ICAMEM
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The 8th International Conference on Advances in Mechanical Engineering and Mechanics

From Fundamentals & Laboratory to Industrial Applications

Abstract proceedings

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Introduction

The International Conference on Advances in Mechanical Engineering and Mechanics (ICAMEM2024) aims to attract the interest of specialists, academicians and researchers from the international community working in research areas related to Mechanical Engineering and Mechanics.

ICAMEM2024 allows the scientific community in Tunisia, North Africa, Middle East, North America and Europe to productively exchange cutting-edge research and educational experience.

Contributions to ICAMEM2024 span from theoretical engineering fundamentals to applied research and industrial applications, featuring pioneering ideas and implementation, advanced educational resources, innovative technology, and best practices.

The conference is organized in eight specialized symposia chaired by national and international scholars and focusing on the following themes.

Applied Mechanics

Industrial Applications and Technology Transfer

Design and Manufacturing

Thermal Sciences and Renewable Energy

Dynamics of Systems

Materials

Fluid Mechanics

Machine Learning and Deep learning

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General chair of ICAMEM 2024

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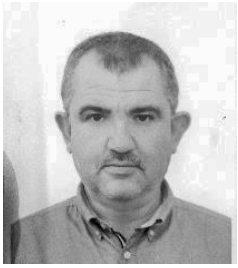

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Keynotes

PROF. STEFANO LENCI

Department of Civil and Building Engineering, and Architecture (DICEA)Polytechnic University of Marche (UNIVPM) Italy

Biography:

Professor Stefano Lenci did research and taught at the Universities of Ancona (now Polytechnic University of Marche), Camerino, Pisa, Rome "La Sapienza" and Paris 6, where he stayed for two years and a half. He has been responsible for various national and international scientific projects and has supervised over 200 undergraduate students and 25 PhD students (4 ongoing). Prof. Lenci was invited to deliver more than 40 seminars at different universities. He is the author of about 400 scientific publications including 12 books and 213 journal articles. He has been Guest Editor of Special Issues and a reviewer for 187 international scientific journals. He has delivered invited/keynote/plenary lectures at various Conferences and chaired several sessions at international Congresses.

His research is focused on the investigation of several aspects of the nonlinear dynamics of various mechanical systems and models, including buckled beams, shallow arches, rolling ships, inverted pendulum between lateral walls, mathematical pendulum, rigid block, infinite beams on unilateral soil, frictional impact oscillator, bilayer beams. An original method for controlling nonlinear dynamics and chaos has been developed and applied to various mechanical systems. The dynamical integrity of mechanical systems has been investigated, too. Other specific research issues include laying of marine pipelines in deep and ultra-deep waters (the J-lay problem), the dynamic of windscreen wiper, various aspects of the mechanical behaviour of interfaces, and mechanical models for detecting elastic and damaged behaviour of composites. Recently, he has investigated the nonlinear vibrations of non-uniform beams, the effects of the boundary conditions of the nonlinear oscillations of beams, the isochronous oscillations of nonlinear beams, wave propagation in beams on unilateral soil, and exact solutions for nonlinear oscillators and nonlinear dynamics of wind towers.

PROF. LAMINE DIENG

Metallic and Cable Structures Laboratory (SMC), Department of Materials and Structures (MAST) Gustave Eiffel University (UGE) France

Biography:

Professor Lamine Dieng has conducted research and taught at the Universities of Nancy, Nantes, Bretagne-Sud and Québec. He has managed various national and international scientific projects and has supervised over 35 master class students and 10 PhD students. Prof. Dieng was invited to deliver more than 45 seminars at different universities. He has authored about 105 scientific publications including 41 journal articles. Since 2022, he has served as the Director of Cooperation and Development at the French and South African Institute of Technology (F'SATI) in Pretoria and Cape Town, South Africa, representing Gustave Eiffel University.

His academic and professional journey is distinguished by deep expertise in mechanics and civil engineering, with a particular focus on the durability of metallic and cable structures. his research focuses mainly on the study of the behavior of cables (bridge cables, offshore platform anchor cables, conductor cables, overhead conductors, etc.) and on the characterization of pathologies (fatigue fretting corrosion of welded assemblies – residual stresses – completion Behavior of gusset plates, bolted assemblies).

His recent studies concern the use of acoustic emission and machine learning tools for smart monitoring of cable damages in bridges, the investigation of dynamic marine power cables that are suitable for application in devices that harness energy from ocean currents, waves, and tides. Other specific research issues include modal analysis of a riveted lattice beam for improved retrofitting operations and the characterization of the mechanical properties of low stiffness marine power cables through tension, bending, torsion, and fatigue Testing.

Dr. DANIIL YURCHENKO

Institute of Sound and Vibration Research, University of Southampton
United Kingdom

Biography:

Dr Yurchenko is an expert in the area of Nonlinear Stochastic Dynamics and Control, Vibration mitigation, and mathematical and experimental modelling of complex dynamic systems. He obtained a PhD degree in Mechanical Engineering from Worcester Polytechnic Institute, USA on the development of stochastic optimal control theory for dynamic multi-degree-of-freedom systems and systems subjected to impact loading. In 2007 became a full Professor at the Department of Mathematical Sciences, St. Peterburg State Polytechnic University. In 2008 he received a Young Scientists Award from the Russian President Science Council. Dr Yurchenko has published over 150 scientific publications including peer-reviewed journals and conference proceedings, and delivered Keynote lectures. He is an Editorial board member of Mechanical Systems and Signal Processing, Int. J. of Dynamics and Control, Journal of Vibrations, Energies.

SOPAL's footprint in scientific research in Tunisia: a new culture

A model of economic patriotism

MOHAMED REGAYEG

CEO of SOPAL

A true captain of industry, keen on innovation, with a well-honed speech, in incessant quest for industry, **Mr. Mohamed REGAYEG**, invests body and soul in the continuous improvement of the quality of his environment. He was trained under

the tutelage of the great figures and the elite of the 70s and 80s, who shaped modern Tunisia. His constant ambition is to establish Tunisia's industrial vocation, a sector often neglected in these times of openness and trade war. However, he firmly believes in it and proves it by establishing himself among the greatest leaders.

A mechanical engineer graduated from the École Centrale de Lille, he acquired almost ten years of experience in two state-owned companies (SOFOMECA and SOMATRA), specializing in foundries and public works. His job is gradually becoming a passion, with a deep commitment to meeting the needs of Tunisia, aiming to align the country with international standards and ensure its self-sufficiency in sanitary equipment. Founded in 1981 as part of the FOPRODI program, SOPAL is the result of a true human adventure which deserves to be taught in management schools. According to him, “Innovation, good governance, respect, passion, fairness, sharing, responsibility, professionalism are our fundamental values. He is building his empire stone by stone, with a core business which today extends over more than 40,000 square meters, radiating across the Tunisian territory. In 43 years, his company has become an undisputed leader in the manufacturing and distribution of sanitary equipment, as well as in water and gas connections.

Three main logics found his societal policy: insurance, assistance and solidarity. He believes that science is a social and consensual process. This is where it draws its power and legitimacy.

In this context, **Mr. Mohamed REGAYEG** largely participated in the training of qualified technicians and engineers : Sopal Academy has just seen the light a few days ago.

In addition, he made a strong contribution to scientific research in Tunisia through his moral and material support of several doctoral theses. His personal material and moral investment in research activities is considered a belief for him. Without this support, ten theses defended and three theses in progress in the history of the partnership between ENIS and SOPAL would not have seen the light. The history of this collaboration began in March 2005 and continues until today. Several research themes were covered, ranging from the mechanical characterization of non-ferrous, ferrous, polymer and composite materials, damage and fatigue, tribology and industrial production techniques, to numerical modeling and simulation.

A story of life, management and ultimately an industrial change…

L’empreinte de SOPAL dans la recherche scientifique en Tunisie : une nouvelle culture

Un modèle de patriotisme économique

MOHAMED REGAYEG

PDG de SOPAL

Un vrai capitaine d’industrie, féru d’innovation, au discours bien rodé, en quête incessante d’industrie, M. **Mohamed REGAYEG**, s'investit corps et âme dans l'amélioration continue de la qualité et de son environnement. Il est formé sous la

tutelle des grandes figures et de l'élite des années 70 et 80, qui ont façonné la Tunisie moderne. Son ambition constante est de consacrer la vocation industrielle de la Tunisie, un secteur souvent délaissé en ces temps d'ouverture et de guerre commerciale. Pourtant, il y croit fermement et le prouve en s'imposant parmi les plus grands.

Ingénieur en mécanique diplômé de l'École Centrale de Lille, il acquiert une expérience de près de dix ans dans deux entreprises étatiques (SOFOMECA et SOMATRA), spécialisées dans la fonderie et les travaux publics. Son métier devient peu à peu une passion, avec un engagement profond pour répondre aux besoins de la Tunisie, visant à aligner le pays sur les standards internationaux et à assurer son autosuffisance en équipements sanitaires. Fondée en 1981 dans le cadre du programme FOPRODI, SOPAL est le fruit d'une véritable aventure humaine qui mérite d'être enseignée dans les écoles de gestion. Selon lui, « Innovation, bonne gouvernance, respect, passion, équité, partage, responsabilité, professionnalisme sont nos valeurs fondamentales. Il bâtit son empire pierre par pierre, avec un cœur de métier qui s'étend aujourd'hui sur plus de 40 000 mètres carrés, rayonnant sur le territoire Tunisien. En 43 ans, son entreprise est devenue un leader incontesté dans la fabrication et la distribution d'équipements sanitaires, ainsi que dans le branchement d'eau et de gaz.

Trois grandes logiques fondent sa politique sociétale : l'assurance, l'assistance et la solidarité. Il croit que la science est un processus social et consensuel. C'est de là qu'elle tire son pouvoir et sa légitimité.

Dans ce cadre, M. **Mohamed REGAYEG** a largement participé à la formation des techniciens diplômés et des ingénieurs : Sopal Académie a vu la lumière depuis quelques jours.

