These structures, whose state of preservation varies considerably, are generally of a low height and have relatively thick load-bearing walls. Our research aims to analyze analytically the seismic vulnerability of these structures. We then proceed to construct capacity curves that describe their behavior under seismic loads. Capacity curves represent the variation of the shear force at the base of the structure as a function of the displacement at the top and describe the structure's response to progressive loading. The variation of this displacement as a function of the spectral displacement which characterizes the seismic action, associated with a damage measurement, leads to vulnerability curves for these structures.

Keywords: *Vulnerability, masonry, capacity curves, seismic damage.*

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CALCINING MORDENITE-RICH TUFF AND ITS EFFECT ON CEMENT MORTARS CHARACTERISTICS

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Abstract

The cement industry is an important economic unit that is growing. The high costs and inadequate ecological effects of commonly used cement materials have prompted research into alternate cementitious materials such as pozzolans, and studying the pozzolanic characteristics of mordenite-rich tuffs will thus benefit the cement industry. Many recent studies have looked into the feasibility and advantages of using mordenite-rich tuff as an additive in cement and mortars. The study's findings revealed that using mordenite-rich tuff in its natural state, without pretreatment, is not always as effective as it should be. Then, improving its reactivity could potentially overcome for this weakness.

In order to improve the raw mordenite-rich tuff's performance when used in mortars to partially substitute Portland cement, the material was calcined at 300 °C and 500 °C. The studied samples are normalized mortars with tuff replacing cement on a weight-for-weight basis at amounts of 0, 5, 10, 15, and 20%. The produced mortars were investigated by measuring changes in dynamic workability, total shrinkage, pore size distribution, dynamic Young's modulus, mechanical strength, and SEM micrograph. The results clearly show that thermal activation improves the performance of the raw mordenite-rich tuff. Calcination improved the flow rate of the mortars and reduced the total shrinkage. Calcination significantly improved the mechanical resistance and reduced the rate of large pores (> 50 nm).

Keywords: *mordenite-rich tuff, calcination, Portland cement, substitution.*

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EXCEEDING MEMBRANE STRUCTURE ANALYSIS'S LIMITS: INNOVATIONS IN RECTANGULAR FINITE ELEMENT DESIGN

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Abstract

The precision for determining various domains such as stresses, strains, and mobility is crucial in the static study of structures. This innovative study focuses on designing a specifically rectangular finite element specialized in the analysis of structural membranes, emphasizing the importance of incorporating limitations. Unlike traditional approaches, this element takes into account particular geometric significance in determining the overall conformity of the structure, providing a more secure way to represent membrane behavior.

Through the utilization of linear constraints, the results achieved show a more favorable convergence of this element compared to other methods, including the standard solution.

Advances enhance our understanding of membrane structures and create new perspectives in terms of structural analysis, solidifying the foundations of building design,

Keywords: *Structural Membranes, Finite Element Analysis, Rectangular Finite Element, Geometric Constraints, Static Analysis, Linear Constraints*

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PERFORMANCES AND EFFECT TEMPERATURE ON THE SHRINKAGE OF CONCRETE MADE WITH RAP

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Abstract

The objective of this study is to determine the effect of curing temperatures (20, 40, and 60 °C) and replacement rates of recycled asphalt pavement (RAP) on mechanical properties and shrinkage of recycled asphalt pavement (RAPC). Three mixes were produced: one with natural aggregate (NA) and four with manufactured with four RAP replacement ratios (0%, 50% and 100%). The results show that using RAP reduces the mechanical performance of RAPC. Moreover, this study highlighted the total shrinkage, which had been found to increase with RAP content. However, the total shrinkage of RAPC decreases as the curing temperature increases, and this reduction can be as much as 20% at 60°C in comparison with conventional concrete.