De plus, il a vivement contribué à la recherche scientifique en Tunisie à travers son soutien moral et matériel de plusieurs thèses doctorales. Son investissement personnel matériel et moral dans les activités de recherche est pour lui tenue pour une croyance. Sans cet appui, dix thèses soutenues dans l'historique du partenariat entre ENIS et SOPAL n'auraient pas vu la lumière. L'histoire de cette collaboration a commencé depuis Mars 2008 et se prolonge jusqu'au aujourd'hui. Plusieurs thématiques de recherche ont été touchées allant de la caractérisation mécanique des matériaux ferreux non ferreux, polymère et composite, l'endommagement et fatigue, tribologie et technique de production industrielle, vers la modélisation et la simulation numérique.

Une histoire de vie, de gestion et au final un changement industriel….

Oral presentations

ID : 38 A general approach for crack jump calculation in bonded structures under mode I fracture: Application to adhesive defects

M. TALEB ALI, Z. JEBRI, J. JUMEL

THIS STUDY PRESENTS A GENERALISED MODEL FOR PREDICTING CRACK SIZE IN HETEROGENEOUS BONDED INTERFACES UNDER MODE I FRACTURE CONDITIONS. ADHESIVE BONDING HAS GAINED WIDESPREAD USE ACROSS INDUSTRIES BECAUSE OF ITS NUMEROUS ADVANTAGES, BUT THE PRESENCE OF FLAWS WITHIN THE BOND LINE CAN SIGNIFICANTLY AFFECT STRUCTURAL INTEGRITY. THE MODEL ACCOUNTS FOR VARIOUS TYPES OF DEFECTS, INCLUDING SQUARE AND CIRCULAR FLAWS, AND CONSIDERS THE DYNAMIC EFFECTS OF CRACK PROPAGATION. EXPERIMENTAL VALIDATION DEMONSTRATED EXCELLENT AGREEMENT BETWEEN MODEL PREDICTIONS AND OB-SERVED CRACK SIZES. INSIGHTS INTO THE BEHAVIOUR OF DEFECTS, SUCH AS THE DETECTION CHALLENGES POSED BY CIRCULAR FLAWS, ARE DISCUSSED.

ID : 57 Natural frequencies of functionally graded plate with complex cutouts

A. HADRICH, S. ZGHAL, S. KOUBAA, Z. BOUAZIZ, R. ABDELMOULA

THIS PAPER IS INTENDED TO STUDY THE VIBRATIONAL BEHAVIOR OF FUNCTIONALLY GRAD-ED PLATE WITH COMPLEX CUTOUTS USING A 3D FINITE ELEMENT APPROACH. THE EFFEC-TIVE MATERIALS PROPERTIES OF FGM PLATE ARE DETERMINED USING A POWER-LAW FOR-MULA (P-FGM) AND IT IS IMPLEMENTED IN COMSOL FINITE ELEMENT SOFTWARE. THE GOVERNING EQUATIONS ARE OBTAINED VIA THE PRINCIPLE OF VIRTUAL WORKS AND THEY ARE DISCRETIZED USING FOUR NODED TETRAHEDRON FINITE ELEMENT. THE CURRENT AP-PROACH CAN EFFICIENTLY MODEL COMPLEX GEOMETRIES WITHOUT NEEDS OF INTRODUCTION OF SHEAR CORRECTION FACTORS OR ADDITION OF FURTHER HIGH ORDER KINEMATIC VARIABLES AS CLASSICAL PLATE/SHELL THEORIES. THE RELIABILITY OF THE MODEL IS VERIFIED VIA A COMPARISON STUDY WITH DATA AVAILABLE IN LITERATURE AND THE EFFECT OF POWER-LAW INDEX AND CUTOUT-GEOMETRY ON NATURAL FREQUENCIES OF PERFORATED FGM PLATE WITH COMPLEX CUTOUT IS STUDIED AND INTERPRETED.

ID : 79 Numerical analysis of the mechanical behavior to the ovality of the shell of a rotary kiln of cement

M. BOUHAFS, N. BOUHAMRI, I. DJELLID

OVENS ARE MACHINES WIDELY USED IN THE INDUSTRY, ESPECIALLY IN THE CEMENT INDUSTRY. THEY ARE OFTEN SUBJECTED TO STRONG MECHANICAL AND THERMAL STRESS. THE ROTARY KILN IS A CRITICAL COMPONENT IN THE CEMENT MANUFACTURING PROCESS, PROVIDING THE CONDITIONS NECESSARY FOR THE FORMATION OF HIGH QUALITY CLINKER IN AN EFFICIENT, ECONOMICAL AND CONTROLLED MANNER. ITS PROPER OPERATION AND PROPER MAINTENANCE ARE ESSENTIAL TO

ensure the profitability and sustainability of a cement plant's operations. This work aims to study the mechanical behavior of a rotary kiln by calculating the deformability of the shells. The numerical simulation of the shell and the layers of the refractory and the crusting by the finite volume method was developed using the WORKBENCH software (ANSYS). The idea is to check the behavior of the oven under three different conditions chosen, which are the own load of the kiln, consideration of thermal conditions and with different thick- ness of refractory brick. Ovalization of the rotary kiln shell is a serious problem which can have significant repercussions on the operation and safety of a cement plant. It is essential to carefully monitor the condition of the shell, take appropriate preventive measures and perform regular inspections for any signs of ovality to minimize the risks and costs associated with this problem.

ID : 85 The Influence of skewed electrostatic excitation on symmetry breaking of arch micro-beams

H. M Ouakad, A. H Qabur, A. M Alneamy

This study presents a numerical investigation of the symmetry breaking in MEMS (micro-electromechanical systems) arches electrically actuated assuming a skewed electrostatic field configuration. Three different stationary actuating electrode arrangements were considered with a length of 25%, 40%, and 100% the beam's length. To simulate the shallow microarch's behaviour, a nonlinear model was developed considering the geometric and forcing nonlinearities. The nonlinear equation of motion was numerically discretised through simultaneously solving the static equation assuming five modes approximation in Galerkin's expansion. The findings demonstrated that the deflection at the mid-point, the static profile, and the variation of the modal coordinates are all dependent on the electrostatic force profile. It can be deduced that when a symmetrical electrostatic field is present, the beam will maintain a symmetrical shape profile. However, this is not the case when the electrode only encloses a limited beam portion.

ID : 93 Predicting aerodynamic loads on horizontal axis wind turbine blades for different operating conditions using Qblade

C. Huish, P. Shakya, A. C. Seibi, M. Shekaramiz, M. Masoum

With the rapid advancement in the energy sector, there arises an increasing imperative to bolster energy efficiency and prolong the operational lifespan of wind turbines. Among the vital and costly components in wind energy infrastructure are the wind turbine blades. Hence, understanding the forces exerted on these blades is of paramount importance. In this study, we have predicted the aerody-namic loads acting on horizontal axis wind turbine (HAWT) blades for different wind speeds and tip-speed

RATIOS (TSR) USING AN OPEN-SOURCE SOFTWARE (QBLADE). USING NACA 4412 AIRFOIL, A MODEL OF WIND TURBINE BLADE (WTB) IN CREATED IN QBLADE HAVING 77.5 M ROTOR RADIUS. IT IS OBSERVED THAT THE LOADS ACTING ON WTB INCREASES WITH WIND SPEED WHILE FOR CONSTANT WIND SPEED AND INCREMENT IN TSR LEAD TO DECREMENT IN TANGENTIAL FORCE.

ID : 96 The magnetisation effects on the production of astrophysical cold jets

H. MARZOUGUI, M. KHLIFI

IN THE PRESENT PAPER, WE PROPOSE TO STUDY THE MAGNETIZATION EFFECTS ON PURELY MAGNETIZED ACCRETION DISC AROUND STELLAR OBJECT DRIVING NON-RELATIVISTIC COLD JETS. THIS WORK IS CARRIED OUT WITHIN THE MHD THEORY FRAMEWORK IN WHICH THE DISC IS CROSSED BY BIPOLAR LARGE-SCALE MAGNETIC FIELD IN EQUIPARTITION WITH THE PLASMA THERMAL PRESSURE IN THE DISC-MIDPLANE. THE OBTAINED RESULTS ARE COMPARED WITH THOSE OF ZANNI ET AL. AND TZEFERACOS ET AL.

ID : 113 Vibrational study on plate with functional gradient material and various boundary conditions

A. KARMI, A. HADRICH, S. ZGHAL, Z. BOUAZIZ

THIS PAPER DEALS WITH VIBRATIONAL BEHAVIOR OF FUNCTIONALLY GRADED PLATE, CONSIDERING DIFFERENT BOUNDARY CONDITIONS. THE APPLIED BOUNDARY CONDITION ON THE PLATE EDGE CAN BE SIMPLY SUPPORTED (S), CLAMPED (C) OR FREE (F). THE MATERIAL PROPERTIES OF THE PLATE ARE MADE FROM A MIXTURE OF METAL AND CERAMIC WITH A GRADED VARIATION OF THEIR MECHANICAL PROPERTIES IN Z-AXIS. THE THEORETICAL MODELING INVOLVES A FOUR NODES TETRAHEDRON FINITE ELEMENT TO SIMULATE THE FREQUENCIES OF THE PLATE UNDER DIFFERENT BOUNDARY CONDITIONS. THE MASS AND STIFFNESS MATRICES ARE DERIVED BASED ON THE VARIATIONAL FORM OF THE HAMILTON'S PRINCIPLE COMBINED WITH FINITE ELEMENT FRAMEWORK. FIRST, THE ACCURACY OF THE MODEL IS VALIDATED BY COMPARING THE OBTAINED FREQUENCIES WITH THOSE OF LITERATURE. NEXT, THE EFFECTS OF APPLIED BOUNDARY CONDITIONS AND GRADED INDEX ON VIBRATIONAL BEHAVIOR OF FUNCTIONALLY GRADED PLATE ARE EXAMINED AND SHOWN.

ID : 129 Performance optimization of sub-stiffened composite panels under uniaxial compression loading

H. CHAGRAOUI, M. SOULA

THE OBJECTIVE IS TO ENHANCE THE BUCKLING PERFORMANCE OF A T-SHAPED STIFFENED COMPOSITE PANEL DESIGN COMMONLY USED IN AIRCRAFT STRUCTURES. FIRST, THE PREDICTED BUCKLING BEHAVIOR OF THE T-SHAPED STIFFENED COMPOSITE PANEL IS VALIDATED WITH EXPERIMENTAL RESULTS TAKEN FROM THE EXISTING LITERATURE. THEN, COMPOSITE I-SHAPED SUB-STIFFENERS WERE INTRODUCED INTO THE T-SHAPED STIFFENED COMPOSITE PANEL AND OPTIMIZED TO IMPROVE

INITIAL BUCKLING PERFORMANCE WITHOUT ADDING MASS. THE OPTIMIZATION OF THE SUB-STIFFENED COMPOSITE PANEL DESIGN WAS DONE THROUGH NON-LINEAR PROGRAMMING WITH QUADRATIC LAGRANGIAN (NLPQL), WHICH DETERMINED THE OPTIMAL LAMINATE STACKING SEQUENCE OF THE SKIN AND THE DISTRIBUTION, AS WELL AS THE ORIENTATION ANGLES OF THE SUB-STIFFENERS, TO MAXIMIZE BUCKLING PERFORMANCE WITHOUT ADDING WEIGHT. OPTIMIZATION RESULTS DEMONSTRATE A SUBSTANTIAL IMPROVEMENT IN THE INITIAL BUCKLING PERFORMANCE WITH THE INTRODUCTION OF THE I-SHAPED SUB-STIFFENERS. SPECIFICALLY, THE SUB-STIFFENED COMPOSITE PANEL WITH I-SHAPED COMPO-SITE SUB-STIFFENERS SHOWS IMPROVEMENTS OF UP TO 200% COMPARED TO THE BUCKLING PERFORMANCE OF THE T-SHAPED STIFFENED COMPOSITE PANEL. THIS HIGHLIGHTS THE IMPORTANCE OF UTILIZING THE COMPOSITE SUB-STIFFENERS TO IMPROVE STABILITY AND REDUCE THE RISK OF FAILURE IN THIN-WALLED STRUCTURES, ALL WHILE MEETING LIGHTWEIGHT DESIGN CRITERIA.

ID : 138 New approximation formula for the deflection of inflated circular thin plate using Galerkin's method

F. MAMMARI, K. YAYA

EXTENSIVE RESEARCH HAS BEEN CONDUCTED ON THE APPROXIMATION EQUATIONS THAT DESCRIBE THE RELATIONSHIP BETWEEN LOAD AND CENTRAL DEFLECTION IN CLAMPED CIRCULAR THIN-PLATES, DUE TO THEIR BROAD APPLICABILITY IN ENGINEERING. IN THIS STUDY, GALERKIN'S METHOD IS USED TO DERIVE A LOAD-DEFLECTION FORMULA REPRESENTED AS A POLYNOMIAL FRACTION. TO ACCOMPLISH THIS, A NOVEL DISPLACEMENT FIELD INVOLVING TWO UNKNOWN PARAMETERS IS INTRODUCED. THE RESULTS FROM THIS RESEARCH ARE COMPARED WITH TIMOSHENKO'S MODEL AND NUMERICAL SOLUTION OBTAINED THROUGH FINITE DIFFERENCE METHODS, INDICATING VERY HIGH ACCURACY IN EXPRESSING CENTRAL DEFLECTION AS A FUNCTION OF LOAD. FURTHERMORE, IT DEMONSTRATES THAT THE PROPOSED DISPLACEMENT FIELD CLOSELY REPLICATES THE SHAPE OF THE PLATE WHEN CONTRASTED WITH TIMOSHENKO'S MODEL. THE FORMULAS DEVELOPED IN THIS STUDY COULD OFFER A DEPENDABLE ALTERNATIVE TO EXISTING FORMULAS AVAILABLE IN LITERATURE FOR ANALYZING LARGE DEFLECTIONS OF THIN PLATES.

ID : 140 Numerical analysis of the dynamic properties of a 3D printed biocomposite sandwich beam with a periodic core

M. A. AJMI, H. DAOUD, Z. JENDLI, A. EL MAHI, M. A. BEN SOUF, M. HADDAR

THIS PAPER DEALS WITH THE USE OF PERIODIC CORES IN 3D PRINTED BIO-BASED SAND-WICH BEAMS TO ATTENUATE VIBRATIONS THROUGH BAND-GAPS AS WELL AS INVESTIGATING, BY NUMERICAL APPROACH, THEIR MATERIAL AND STRUCTURAL CHARACTERISTICS. HARMONIC ANALYSES USING THE FINITE ELEMENT METHOD WERE PERFORMED ON THREE 3D PRINTED BEAMS. ONE OF THEM IS SOLID WHILE THE OTHER TWO ARE SANDWICH BEAMS WITH DIFFERENT PERIODIC CORE CONFIGURATIONS. ALL THREE STRUCTURES WERE PRIMARILY MADE FROM THE SAME PLA/FLAX SHORT FIBER COMPOSITE FILAMENT USING THE FUSED DEPOSITION MODELLING (FDM) PROCESS, WITH THE

ADDITION OF VISCOELASTIC ELEMENTS INSIDE THE PERIODIC CORES OF THE SANDWICH BEAMS. THE TWO CORES DIFFER SOLELY IN THE RATIO OF MATERIALS WITHIN THEIR CELLS. COMPARATIVE ANALYSIS OF THE RESULTS FOR THE SOLID AND ONE OF THE SANDWICH STRUCTURES HAS REVEALED SEVERAL BAND-GAPS WHERE VIBRATIONS WERE SIGNIFICANTLY ATTENUATED. REPEATING THE SAME ANALYSIS ON THE TWO SANDWICH BEAMS WITH DIFFERING MATERIAL RATIOS HAS DEMONSTRATED MULTIPLE CHANGES IN THE BAND-GAP CHARACTERISTICS, THUS PROVING THAT THEY DEPEND ON AT LEAST ONE CORE PARAMETER. THIS RESEARCH COULD POSSIBLY HELP PAVE THE WAY FOR MORE IN-DEPTH INVESTIGATIONS INTO MAKING USE OF BAND-GAPS TO ATTENUATE VIBRATIONS.

ID : 148 Fatigue behavior of 3D printed biocomposites with interleaved layers

F. MEDDEB, H. DAOUD, A. EL MAHI, J. L. REBIERE, M. A. BEN SOUF, M. HADDAR

THIS STUDY EXPLORES THE IMPACT OF 3D PRINTING ON BIOCOMPOSITE FATIGUE PROPERTIES BY INVESTIGATING A NOVEL DESIGN INCORPORATING AN INTERLEAVED VISCOELASTIC LAYER. THE USED MATERIALS ARE COMPOSITE OF POLYLACTIC ACID (PLA) REINFORCED WITH FLAX FIBERS AND A LAYER OF TPU RUBBER. TWO STACKING CONFIGURATIONS WERE 3D PRINTED: ONE WITH A SINGLE VISCOELASTIC LAYER (CVC) AND ANOTHER WITH TWO INTERLEAVED LAYERS (CVCVC). EXPERIMENTAL FATIGUE TESTING SHOWED THAT THE SINGLE VISCOELASTIC LAYER CONFIGURATION (CVC) EXHIBITED SUPERIOR FATIGUE LIFE AND ENERGY DISSIPATION COMPARED TO THE DOUBLE-LAYERED VERSION (CVCVC). THE CVC STACKING DISPLAYED SLOWER STIFFNESS REDUCTION OVER THE FATIGUE LIFE CYCLES. INCORPORATING THE VISCOELASTIC LAYER ENHANCED THE FATIGUE LIFE COMPARED TO THE BIOCOMPOSITE WITHOUT THE VISCOELASTIC LAYER (C). HOWEVER, INTERLEAVING TWO VISCOELASTIC LAYERS LED TO FASTER STIFFNESS DEGRADATION COMPARED TO CVC, LIKELY DUE TO ALTERED STRESS DISTRIBUTION OR INTRODUCED DEFECTS. THE RESULTS DEMONSTRATE THE CRITICAL ROLE OF VISCOELASTIC LAYER PLACEMENT IN TAILORING FATIGUE PERFORMANCE, WITH THE SINGLE LAYER CONFIGURATION SHOWING THE MOST PROMISING ENERGY DISSIPATION AND FATIGUE RESISTANCE CHARACTERISTICS.

ID : 199 Effect of thermostat faults on diesel engine vehicle vibrations

A. HELALI, I. BELKACEM, A. ZEGNANI, J. ABDELLAOUI

THE COMFORT OF ROAD VEHICLE DRIVERS HOLDS AN IMPORTANT ROLE IN THE AUTOMOTIVE INDUSTRY. THE CURRENT STUDY WAS FOCUSED ON INVESTIGATING OF THE VIBRATIONS RESULTING FROM A THERMOSTAT FAILURE IN DIESEL ENGINES AND THEIR IMPACT ON DRIVER COMFORT. BASING ON REAL TIME MEASUREMENTS OF VARIED ENGINE SPEED, THE VIBRATIONS INDUCED FROM DIESEL ENGINES HAVE BEEN CONTROLLED, PARTICULARLY IN DYSFUNCTION OF COOLING CIRCUIT THERMOSTAT CASE. SEVERAL STATISTICAL INDICATORS HAVE BEEN USED IN ORDER TO EVALUATE THE VIBRATION SIGNAL VARIATIONS SUCH AS; KURTOSIS FACTORS, ROOT MEAN SQUARE (RMS), AND STANDARD DEVIATION (SD). THIS EVALUATION TENDS TO DETECT AND CHARACTERIZE THE VIBRATIONAL ANOMALIES DUE TO THERMOSTAT FAILURE, WHICH PROVIDE CRUCIAL INSIGHTS INTO THEIR OVERALL IMPACT ON DRIVER COMFORT. FURTHERMORE, THE NEURAL NETWORKS (RNN)

METHOD WAS APPLIED FOR MODELLING THE EMITTED VIBRATIONAL SIGNALS. THE RNN IS AN EFFICIENT METHOD IN ANALYSING COMPLEX TIME SERIES, LIKE THE ENGINE VIBRATIONS. THIS STUDY DISPOSES TO ENHANCE THE PERFORMANCE OF DIESEL ENGINES BY IDENTIFYING THE UNDERLYING VIBRATIONAL MECHANISMS OF THESE FAILURES. IN ADDITION, IT TENDS TO OPTIMIZE THE DRIVER EXPERIENCE AND BOLSTERING AUTOMOTIVE INDUSTRY EFFICIENCY.