Keywords: *Recycled asphalt pavement; curing temperature; strength; shrinkage.*

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PROPOSAL FOR NEW THERMAL INSULATION SYSTEMS BASED ON NATURAL MATERIALS IN DESERT REGIONS

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Abstract

In Algeria, the construction of the exterior envelope of buildings is primarily based on the use of common materials such as concrete, breeze blocks, red bricks, cement coatings, etc. However, while these materials are widely used in the residential sector, both for collective and individual housing, they are not reliable for thermal insulation due to their poor thermo-physical properties (thermal conductivity, specific heat, and density), and the lack of application of thermal insulation standards. This results in energy-intensive buildings that do not meet the thermal comfort requirements for users. In this context, the main goal of this work is to propose new thermal insulation systems using natural insulating materials suitable for occupants in Saharan regions characterized by a hot and dry climate. To achieve this, we propose thermal insulation systems for vertical walls using natural insulating materials with a lower environmental impact, in order to minimize the shortcomings of ordinary materials used in the building envelope in terms of thermal insulation. The results obtained show that natural insulating materials play an important role in energy performance, which is primarily linked to several factors: the type of insulating material, the climate, and the type of thermal insulation system.

Keywords: *Natural materials-Insulation system-Energy performance-Residential-Thermal comfort-Desert environment.*

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COMPRESSIVE STRENGTH AND ULTRASONIC CHARACTERISTICS OF STABILIZED EARTH CONCRETE WITH QUICKLIME, PORTLAND CEMENT AND DATE PALM FIBERS

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Abstract

Given the alarming rise in carbon emissions, natural resource depletion, and environmental degradation, the demand for eco-friendly, energy-efficient, and sustainable construction has become increasingly urgent. Earthen construction materials are gaining renewed interest as viable and sustainable alternatives. In Algeria, earth has a long history of use in construction, particularly in the Ksour of the southern regions. However, their abandonment, coupled with the harsh weather conditions of the Sahara, has resulted in their significant deterioration. To enable appropriate restoration interventions for this type of construction and to produce earth materials that meet contemporary construction demands, a better understanding of the behavior of these materials is essential. In this context, this research aims to assess the compressive strength and ultrasonic properties of earth concrete incorporating varying contents of quicklime, Portland cement, and date palm fiber, using soil from the degraded part of Ksar Mougheul. The findings revealed that the stabilizers improved both properties, while the inclusion of date palm fibers had an adverse effect. Furthermore, a positive correlation was found between the ultrasonic characteristics and strength outcomes.

Keywords: *Stabilized earth concrete, Date palm fiber, Compressive strength, Ultrasonic characteristics*

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NUMERICAL MODELING OF THE GROUP IMPACT ON THE REINFORCED SOFT SOIL BY RIGID INCLUSIONS UNDER SEISMIC LOADING

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Abstract

The rigid inclusions are one of the reinforcement techniques that offer a fair balance between lead time, cost, and a notable decrease in displacements. The dynamic response of the soil-inclusion-mattress system under seismic loading is numerically modeled in this research. In order to examine how the number of inclusions affects the system's overall behavior and the variation in internal stresses within each inclusion, six models with varied numbers of inclusions were simulated in this study. The results show that as the number of inclusions increases, the internal stresses and displacement decrease, and then we compared the outcomes in the inclusions network, which appear to decrease when we get far from the central inclusion. This drop is explained by the fact that the overall stress is shared by all of the inclusions in the system. As for the results of the internal stresses as a function of depth, when examining the central inclusion, which experiences the highest load in each model, a distinctive pattern emerges for the shear force; it displays a linear relationship along the depth with opposite signs in the upper and lower halves. The bending moment results display a nearly parabolic relationship, with almost zero values at the top and bottom, and the peak is typically found at the inclusion's midpoint. These results confirm the group impact on the overall behavior of the system and the importance of the rigid inclusions as one of the best reinforcement techniques to improve the soft soil subjected to seismic loading.

Keywords: *Numerical modeling, Reinforcement techniques, Rigid inclusions, Soft soil, Seismic loading.*

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EFFECT OF SAND TYPE AND POLYPROPYLENE SHORT FIBERS ADDITION ON COMPRESSIVE PERFORMANCES OF TEXTILE-REINFORCED MORTARS