ID : 200 Vibration diagnosis of Diesel engines with air flow sensor failure

J. ABDELLAOUI, I. BELKACEM, A. ZEGNANI, A. HELALI

EFFICIENT DIAGNOSTIC AND PREVENTIVE MAINTENANCE SYSTEMS ARE CRITICAL FOR MAXIMIZING DIESEL ENGINE PERFORMANCE AND LONGEVITY. THESE SYSTEMS ENABLE EARLY DETECTION AND RESOLUTION OF POTENTIAL ISSUES, MINIMIZING DOWNTIME AND REPAIR COSTS. VIBRATION ANALYSIS IS A POWERFUL DIAGNOSTIC TOOL USED TO ASSESS ENGINE HEALTH BY ANALYZING VIBRATORY EMISSIONS. THIS STUDY FOCUSES ON INVESTIGATING THE IMPACT OF MASS AIRFLOW SENSOR FAULTS ON DIESEL ENGINE VIBRATIONS AT DIFFERENT SPEEDS. THROUGH EXPERIMENTAL STUDIES AND DATA ANALYSIS IN TIME DOMAINS, THE RESEARCH AIMS TO UNDERSTAND THE RELATIONSHIP BETWEEN SENSOR FAULTS AND VIBRATION BEHAVIOR.

ID : 201 Wind turbine aerodynamic enhancement with vortex generators integration on blade leading edge

M. M. DOGGUI, F. ATTIG-BAHAR, A. HAFOUDHI, M. CHAFRA

WIND TURBINES ARE INCREASINGLY RECOGNIZED AS ONE OF THE MOST RELIABLE SOURCES OF SUSTAINABLE ENERGY. HOWEVER, THEIR ENERGY PRODUCTION IS OFTEN LIMITED BY WIND CONDITIONS, PARTICULARLY HIGH WINDS THAT CAN CAUSE SIGNIFICANT POWER LOSSES DUE TO BLADE STALL. SINCE HIGH WIND CAN SEVERELY IMPACT ENERGY PRODUCTION BY CAUSING DRASTIC OUTPUT POWER LOSS OF 20 TO 30% [1,2]. THIS STALL OCCURS AT A CERTAIN WIND SPEED LINKED TO A CRITICAL ANGLE OF ATTACK DIRECTLY IMPACTING THE ENERGY PRODUCTION. TO RESOLVE THIS ISSUE, MANY ACTIVE AND PASSIVE SOLUTION WERE ENGINEERED IN ORDER TO GET BACK THE BLADE IN A LOWER ANGLE OF ATTACK HENCE PREVENTING THE STALL BUT THESE MECHANISM WERE FOUND TO BE COSTLY AND EVEN ENERGY CONSUMING , THAT'S WHY MORE CONVENIENT SOLUTION EXISTS LIKE VORTEX GENERATOR WHICH NOT ONLY IMPROVE THE OVERALL AERODYNAMIC PERFORMANCE BUT ALSO SUCCESSFULLY ACHIEVE A NOTICEABLE STALL DELAY THAT HAVE A DIRECT IMPACT ON WIND LIMITATION AND ENERGY PRODUCTION RANGE SINCE THE HAWT BECOME EFFECTIVE IN THE REACHED ANGLE OF ATTACK. NEVERTHELESS, THE OPTIMAL PLACEMENT OF THESE VGS IS STILL A MATTER OF DISCUSSION AND A LACK OF CONSENSUS CLEARLY EXISTS ON HOW TO CHOOSE THE CHORDWISE POSITION. IN THIS CONTEXT, OUR STUDY ADDRESSES THESE CHALLENGES AND PRESENTS AN EXPERIMENTAL METHOD USING TUFT FLOW VISUALIZATION COMBINED WITH WIND TUNNEL TESTING FOR A WIDE RANGE OF ANGLE OF ATTACK. THE RESULTS SHOWCASED AN EXPERIMENTAL INVESTIGATION ON THE EFFECTS OF VORTEX GENERATORS ON THE AERODYNAMIC PERFORMANCE OF AN AIRFOIL BLADE THE NREL S826. THE VORTEX GENERATORS WERE INSTALLED AT DIFFERENT

chordwise positions (10 %, 30 % and 50 %) on the suction side of the airfoil. The experiments were conducted inside an open return suction type wind tunnel of 8m at a Reynolds number of 100,000. Results showed a significative stall delay for a certain position of VGs. Also, it demonstrated the VGs effects on the aerodynamics of the blade like its lift and its drag. These promising results extended the operative range beyond the initial stall angle of 12 degrees and gave important insights for a future study on the estimated annual energy production gain for such passive devices.

Design and Manufacturing

ID : 23 Effects of mechanical loading type on the relaxation of residual stresses induced by shot peening

S. Manchoul, R. Seddik

This paper presents an engineering approach to analyze the shot peen- ing surface proprieties modifications during cyclic loading. Such approach has been divided into two steps: (i) implementation of a finite element modeling of the shot peening process; (ii) simulation of the first applied cycles on the peened metallic part, residual stress relaxation phenomenon, in order to predict the initial shot-peened surfaces proprieties modifications for the case of torsion and tensile loading. The influence of the loading ratio is also evaluated. The finite element modeling of shot peening process is validated by comparing the numerical prediction of residual stress with the experimental findings. The prediction of the modifications of residual stress under mechanical loading for different conditions leads to have physically consistent results.

ID : 45 Manufacturing process challenges of an aircraft landing gear component

W, Jomaa, K. Ba, J. Levesque, A. Gakwaya

Structural aircraft landing gear components are commonly manufactured from forgings and thereafter undergo several machining operations and heat treatments. Each of these manufacturing steps introduces its inherent residual stress state. The interaction between inherent residual stresses and machining induced-residual stress and stress relaxation results in part's distortion. The present paper presents an overview of the manufacturing workflow of a generic landing gear component with a focus on the effects of manufacturing workflow on residual stress evolution and part distortion. Generic parts, representing geometrical features of a real landing components, were hot forged from a 7175 aluminum alloy stock. Once forged, the generic parts incur different machining operations, sequences and conditions along with specific heat treatments.

ID : 48 Analyzing the bulging factor and stress intensity factor of cracks in pressurized cylindrical panels for aircraft fuselage applications through numerical methods

A. F. ZAYATI, M. SOULA, T. LAZGHAB

SEVERAL AIRCRAFT ACCIDENTS HAVE BEEN ATTRIBUTED TO GENERAL FATIGUE DAMAGE, PARTICULARLY CONCERNING CRACKS IN THE FUSELAGE. THE STRESS STATE IN SUCH CASES IS INFLUENCED BY THE BULGING AROUND THE CRACK INDUCED BY INTERNAL PRESSURE. THIS PHENOMENON IS QUANTIFIED BY THE BULGING FACTOR, WHICH COMPARES THE STRESS INTE SITY FACTOR OF A CRACK IN A CURVED SHELL TO THAT IN A FLAT PLATE. THE OBJECTIVE OF THIS STUDY IS TO INVESTIGATE THE IMPACT OF A HEXAGONAL GRID PATTERN ON BOTH THE BULGING FACTOR AND STRESS INTENSITY FACTOR OF CRACKS OF VA-RYING LENGTHS IN THE FUSELAGE SKIN. THE FINDINGS ARE COMPARED TO THOSE OBTAI-NED USING THE CO VENTIONAL ORTHOGONAL GRID STIFFENING PATTERN TYPICALLY FOUND IN FUSELAGE STRUCTURES.

ID : 62 Worker allocation strategies in the multi- manned assembly line balancing problem: A review of the most recent literature

Z. TKITEK, H. TRIKI, H. MOALLA FRIKHA

DESPITE THE INCREASING AUTOMATION OF PRODUCTION SYSTEMS IN RECENT YEARS, THE HUMAN FACTOR REMAINS ONE OF THE KEY ELEMENTS OF COMPANIES' COMPETITIVENESS IN THIS CONSTANTLY CHANGING ENVIRONMENT. THIS TRANSFORMATION OF THE INDUSTRIAL WORLD HAS LED TO A PERPETUAL QUESTIONING OF PRODUCTION METHODS, PARTICULARLY REGARDING THE INCLUSION OF OPERATORS. THE CHALLENGES ASSOCIATED WITH MULTI-MANNED ASSEMBLY LINES INVOLVE EFFICIENTLY DISTRIBUTING WORK AND TASKS AMONG MULTIPLE WORKERS. THE GOAL IS TO ENHANCE PRODUCTIVITY AND EFFECTIVENESS BY CONSIDERING THE SKILLS, ASSIGNMENTS, AND CONSTRAINTS OF EACH WORKER TO MINIMIZE WORKLOAD IMBALANCES AND FULLY LEVERAGE THE AVAILABLE HUMAN RESOURCES. THIS ARTICLE PROVIDES A CONCISE SYNTHESIS OF THE LITERATURE ON CURRENT CHALLENGES RELATED TO MULTI-MANNED ASSEMBLY LINE BALANCING PROBLEMS, EMPHASIZING WORKER ASSIGNMENT CRITERIA FOR STATIONS AND PROPOSING AVENUES FOR FURTHER RESEARCH.