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Abstract

Efforts to reduce the environmental impact of the construction industry are intensifying. Researchers are increasingly focusing on eco-friendly alternatives to minimize its ecological footprint. One promising resource is dune sand, which covers approximately 20% of the Earth's land surface, offering a vast, untapped supply for construction purposes. The environmental benefits of dune sand are considerable: its extraction has a far lower carbon footprint compared to traditional materials like river sand or crushed stone, which require more energy-intensive processes such as quarrying, crushing, and transportation. Moreover, dune sand's availability in vast, naturally occurring deposits reduces the need for extensive mining operations, thereby limiting habitat disruption and preserving biodiversity. By integrating dune sand into concrete and mortar formulations, the construction industry can significantly reduce its reliance on over-exploited natural resources, lower greenhouse gas emissions, and move towards more sustainable building practices. This makes dune sand a highly attractive option for addressing the industry's pressing need for sustainable development. In this context, to reduce the amount of cement used and to valorize dune sand; an experimental study of the compressive strength of a new eco-friendly mortar, designed for the production of textile reinforced mortars based on Tougourt and Bossada dune sand. The sand/binder ratio (s/b) was increased to 2.16 and polypropylene short fibers were added to the various compositions at rates of 1.5% and 2%. The obtained results revealed that Bou Saâda sand is distinguished by its ability to form a high-performance combination with short fibers, creating a synergy that considerably optimizes the strength of the TRM.

Keywords: *Keywords: Dune sand, Short fiber, Compression, Mortar, Eco-friendly*

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NONLINEAR ANALYSIS OF REINFORCED CONCRETE STRUCTURES UNDER STATIC LOADING TAKEN INTO ACCOUNT THE EFFECT TO TENSION CONCRETE

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Abstract

In this article, we present a method for the nonlinear analysis of plane frames, applicable to reinforced concrete structures, taking into account the behavior laws of the materials (Concrete and Steel). The concrete section is defined by a succession of trapezoidal tables and the effect of tensile concrete after cracking is taken into account (Grelat model), the structure is discretized into one-dimensional finite elements (Bar elements) connecting two nodes. Nonlinearity is considered under its two aspects, material and geometric. A FORTRAN 90 calculation program has been developed to simulate the nonlinear behavior of reinforced concrete structures up to structural failure, and to determine the maximum 'Moment-Displacement' capacity diagrams under the effect of static loading applied progressively (step by step). The numerical calculation results obtained and the comparison with results taken from the literature show very good agreement.

Keywords: *Plane structure, Reinforced concrete, Nonlinear modeling, Failure, Capacity curve*

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IMPACT OF BEAM-COLUMN JOINT FLEXIBILITY ON THE SEISMIC PERFORMANCE OF SETBACK RC BUILDINGS DESIGNED PER ALGERIAN SEISMIC CODE

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Abstract

The Algerian seismic code assumes that beam-column joints in monolithic reinforced concrete (RC) structures are fully rigid. However, numerous experiments have demonstrated that these joints exhibit relative rotations, leading to the partial transfer of bending moments. This study investigates how the modeling of beam-column joints influences the overall seismic performance of RC moment-resisting frame buildings designed in accordance with Algerian seismic code guidelines. To account for the nonlinear behavior of the joints, a recently developed analytical model is utilized. This model incorporates two primary deformation mechanisms: slippage of continuous reinforcement within the columns and bending-induced slippage at the beam ends due to cracking. Three multi-storey RC frames with varying setback geometries, including a reference frame, are analyzed with the joints modeled as either rigid or flexible. A nonlinear static (pushover) analysis is conducted, and the results—capacity curves, target displacements, story drift, story stiffness, and response reduction factors—are presented. The findings emphasize the importance of incorporating beam-column joint flexibility in the modeling of such structures.

Keywords: *Beam-column joints; pushover analysis; RC buildings; setback buildings; seismic behaviour.*

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NUMERICAL COMPUTATIONAL OF MAGNETIC FIELD EFFECT ON SYMMETRY BREAKING IN CZ CRYSTAL GROWTH

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Abstract

This study focuses on the numerical investigation of the influence of an external magnetic field on symmetry breaking during crystal growth using the Czochralski (Cz) method. The model incorporates the simultaneous rotation of both the crystal and the crucible to account for their coupled effects on fluid dynamics and thermal distribution. The research explores the interactions between electromagnetic forces, convective fluid motion, and thermal gradients, which are crucial in determining the quality of the grown crystal.