ID : 63 Box-Behnken optimization on friction stir welding of an aluminum alloy

D. SAIDI, M. A. DJEMA, H. SIGUERJIJENE, K. HAMOUDA

THE PRESENT WORK FOCUSES ON EXPERIMENTAL RESEARCH IN THE FIELD OF FRICTION STIR WELDING OF ALUMINUM ALLOY, WHICH IS USED IN VARIOUS INDUSTRIES, FOR EXAMPLE, THE AERONAUTICAL INDUSTRY, THE SHIPBUILDING INDUSTRY, THE AUTOMOBILE INDUSTRY AND THE RAILWAY INDUSTRY. THE VARIATION OF THE FACTORS NAMELY, THE ROTATION SPEED, THE FEED SPEED, AND THE INCLINATION OF THE TOOL WILL HAVE AN INFLUENCE ON THE WELD BEAD. THE USE OF BOX-BEHNKEN EXPERIMENTAL PLANS WHICH IS A POWERFUL TOOL FOR OPTIMIZING PROCESS PARAMETERS IN

ORDER TO ANALYZE THE VARIATION OF THESE PARAMETERS AND THEIR INFLUENCE BY CARRYING OUT TENSILE AND MICRO HARDNESS TESTS.

ID : 67 Effect of weld bead shape on temperature profile in wire-arc additive manufacturing simulation

K. BOUZGARROU, F. MZALI

A SINGLE 316L STAINLESS STEEL WELDING SEAM, DEPOSED ON A 304L SUBSTRATE PLATE USING A GMAW SOURCE, IS SIMULATED USING SIMUFACT VERSION 2023.4. THE 3D HEAT TRANSFER MODEL TAKES INTO ACCOUNT THE ADDED FILLER METAL, THE HEAT RE-LEASE DURING THE SOLIDIFICATION PHASE CHANGE AND THE HEAT LOSSES BY RADIATION AND CONVECTION. THE VOLUMETRIC HEAT SOURCE IS MODELED BY A GOLDAK DOUBLE ELLIPSOID FUNCTION. THE RECTANGULAR WELD BEAD SHAPE OF THE ADDED FILLER METAL, COMMONLY USED IN WAAM, IS ANALYZED IN COMPARISON WITH THE NEAR-TO-REALITY CONVEX WELD BEAD SHAPE. THE RESULTS SHOWED THAT THE TEMPERATURE PROFILE OF THE RECTANGULAR WELD BEAD SHAPE ONLY BECOME NEAR TO THESE OF THE CONVEX WELD BEAD IF A HEIGHT CORRECTION IS MADE. TEMPERATURE EVOLUTION VERSUS TIME SHOWED ALSO THAT THIS CORRECTED RECTANGULAR WELD SHAPE GIVES NEARLY THE SAME RESULTS AS THE CONVEX ONE.

ID : 72 Effect of manufacturing parameters on the hardness of electron-beam melted maraging steel: An experimental study

A. CHAABENE, S. BEN-ELECHI, S. CHATTI, M. K. GUERICH

MARAGING STEELS ARE COMMONLY USED IN INDUSTRIES THAT REQUIRE HIGH PRECISION DUE TO THEIR EXCELLENT MECHANICAL PROPERTIES, INCLUDING HIGH STRENGTH, TOUGHNESS, FORMABILITY, WELDABILITY, DIMENSIONAL ACCURACY, AND FORMABILITY. THESE STEELS ARE CHARACTERIZED BY A TYPICAL MARTENSITIC STRUCTURE OBTAINED THROUGH AGING HEAT TREATMENTS. THE TREND TOWARDS USING HIGH-STRENGTH STEELS IN THE INDUSTRY HAS LED TO THE NEED TO OPTIMIZE MASS WHILE MAINTAINING GOOD MECHANICAL PROPERTIES FOR SPECIFIC APPLICATIONS. ELECTRON BEAM MELTING (EBM) IS AN ADDITIVE MANUFACTURING TECHNIQUE THAT OFFERS SEVERAL ADVANTAGES OVER TRADITIONAL METHODS. IT ENABLES THE PRODUCTION OF COMPLEX GEOMETRY PARTS IN SMALL SERIES AND THE CREATION OF PROTOTYPES FROM CAD MODELS. HOWEVER, OPTIMIZING THE PARAMETERS OF THE EBM PROCESS IS A MAJOR CHALLENGE DUE TO THE COMPLEX PHYSICAL PHENOMENA INVOLVED, SUCH AS PHASE AND MATERIAL CHANGES. THIS STUDY INVESTIGATES THE IMPACT OF THREE EBM PROCESS PARAMETERS (LAYER THICKNESS, ELECTRON BEAM POWER, AND PREHEATING TEMPERATURE) ON THE HARDNESS OF MARAGING STEEL. THE FINDINGS CONTRIBUTE TO THE IMPROVEMENT OF THE EBM PROCESS AND THE PRODUCTION OF HIGH-QUALITY COMPONENTS. THESE COMPONENTS HAVE APPLICATIONS IN VARIOUS SECTORS, INCLUDING MEDICAL, AUTOMOTIVE, AND AEROSPACE, HIGHLIGHTING THE IMPORTANCE OF THIS RESEARCH FOR A WIDE RANGE OF ADVANCED APPLICATIONS.

ID : 88 Experimental and numerical investigation on crack growth failure in aluminium extrusion die

M. C. YAKOUBI, M. BEN HASSEN, M. ABDELAZIZ, S. BEN ELECHI, H. MRAD

THE DIE IS CONSIDERED AS A CRUCIAL COMPONENT IN THE ALUMINIUM EXTRUSION PROCESS. MAINTAINING DIE INTEGRITY IS KEY TO THE EFFICIENCY OF THE EXTRUSION PROCESS, GUARANTEEING HIGH PRODUCT QUALITY AND UNINTERRUPTED OPERATIONS. WITHIN THIS SPECIFIC CONTEXT, THE INVESTIGATION OF CRACK INITIATION GROWTH EXTRUSION DIE IS BEING CONDUCTED. INITIALLY, NUMERICAL ANALYSIS WAS CARRIED OUT AND VALIDATED BASED ON EXPERIMENTAL INVESTIGATION OF EXTRUSION DIE CRACK LOCATION AND ORIENTATION. AFTERWARD, A NUMERICAL INVESTIGATION WAS UNDERTAKEN ON THE DIE CRACK PROPAGATION. THE ANALYSIS WAS PERFORMED USING THE EXTENDED FINITE ELEMENT METHOD (XFEM). THE RESULTS LED TO AN ENHANCED COMPREHENSION AND PREDICTION OF THE SPREAD OF CRACKS IN THE EXTRUSION DIE. THE FINDINGS PROVIDED IMPROVED UNDERSTANDING AND PREDICTION OF THE PROPAGATION OF MULTIPLE CRACKS IN SEVERAL LOCATIONS IN THE DIE. BY COMPUTING THE DIE CRACK PROPAGATION, WE SEEK TOWARDS A MORE ROBUST AND SCIENTIFICALLY ANALYSIS METHODOLOGY FOR EXTRUSION DIE DESIGN OPTIMIZATION.

ID : 99 3D-printing continuous natural fiber/polylactic acid composites: effects of fiber types and content on mechanical, rheology and thermal properties

D. XING, H. WANG , Y. TAO, J. ZHANG, L. PENG, A. KOUBAA

CONTINUOUS NATURAL FIBER-REINFORCED POLYLACTIC ACID (PLA) COMPOSITES WERE CREATED USING IN-SITU 3D PRINTING TO ASSESS THEIR SUITABILITY AS ALTERNATIVES TO SYNTHETIC FIBERS IN INDUSTRIAL ADDITIVE MANUFACTURING. THE STUDY INVESTIGATED HOW NATURAL FIBER CHARACTERISTICS AFFECT COMPOSITE STRUCTURES AND MECHANICAL PROPERTIES. NATURAL FIBERS FACILITATED PLA CRYSTALLIZATION VIA SHEAR INDUCTION AND NUCLEATION WHILE REDUCING TRIANGULAR VOID DEFECTS. THE TENSILE STRENGTH OF FLAX FIBER/PLA COMPOSITE (WITH A 50.79% VOLUME FRACTION) INCREASED BY 342.37% COMPARED TO PURE PLA, WITH A 22.2% DENSITY REDUCTION. FLAX FIBER OUTPERFORMED CARBON FIBER IN COMPRESSIVE STRENGTH FOR 3D PRINTED HONEYCOMB SHEETS, WITH LOWER ENERGY CONSUMPTION AND FOOTPRINT. THIS RESEARCH UNDERSCORES THE PROMISE OF NATURAL FIBERS AS ECO-FRIENDLY ALTERNATIVES IN ADDITIVE MANUFACTURING, PAVING THE WAY FOR GREENER AND MORE SUSTAINABLE COMPOSITE MATERIALS IN VARIOUS INDUSTRIAL APPLICATIONS, PARTICULARLY IN THE AUTOMOTIVE SECTOR.

ID : 100 Controlling displacement in butt fusion welding of HDPE pipes to ameliorate mechanical characteristics

W. AWADI, M. ZIDI

THERMOMECHANICAL BUTT FUSION WELDING OF HDPE PIPES IS VERY SENSITIVE TO VARIATIONS IN WELDING PARAMETERS AND CONDITIONS. SO FAR, THE RESEARCHERS HAVE ALL CONFIRMED THE CHANGE IN ORIENTATION FROM AXIAL TO RADIAL REGARDING THE FLOW AND THE MOLECULAR CHAINS IN THE CENTER OF THE SOLDERED JUNCTION. THEY EXPLAINED THE DECREASE OF CERTAIN MECHANICAL PROPERTIES AT THE WELDED JUNCTION TO THIS CHANGE IN ORIENTATION AND THE FORMATION OF A NEW STRUCTURE DIFFERENT FROM THE REST OF THE PIPES. THE CHANGE IN ORIENTATION IS MAINLY DUE TO THERMAL AND MECHANICAL STRESSES APPLIED IN STANDARD WELDING CYCLE. THE MAIN IDEA OF THIS PAPER IS CHANGING PROCESS IN ORDER TO MINIMIZE THE MECHANICAL STRESSES OF THE WELDING PHASE. THE PROCEDURE IS TO MONITOR AND REGULATE POSITION INSTEAD OF PRESSURE. WE OPTED TO CARRY OUT THE TESTS ACCORDING TO TWO CLOSELY LINKED DOE EXPERIMENTAL PLANS, THE OUTPUT OF THE FIRST PLAN (DOE-1, CONTROLLED FORCE) ALLOWS THE DEFINITION OF THE SECOND PLAN (DOE-2, CONTROLLED DISPLACEMENT). AN IMPORTANT IMPROVEMENT OF THE MECHANICAL PROPERTIES IS RECORDED AND THE ORIGINAL AXIAL ORIENTATION OF THE FLOW IN THE JUNCTION IS KEPT.