The numerical results demonstrate that the application of a magnetic field significantly alters the hydrodynamic and thermal behaviors within the melt, resulting in noticeable symmetry breaking. This phenomenon affects the uniformity of temperature distribution and the stability of the growth process. Furthermore, the relative rotational velocities of the crystal and crucible are shown to play a pivotal role in mitigating these disturbances, providing a potential means to enhance the stability and homogeneity of the crystal structure.

The findings underscore the importance of optimizing process parameters, such as magnetic field intensity and rotation rates, to minimize structural defects and improve crystal quality. This work contributes to a deeper understanding of the physical mechanisms governing Cz crystal growth under electromagnetic conditions and offers practical insights for refining industrial crystal growth processes.

Keywords: *Czochralski (Cz) method, Crystal growth, Magnetic field, Convective flows*

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A NEW METHOD FOR ASSESSING THE TENSILE STRENGTH OF CONCRETE

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Abstract

Unlike compressive strength, it is difficult to determine the real tensile strength of concrete using the uniaxial tension test due to concrete brittleness behaviour. The aim of this experimental investigation is to introduce a novel method for testing concrete under uniaxial tension, designed to address the challenges encountered in previous research methodologies. Three types of concrete specimens -ordinary concrete (OC), self-compacting concrete (SCC), and steel fiber-reinforced concrete (SFRC)- were tested at 28 days to assess the effectiveness of the developed method. In addition to the uniaxial tension tests, indirect tensile tests (splitting and flexural strength tests) were also performed to verify the reliability of the proposed testing method. The results obtained are quite converged and show that the tensile strength determined by the suggested method is clearly lower than that of the flexural test and slightly lower than the Brazilian test, with less variation. As expected, a unique cracking location was observed in the middle of all specimens subjected to the direct tension test.

Keywords: *Concrete, tensile strength, Uniaxial tension test, Brazilian test, Flexural test.*

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ENHANCING BORDER SECURITY THROUGH DEEP LEARNING-DRIVEN PASSPORT AUTHENTICATION: A NOVEL HYBRID MODEL

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Abstract

The purpose of this conference paper is to demonstrate a complete deep learning-based face recognition system for passport authentication, with the goal of improving border security and streamlining travel operations. MTCNN is used for reliable face identification, VGGFace is fine-tuned for discriminative feature extraction, LBP is used for efficient feature encoding, and a similarity score function with manual threshold determination is used for similarity evaluation. Extensive experimentation and assessment on a carefully chosen dataset demonstrate the system's usefulness, with a high recognition accuracy of 95\% achieved. The suggested approach overcomes issues such as illumination, face variations, and identity authentication, resulting in a dependable and effective solution for safe passport verification.

Keywords: *deep learning, passport authentication, VGGFace, Local Binary Patterns (LBP), face recognition, border security*

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AUTOMATED KNEE OSTEOARTHRITIS CLASSIFICATION USING A COMBINED DEEP LEARNING MODEL: DATA FROM OSTEOARTHRITIS INITIATIVE

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Abstract

Knee Osteoarthritis (KOA) is a prevalent chronic joint disorder in adults aged 65 and above,
characterized by progressive cartilage loss that leads to pain, stiffness, and reduced mobility.
The diagnosis of KOA often involves clinical assessments, imaging tests, and laboratory
analyses, with radiography being a common method despite its challenges, especially in the
early stages of the disease. This study aimed to explore the viability of deep learning for the
automatic classification of KOA using radiographic images, providing medical professionals
with a reliable and sophisticated diagnostic tool.
The study utilized a dataset of 1280 knee X-ray images from the Osteoarthritis Initiative (OAI),evenly divided between osteoarthritic (KL2) and normal knees (KL0). To enhance the dataset and improve model robustness, data augmentation techniques such as translation and rotation were employed. Three Convolutional Neural Network (CNN) architectures DenseNet201,AlexNet, and SqueezeNet were selected for feature extraction due to their proven effectiveness in image analysis tasks. The Grid Search algorithm was used to optimize the feature selection process, identifying the most discriminative subset of features for KOA classification. These features were then input into a logistic regression classifier, chosen for its interpretability and efficiency in binary classification tasks.
The combined model of CNN architectures outperformed each individual model, achieving an accuracy of 91.4%. In comparison, the individual models AlexNet, SqueezeNet, and DenseNet201 achieved accuracies of 88%, 86%, and 84%, respectively. The combined model
also demonstrated a high specificity of 92.24% and a sensitivity of 90.51%, surpassing previous deep learning studies on KOA classification.
This study demonstrates that deep learning holds significant potential for automating KOA classification from radiographic images with high accuracy, specificity, and sensitivity.