ID : 127 Robotic grippers design optimization

B. NAJLAOUI, Z. AFFI, L. ROMDHANE

ROBOTIC GRIPPERS PLAY AN IMPORTANT ROLE IN INDUSTRIAL APPLICATIONS SUCH AS SELECT AND SET, ASSEMBLY TASKS, AND MORE. DESIGNING A GRIPPER WITH APPROPRIATELY SPECIFICATIONS IS CRUCIAL FOR IMPROVING THE PERFORMANCES IN AUTOMATION INDUSTRIES. THIS WORK INTRODUCES A MULTI-CRITERIA DESIGN OPTIMIZATION OF THE ROBOTIC GRIPPERS. THE DIFFERENCE BETWEEN THE MAXIMUM AND MINIMUM GRIPPING FORCES (GFE) AND THE FORCE TRANSMISSION RATIO (FTR) ARE MINIMIZED SIMULTANEOUSLY. THE AIM IS TO OPTIMIZE THE FLUCTUATION OF THE POWER APPLIED TO AN OBJECT BY A GRIPPER AND THE POWER TRANSFER RATE BETWEEN ACTUATOR AND ENDS OF A GRIPPER. THE MULTI-OBJECTIVE HARRIS HAWKS ALGORITHM (MOHHA) IS USED TO PERFORM THE DESIGN OPTIMIZATION. THE OBTAINED RESULTS CONFIRM IMPROVEMENT OF THE REQUIRED DESIGN CRITERIA OF THE ROBOTIC GRIPPERS IN THIS STUDY. IT IS ALSO CONCLUDED THAT THE OPTIMIZED ROBOTIC GRIPPERS HAS 53% LESS IN TERM OF THE GRIPPING FORCE ERROR (GFE) AND 11% REDUCTION IN TERM OF THE FORCE TRANSMISSION RATIO (FTR) THAN THE LITERATURE RESULTS.

ID : 130 Analytical comparison between RBDO's methods for finding lifetime of a composite cantilever beam under fatigue stress.

R. J. MUTAR, A. AKROUT, Q. OGLAH SALIH, M. HADDAR

THE MECHANICAL BEHAVIOR OF OPERATION UNDER FATIGUE STRESS DURING PRODUCTION OF A STRUCTURE MAY DEVIATE SOMEWHAT FROM THAT ANTICIPATED DURING ITS DESIGN. UNCERTAINTIES ARE INHERENT IN THE CONDITIONS OF REALIZATION AND PRODUCTION. IT IS CRUCIAL TO CONSIDER UNCERTAINTY FROM THE BEGINNING OF THE DESIGN PROCESS SO THAT THE STRUCTURE CAN PERFORM AS INTENDED. THERE ARE A NUMBER OF THEORIES IN THE LITERATURE THAT ATTEMPT TO MAKE SENSE OF THE AMBIGUITIES OF A TIRED EXISTENCE. DETERMINING HOW LIKELY IT IS THAT A GIVEN STRUCTURE WILL FAIL IF ITS OPTIMAL OPERATING CONDITIONS ARE VIOLATED IS A CRUCIAL STEP IN IMPROVING STRUCTURAL DEPENDABILITY. TESTING THE COMPOSITE CANTILEVER BEAM (CCB) UNDER FATIGUE STRESS IS A RELATIVELY NEW FIELD THAT INTEGRATES RELIABILITY ANALYSIS INTO OPTIMIZATION ISSUES TO INTRODUCE RELIABILITY CRITERIA TO THE QUEST FOR OPTIMUM STRUCTURAL CONFIGURATION. RELIABILITY-BASED DESIGN OPTIMIZATION (RBDO) IS THE SPECIALTY OF THE RELIABILITY EXPERT.

ID : 134 Elastic properties of an additively manufactured anti-trichiral composite structure

A. HAMROUNI, J.L. REBIERE, A. EL MAHI, M. BEYAOUI, M. HADDAR

ENHANCING THE MECHANICAL PROPERTIES OF BIOBASED POLYMERS THROUGH THE INCORPORATION OF CELLULOSE-BASED FIBERS NOT ONLY SIGNIFIES A PIVOTAL STRIDE TOWARDS SUSTAINABLE MATERIAL DEVELOPMENT BUT ALSO OPENS UP A REALM OF OPPORTUNITIES FOR COST-EFFECTIVE ADDITIVE MANUFACTURING. THIS STUDY FOCUSED ON FORTIFYING POLYLACTIC ACID (PLA) WITH SHORT FLAX FIBERS, LEVERAGING THEIR RENEWABLE AND VERSATILE NATURE AS A CELLULOSE RESOURCE, TO ENGINEER ARCHITECTURAL MATERIALS. EMPLOYING ADDITIVE MANUFACTURING TECHNIQUES FOR FABRICATION, THE STUDY EN-TAILED THE 3D PRINTING AND SUBSEQUENT TESTING OF ANTI-TRICHIRAL HONEYCOMBS. VARIOUS SPECIMENS WERE CRAFTED WITH THREE DISTINCT RELATIVE DENSITIES OF AUXETIC CORE, EACH SERVING AS A UNIQUE TESTBED. THROUGH QUASI-STATIC TESTS CONDUCTED ON THE ARCHITECTURAL CORES, THE TENSILE PROPERTIES OF THESE STRUCTURES WERE SYSTEMATICALLY CHARACTERIZED. THE EMPIRICAL FINDINGS UNVEILED A NUANCED RELATIONSHIP BETWEEN THE AUXETIC BEHAVIOR OF HONEYCOMB MATERIALS AND THE RELATIVE DENSITY OF THE CORE CELL. NOTABLY, STRUCTURES FEATURING HIGHER RELATIVE DENSITIES SHOWCASED A PRONOUNCED ELEVATION IN YOUNG'S MODULUS, UNDERSCORING THE SIGNIFICANCE OF CORE DENSITY IN INFLUENCING MECHANICAL PERFORMANCE. THIS STUDY NOT ONLY CONTRIBUTES TO THE BURGEONING FIELD OF SUSTAINABLE MATERIALS BUT ALSO SHEDS LIGHT ON THE INTERPLAY BETWEEN MATERIAL COMPOSITION AND MECHANICAL BEHAVIOR, OFFERING INSIGHTS FOR FUTURE ADVANCEMENTS IN ADDITIVE MANUFACTURING AND STRUCTURAL DESIGN.

ID : 145 An experimental work of punch-die clearance effect on punching force in the event of punching S500 MC sheet metal

A. ZEIDI, F. BEN SAADA , K. ELLEUCH, H. ATAPEK

COLD FORMING STILL REMAINS AN EFFECTIVE SOLUTION IN TERMS OF COST AND TIME, ESPECIALLY IN MASS PRODUCTION. INDEED, THIS PROCESS HAS THE ADVANTAGE OF BEING SIMPLER TO CARRY OUT THAN HOT WORKING TECHNIQUES. THE IMPORTANCE OF THIS WORK ARISES ESSENTIALLY FROM PUNCH-DIE CLEARANCE STUDY IN THE CASE OF A SHEET METAL HAVING THE SAME THICKNESS AS PUNCH-DIAMETER. THIS WORK FOCUSES ON THE EFFECT OF ONE OF PUNCHING PARAMETERS WHICH IS PUNCH-DIE CLEARANCE. A TRACTION MACHINE WAS USED AS A PRESS TO SATISFY THIS OBJECTIVE. A LABORATORY PROTOTYPE MOLD WAS REALIZED AND THEN ASSEMBLED ON TENSILE MACHINE TO CONDUCT EXPERIMENTS. IN THE PRESENT STUDY, PUNCHING FORCE EVOLUTION IN CASE OF PUNCH DISPLACEMENT INCREASE WAS PRESENTED AT DIFFERENT CLERANCES. TOOL COLD FORMING-DIE CLEARANCE OF 0.35 MM HAD THE LEAST PUNCHING FORCE.