Keywords: *X-ray images, Classification, Deep learning, Knee Osteoarthritis.*

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PHISHING EMAILS DETECTION USING LARGE LANGUAGE MODELS

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Abstract

Phishing is a type of social engineering crime that leverages digital media to deceive victims. While the majority of phishing attacks are via email, websites, instant messaging, text messages, and voice calls are also communication channels exploited by attackers. Currently, traditional detection techniques are no longer effective in dealing with the malicious phishing strategies adopted by attackers. In this context, advanced methods based on artificial intelligence are becoming imperative. Machine learning (ML) and deep learning (DL) algorithms are widely used to develop predictive models for effective phishing detection.

Large Language Models (LLMs) are artificial intelligence models designed to understand, generate, and communicate using human-like languages. These models are based on advanced neural network architectures and use complex structures such as transformers and attention mechanisms, which give them the enormous capacity to understand the meaning of a word in a particular context. These properties make LLMs a good candidate to solve the phishing detection problem. The aim of this paper is to use the technique of transfer learning to fine-tune LLMs to enhance their ability for phishing detection tasks. Our experiments show that LLMs significantly improve phishing detection compared to traditional methods, enabling the development of more robust and adaptive security systems, thus strengthening enterprise cybersecurity.

Keywords: *Phishing Emails detection, Deep Learning, Classification, Natural Language Processing (NLP), Large Language Models (LLMs)*

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ADVANCED SLEEP ANALYSIS: MACHINE LEARNING TECHNIQUES FOR MULTI-SIGNAL-BASED SLEEP STAGE CLASSIFICATION

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Abstract

Accurate classification of sleep stages is essential for diagnosing and treating sleep disorders. While various approaches have been explored, there remains a significant opportunity for improvement by utilizing multiple physiological signals. In this research, we employed the K-nearest neighbours (KNN) algorithm to classify sleep stages using a combination of Electrocardiogram (ECG), Electroencephalogram (EEG), and Electromyogram (EMG) signals. The data was sourced from the CAP Physio Net database, a well-established resource for biomedical signals. ECG, EEG, and EMG signals were segmented into 30-second epochs, and wavelet transforms were applied to extract meaningful time frequency features from each signal. The extracted features were used in the KNN classification model to enhance the accuracy of sleep stage classification. By combining wavelet-based feature extraction with data from ECG, EEG, and Signals, the model achieved a classification accuracy of 95.2%. This study high lights the effectiveness of multi-signal analysis for sleep stage classification, showing that integrating ECG with EEG and EMG signals can significantly improve the precision of sleep stage identification.

Keywords: *Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyo gram (EMG), sleep stages, K-nearest neighbors (KNN),classification*

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THERMAL BUCKLING ANALYSIS OF FUNCTIONALLY GRADUATED SANDWICH PLATES USING REFINED PLATE THEORY

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Abstract :
This work is devoted to the analysis of the thermal buckling of simply supported FGM sandwich plates. Material properties such as Young's modulus and coefficient of thermal expansion vary across the thickness of the structure according to a power law function (P-FGM) as a function of the volume fractions of the constituents. An exponential shear function refined plate theory (RESDPT) is used to subscribe to a description of the shear stress across thickness that must satisfy the nullity conditions of the shear stresses in the edges of the plate. The displacement field is modeled with only four unknowns, being inferior to the FSDT theory and does not require a shear correction factor. The sandwich plate faces are made of isotropic diffusion, with two constituents (ceramic-metal) through the thickness of the material. Symmetrical and non-symmetrical types of sandwich plates are presented. The equilibrium equations are obtained by applying the virtual work principle. The Navier's approach has been used to solve the system of equilibrium equations. The numerical results of the current shear strain theory are presented to show the effect of material distribution and basic parameters on temperature. Three types of thermal loading vary across the thickness direction are used: uniform thermal loading, linear, and nonlinear. An exact solution of the nonlinear distribution of temperature across the thickness of the sandwich structure has been proposed.
Keywords: *thermal buckling, property gradient material, FGM sandwich plate.*