ID : 150 Experimental study on the bending behavior of additively manufactured bio-based sandwiches with architectural cores

H. MALLEK, H. MELLOULI, M. ALLOUCH, M. WALI, F. DAMMAK

IN NUMEROUS INDUSTRIES, THERE IS A PRESSING DEMAND FOR THE DEVELOPMENT OF LIGHT-WEIGHT STRUCTURES CAPABLE OF WITHSTANDING DIVERSE RANGE OF LOADS. THE PREDOMINANT APPROACH TO MEET THIS DEMAND INVOLVES EMPLOYING ARCHITECTURAL SANDWICHES, WHEREIN TWO SKINS ARE AFFIXED TO AN ARCHITECTURAL CORE. THESE DESIGNED CORES ARE RENOWNED FOR THEIR STRUCTURAL VERSATILITY, WITH EACH STRUCTURE OFFERING DISTINCT MECHANICAL CHARACTERISTICS ADAPTABLE TO VARIOUS INDUSTRIAL SECTORS. WITHIN THIS STUDY, THREE MANUFACTURED SANDWICH STRUCTURES INCORPORATE 3D-PRINTED CORE MATERIAL FEATURING CONVENTIONAL HONEYCOMB, RECTANGULAR, AND RE-ENTRANT HONEYCOMB TOPOLOGIES. THESE SANDWICHES ARE PRINTED FROM A BIO-BASED MATERIAL, SPECIFICALLY POLYLACTIC ACID (PLA). UTILIZING A RAISE3D E2 PRINTER, SPECIMENS ARE FABRICATED, AND A SERIES OF TENSILE TESTS ARE CONDUCTED ON THESE SPECIMENS, VARYING THE PRINTING ORIENTATION. THE PRINCIPAL FINDINGS UNDERSCORE A PRONOUNCED IMPACT OF PRINTING ORIENTATION ON YOUNG'S MODULUS AND TENSILE YIELD STRENGTH. THE OBJECTIVE IS TO EXAMINE THE INFLUENCE OF DIFFERENT ARCHITECTURAL CORES ON THE BENDING BEHAVIOR OF ADDITIVELY MANUFACTURED SANDWICH STRUCTURES. THREE-POINT BENDING TESTS ARE CONDUCTED TO EXPLORE THE BENDING CHARACTERISTICS OF THESE ADDITIVELY MANUFACTURED SANDWICH STRUCTURES EMPLOYING THE BIODEGRADABLE MATERIAL PLA.

ID : 151 Experimental and numerical impact analysis of honeycomb-sandwich structure enabled via fused deposition modeling technique

H. Mellouli, H. Mallek, M. Allouch, M. Wali, F. Dammak

It is investigating, in this work, a low-velocity impact performance of a honeycomb-sandwich structure enabled via Fused Deposition Moddeling (FDM) Additive Manufacturing using Polylactic Acid (PLA) material. Experimental and numerical data are setting up in order to validate the results. In first attempt, the PLA material is characterized by tensile experimental test. Then, the low velocity impact test is performed using a drop weight impact testing machine. In second attempt, in purpose of validation, a Finite Element Model (FEM) is carried out via Abaqus software. Among expanded range of cellular structures, auxetic hexagonal cell, embeded in the sandwich structure, was chosen in this study, for his high strength/weight ratio. The impact force as well as the energy absorbed during the impact test, were monitored, with comparison of experimental and numerical results. It is deduced, from the obtained results, a fair agreement between experimental and numerical results, showing that the auxetic honeycomb performs an adequate energy absorption capacity with a lightweight characteristic.

ID : 170 Assessment of disassembly sequences for end-of-life and recycling of mechatronic products for green design

I. Belhadj, M. A. Ben Abdallah, M. Tlija, N. Aifaoui

This paper proposes a new methodology for evaluating the system's design based on a set of metrics i.e. energy consumption, disassembly time, design efficiency, disassembly quality, and recyclability at the end of life of mechatronic products in order to favorite the recyclability. The trade-off between recovery and destruction of parts to be recycled is implemented and discussed. The proposed methodology starts with the extraction of necessary CAD data used to generate the feasible and optimal disassembly sequences.

ID : 174 Towards green manufacturing: Advanced thermal spray processes for engineering coatings

B. Ben Difallah, M. Kharrat, Y. Mebdoua

This review presents some aspects of the environmentally friendly nature of thermal spray. After a short introduction of the present state of the technological progress and the relations between environment and spraying processes, general thermal spray techniques and their characteristics will be presented. HVOF-sprayed new feedstock powders such as Mo-NiCr, WC-10Co-4Cr, WC-FeCr and WC-FeCrAl can be categorized into environmentally friendly materials used as alternatives to hazardous metals for

ENGINEERING APPLICATIONS. HVOF CERMET COATINGS BASED ON CARBIDE CERAMICS PROVED EFFICIENCY IN REDUCING WEAR OF BRAKE DISCS IN THE AUTOMOTIVE FIELD AND GEOTHERMAL PLANT COMPONENTS, HENCE, OVERCOMING ECOLOGICAL PROBLEMS DUE TO GAS EMISSIONS AND MECHANICAL VULNERABILITY AFTER LONG USE. INCREASED EFFICIENCY IN THERMAL BARRIER COATINGS IS NOW GAINED BY ADVANCED ASP THERMAL SPRAY MATERIALS ALLOWING LOWER FUEL CONSUMPTION AND GAS EMISSIONS. OTHERWISE, COLD SPRAY IS A CLEAN TECHNOLOGY WHERE COATINGS ARE FORMED UNDER LOW TEMPERATURES AND HIGH IMPACT VELOCITIES. THIS TECHNIQUE HELPS TO BRING HARMONY JOINING ENVIRONMENTAL CONCERNS AND INDUSTRIAL APPLICATIONS INCLUDING HEAVILY LOADED ENGINE PARTS, PISTON RINGS, ETC.

ID : 186 Sensitivity of Rotary Bending Fatigue Behavior of Additive-Manufactured PLA Polymers to 3D Printing Orientation

S. MZALI, F. ELWASLI, E. FTOUTOU, S. MEZLINI

THE PURPOSE OF THIS STUDY IS TO EXAMINE THE FATIGUE BEHAVIOR OF A POLYMER PRODUCED USING ADDITIVE MANUFACTURING. TO MANUFACTURE THE FATIGUE SAMPLES, A FUSED DEPOSITION MODELING (FDM) PRINTER WAS USED TO 3D PRINT THE POLYLACTIC ACID (PLA) BIODEGRADABLE POLYMER. THREE DIFFERENT PRINTING ORIENTATIONS WERE SELECTED: VERTICAL, HORIZONTAL [0/90], AND HORIZONTAL [+45/-45]. ROTARY BENDING FATIGUE TESTING WAS USED TO ASSESS THE FATIGUE BEHAVIOR OF THESE SAMPLES AT DIFFERENT ALTERNATE PEAK BENDING STRESS LEVELS, SPECIFICALLY 20, 40, 59, AND 79 MPA. THE RESULTS SHOWED THAT PLA PRINTED IN THE HORIZONTAL [+45/-45] PRINTING ORIENTATION WAS MORE FATIGUE RESISTANT THAN PLA PRINTED IN ANY OTHER ORIENTATION. ADDITIONALLY, THERE IS A GOOD AGREEMENT BETWEEN THE EXPERIMENTAL DATA AND THE PREDICTED S-N CURVES MODEL COMPUTED ACCORDING TO BASQUIN'S INITIAL MODEL OF S-N ONE. FURTHERMORE, AT THE LOWEST ALTERNATE PEAK BENDING STRESS (20MPA), THE FATIGUE STRENGTH OF THE 3D-PRINTED SAMPLES WAS LOWER IN THE VERTICAL DIRECTION THAN IT WAS IN THE HORIZONTAL DI-RECTION.

ID : 187 Impact on the mechanical properties of the geometry and 3D printing parameters of PLA tensile specimens

R. BEN AMOR, M. ZRIDA, H. LAURENT, S. SOUISSI

THE RAPID EXPANSION OF ADDITIVE MANUFACTURING (AM), PARTICULARLY IN FUSED FILAMENT MANUFACTURING (FFF), NECESSITATES SPECIFIC STANDARDS FOR ASSESSING THE MECHANICAL PROPERTIES OF AM-PRODUCED COMPONENTS. CURRENTLY, THERE IS A LACK OF A DEDICATED STANDARD FOR THE GEOMETRY OF SPECIMENS IN 3D PRINTING. THIS GAP EXISTS BECAUSE 3D PRINTING IS CHARACTERIZED BY A MULTITUDE OF PARAMETERS, PROVIDING FLEXIBILITY IN CHOOSING SPECIMEN GEOMETRY OR PARAMETERS. THIS FLEXIBILITY IS A CRITICAL CHOICE THAT CAN SIGNIFICANTLY IMPACT THE MECHANICAL PROPERTIES AND THE EXPECTED PRINT QUALITY. THIS ARTICLE FOCUSES ON INVESTIGATING THE INFLUENCE OF SAMPLE SIZE AND PRINTING PARAMETERS ON THE TENSILE PROPERTIES AND PRINT QUALITY OF FFF SAMPLES. THROUGH PRACTICAL

EXPERIMENTATION WITH POLYLACTIC ACID (PLA) UTILIZING FFF, AND SUPPORTED BY A LITERATURE REVIEW, THE STUDY SHEDS LIGHT ON THE CRUCIAL DECISIONS RELATED TO GEOMETRY AND PRINTING PARAMETERS. THESE DECISIONS PLAY A PIVOTAL ROLE IN ENSURING ACCURATE MECHANICAL PROPERTIES AND OFFER ADDITIONAL BENEFITS IN TERMS OF MATERIAL AND TIME SAVINGS, THEREBY ADVANCING FFF TECHNOLOGY.

ID : 191 Optimization parameter effects on the Thermal conductivity of 3D-printing process using Taguchi method

M. JABEUR, R. BEN AMOR, O. HAMDAOUI, S. SOUISSI, A. ELLOUMI

THIS PAPER EXAMINES THE APPLICATION OF FUSED DEPOSITION MODELING (FDM), THE FOREMOST METHOD IN 3D PRINTING, ACROSS VARIOUS INDUSTRIES INCLUDING AUTOMOTIVE, AEROSPACE, AND BIOMEDICAL SECTORS. FDM IS CELEBRATED FOR ITS ABILITY TO SWIFTLY PROTOTYPE COMPLEX PARTS, OFFERING ADVANTAGES SUCH AS SHORTENED LEAD TIMES, COST EFFICIENCY, AND MINIMAL RAW MATERIAL WASTE. WHILE POLYMERS ARE FAVORED IN THE MANUFACTURING OF HEAT EXCHANGERS DUE TO THEIR CORROSION RESISTANCE, LIGHTWEIGHT, AND SMOOTH SURFACES THAT PREVENT FOULING, THEIR LOW THERMAL CONDUCTIVITY OFTEN LIMITS THEIR USE. RECENT ADVANCEMENTS HAVE SUCCESSFULLY INTEGRATED CONDUCTIVE FILLERS WITHIN THE POLYMER MATRIX TO ENHANCE THERMAL PROPERTIES. THREE MATERIALS WERE STUDIED IN THIS WORK: PLA, PLA-COPPER AND PLA-WOOD. THE CURRENT STUDY FOCUSES ON INVESTIGATING HOW DIFFERENT FDM PROCESS PARAMETERS AFFECT THE THERMAL CHARACTERISTICS OF POLYMER-BASED HEAT EXCHANGERS, AIMING TO OPTIMIZE 3D PRINTING PRACTICES FOR ENHANCED PERFORMANCE IN CRITICAL APPLICATIONS.