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INFLUENCE OF OLIVE MILL WASTE ON THE SKID RESISTANCE OF ASPHALT CONCRETE MADE OF LOCAL LOW-PERFORMANCE AGGREGATES

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Abstract

This paper presents the results of a laboratory experimental study that explores the skid resistance of asphalt concrete mixtures made of local low-performance aggregates by partially replacing sand with olive mill waste (OMW).OMW was mixed with aggregates using a dry process by replacing sand with contents of 5%, 7%, 10% and 15%. The mechanical performances of the mixtures were evaluated using the Marshall and Duriez tests. A modified accelerated polishing machine was used as polishing equipment, and a British pendulum tester (BPT) was used to test the skid resistance of the samples. Finally, texture parameter analysis was performed using scanning electron microscopy (SEM) and MountainsMap software to assess the effect of OMW on the friction coefficient evolution.Using a new road wheel for a modified version of an accelerated polishing machine, which is normally used to determine the polished stone value of aggregates, the results showed that the addition of OMW up to 10% conferred a better skid resistance in comparison to normal asphalt concrete. The presence of olive mill waste in the mixture until 15% guarantees a gain of 22%-29% in skid resistance after polishing compared with the reference mix. Indeed, from texture parameter analysis, it was observed that there was differential wear of the lightweight aggregates (OMW) compared to the other aggregates during the polishing process, which created a new surface microtexture; that had new peaks; and led to a good level of friction compared to the mixtures without OMW. In general, it was found that OMW is a promising modifier for asphalt mixtures with both engineering and economic merits.

Keywords: *skid resistance, olive mill waste, polishing resistance, accelerated polishing machine, local materials, sustainable development.*

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A AB INITIO CALCULATIONS OF TENSILE STRENGTH OF M2CUB (M = Zr, Mo, AND W) NEW POSSIBLE 211 MAX PHASES BORIDES

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The study explored the ideal tensile strength of newly proposed 211 MAX phase borides M2CuB (M = Zr, Mo, and W), using first principle calculations. Stress strain curves are calculated under uniaxial, biaxial, and triaxial tensions, in order to check the stability of the deformation paths, the phonon dispersion curves and the elastic constants are computed. Changes in total energy, lattice parameters, bond lengths, density of states, charge densities were investigated. The values of theoretical tensile strength of M2CuB (M=Zr, Mo, and W) for uniaxial, biaxial and triaxial loading corresponding to the first phonon instability were determined as follows: 15.76, 24.15 and 26.79 GPa for uniaxial loading, 20.9, 32.97, and 33.91 GPa, for biaxial loading ,13.73, 19.77, and 23.64 GPa for triaxial loading. Our analysis reveals that the structural response under different loading conditions is marked by changes in elastic constant's, including the violation of Born-Huang's criteria for mechanical stability. The maximum stresses follow the order : σmax (W2CuB) > σmax (Mo2CuB) > σmax (Zr2CuB).

Keywords: *Tensile strength, Boride, MAX phases, ab initio.*

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A SIMULATION OF THERMAL CONSUMPTION AND COMFORT FOR A BUILDING LOCATED IN CONSTANTINE, ALGERIA

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Abstract. The objective of this study is to analyze the thermal behavior of a residential building with the aim of ensuring maximum thermal comfort for the building occupants besides minimizing the energy needs for heating and cooling.
In this work a numerical simulation was carried out, in order to determine the heating and cooling energy needs of the building for active air-conditioning.
The second part of this simulation allows the estimation of the annual distribution of temperatures inside this building, for the case of a passive air- conditioning. This distribution can be used in the estimation of thermal comfort.
Passive air conditioning can play a major role in promoting energy efficiency in the building sector. Considering that this sector is one of the main targets of the improvement of energy efficiency, since it represents today more than one third of the worldwide consumption of energy and an equivalent amount of its associated emissions. In Algeria, this sector has the highest energy consumption. Its consumption represents more than 42% of the total final consumption.

Keywords: *Thermal engineering, thermal confort, numerical simulation,*

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