ID : 213 Leveraging data analytics and machine learning for enhanced gear transmission efficiency

N. SANOUSSI, M. HAMMAMI, M. S. ABBES

THIS STUDY EXPLORES REDUCING FRICTIONAL POWER LOSSES IN SPUR GEAR TRANSMISSIONS, A KEY FACTOR IMPACTING MECHANICAL SYSTEM EFFICIENCY. IT EXAMINES CONTRIBUTORS TO THESE LOSSES, SUCH AS SLIDING/ROLLING VELOCITIES, CONTACT LOADS, OIL TEMPERATURE, AND GEAR SURFACE ROUGHNESS. ADVANCED ANALYTICAL, NUMERICAL, AND MACHINE LEARNING TECHNIQUES WITHIN THE MODEFRONTIER OPTIMIZATION FRAMEWORK ARE INTEGRATED TO IDENTIFY OPTIMAL DESIGN AND OPERATIONAL PARAMETERS. THIS APPROACH NOT ONLY REDUCES FRICTIONAL LOSSES BUT ALSO LEVERAGES LARGE DATASETS TO IMPROVE PREDICTION ACCURACY OF LOSS PATTERNS AND INTERACTIONS. EXPERIMENTAL VALIDATION CONFIRMS THE MODELS' ABILITY TO SIGNIFICANTLY IMPROVE SYSTEM EFFICIENCY THROUGH OPTIMIZATION. THE APPLICATION OF MACHINE LEARNING TOOLS IN MODEFRONTIER REPRESENTS AN ADVANCEMENT IN GEAR TRANSMISSION PERFORMANCE OPTIMIZATION THAT COULD BE ADAPTED TO OTHER MECHANICAL ENGINEERING DOMAINS TO ENHANCE ROBUSTNESS AND RELIABILITY.

ID : 219 Correlation between microstructure and anisotropic mechanical properties of wire arc additive manufactured 5356 aluminum alloy

F. Makni, E. Ben Zina, R. Elleuch

Wire and Arc Additive Manufacturing (WAAM) is a highly efficient production process that enables the low-cost manufacture of complex components used in a wide range of industrial applications. Several studies have been devoted to explore the impact of the WAAM process on the resulting microstructural features and mechanical properties. The purpose of this study is to assess the anisotropic behaviour under tensile stress considering two different extraction directions according to the deposition layer : horizontal (H) and vertical (V) and to correlate results to microstructural features. To achieve this, two 5356 aluminum alloy parts were manufactured by WAAM using different process parameters. Mechanical characterization of WAAM parts were carried out by means of tensile and micro hardness tests. Metallographic analysis was performed to relate micorstructural characteristics induced by the process to the mechanical properties. An aniso-tropic behavior was revealed considering the sample orientation, with the lowest strength and ductility found for (V) specimens. This anisotropy was correlated with grain size and the presence of larger porosities and discontinuities. This phenomenon was found to be reduced when microstructure presents finer grain size with few microstructural defects. In comparison with previous studies, mechanical characterization highlighted very interesting mechanical properties, when adequate process parameters combination was used.

Fluid Mechanics

ID : 30 Flow topology downstream of the square cylinder with slots

L. Bouazizi, S. Turki

Active control of flow past a square cylinder, placed in a horizontal channel, has been numerically studied using a steady secondary flow (suction and blowing) is-sued from two slots embedded on the cylinder's rear face and placed symmetrically at a distance y from the axis of the cylinder. We examine the effect of the blowing and suction intensity ui and the slots position y on the variations of Strouhal number, drag and lift coefficients as well as the instantaneous wake structure. Results show that, both blowing and suction have the potential effect to reduce the fluctuating in lift and drag forces as well as the vortex shedding frequency. For low jet velocity, a drop in St values is observed because of the split-ting of circulation bubble into multiple vortices. A bistable pattern is observed at y = 0.35, 0.40 and 0.45 for ui = 1.5 and 2. We

DEMONSTRATE, FOR A HIGH-VELOCITY JET FLOW (FROM UI =3.15), THE PERIODIC FLOW REGIME BEGINS TO BE CHARACTERIZED BY AN AL-TERNATE SHEDDING OF A SINGLE VORTEX FROM THE REAR FACE OF THE SQUARE CYLINDER.

ID : 43 Numerical analysis of the cooling efficiency based on feedback temperature of the comfort zone in closed environments

F. R. BUTT, I. AKHTAR

HVAC SYSTEMS IS AN ESSENTIAL COMPONENT OF ANY BUILDING MANAGEMENT SYSTEM TO MAINTAIN COMFORTABLE ENVIRONMENT CONDITIONS. A TYPICAL INDOOR SPLIT AIR CONDITIONING UNIT EMPLOYS TEMPERATURE OF THE RETURNING AIR AS AN INPUT TO THE FEEDBACK CONTROLLER TO MAINTAIN DESIRED TEMPERATURE. THIS MAY LEAD TO OVER COOLING/HEATING CAUSING DISCOMFORT AND INEFFICIENCY. DUE TO LACK OF TEMPERATURE SENSING AT THE COMFORT ZONE, SIGNIFICANT AMOUNT OF ELECTRICITY IS WASTED TO COOL DOWN THE ENTIRE CLOSED ENVIRONMENT IN ORDER TO MAINTAIN THE TEMPERATURE IN THE AREA OF INTEREST WITHIN THE ASHRAE SPECIFIED RANGE. THE SPLIT AIR CONDITIONING SYSTEMS FORM THE BACKBONE OF THE HVAC SYSTEMS USED FOR THE COOLING REQUIREMENTS OF CLOSED ENVIRONMENTS. IN THIS RESEARCH, WE NUMERICALLY INVESTIGATE THE EFFECT OF COUPLING THE TEMPERATURE FIELD WITH THE HVAC SENSOR INSIDE TYPICAL OFFICE AND CONFERENCE ROOMS. WE USE TEMPERATURE IN THE REGION OF INTEREST TO CONTROL THE OPERATION OF THE HVAC SYSTEM. THE RESULTS INDICATE THAT THE PROPOSED FLOW CONTROL METHOD IMPROVES THE OVERALL EFFICIENCY OF THE HVAC SYSTEM WITHOUT ANY MAJOR CHANGES TO THE ALREADY EXISTING INFRASTRUCTURE. CFD SIMULATIONS PREDICT APPROXIMATELY 20% REDUCTION IN POWER CONSUMPTION FOR COOLING.

ID : 49 Effect of morphing trailing edge on flapping foil energy harvesting

T. ZUOA, K. DJIDJELIB, D. YURCHENKO

UNLIKE TRADITIONAL WIND TURBINES, WHICH ARE ASSOCIATED WITH NOISE AND ENVIRONMENTAL ISSUES, FLAPPING FOIL TURBINES HAVE A LOWER ENVIRONMENTAL IMPACT AND MATERIAL REQUIREMENTS. THIS STUDY INVESTIGATES THE EFFECT OF MORPHING TRAILING EDGE ON THE ENERGY HARVESTING OF FLAPPING FOIL. THE NUMERICAL PERFORMANCE OF SUCH A DEVICE IS INVESTIGATED USING UNSTEADY TWO-DIMENSIONAL LAMINAR FLOW SIMULATIONS WITH THE COMMERCIAL ANSYS FLUENT. THE STUDIES WERE CARRIED OUT FOR DIFFERENT OSCILLATION FREQUENCIES, DEFORMABLE TRAILING EDGE DEFLECTIONS (DTE), AND A PITCH ANGLE OF 70 DEGREES. FROM THE SIMULATIONS, IT IS FOUND THAT AS THE TRAILING EDGE OF THE AIRFOIL DEFLECTS, THE ENERGY HARVESTING EFFICIENCY INITIALLY INCREASES WITH THE MAGNITUDE OF THE DEFLECTION, REACHING A MAXIMUM AT DTE=0.05C, AND THEN DECREASES. AT A PITCH ANGLE OF 70 DEGREES AND A FREQUENCY OF 0.14, THE NACA0015 AIRFOIL HAD AN ENERGY HARVESTING EFFICIENCY OF 30.1% FOR THE NON-MORPHED TRAILING EDGE, WHILE WHEN THE TRAILING EDGE OF THE AIRFOIL REACHES DTE=0.05C, THE EFFICIENCY INCREASES TO 34.14%, WHICH IS AN IMPROVEMENT OF APPROXIMATELY 13% (COMPARED TO THE NON-MORPHED).

ID : 87 Large-Eddy Simulations of flow and heat transfer within a rod assembly under baffle jet inflow

M. Ali, A. K. Alkaabi, I. Afgan

The study of baffle jetting is essential for the safe operation of nuclear power plants, involving the horizontal flow impingement on fuel/control rods during the outward flow of primary coolant. To investigate flow and heat transfer characteristics under baffle jetting conditions, Large Eddy Simulations (LES) were performed on a 6×6 fuel rod assembly. Three Reynolds numbers (5,010, 10,000, and 20,000) were considered, along with a 5°C temperature difference between inlet fluid and heated rods. Various flow parameters, including pressure coefficients, mean and fluctuating forces, Strouhal number, and local and averaged Nusselt numbers, were analyzed. LES findings were validated against experimental and numerical data, revealing the significant impact of baffle jetting on the first stream-wise row of rods, with higher averaged Nusselt numbers observed in the stream-wise direction of the jet.

ID : 108 Effects of height dimensions on a soilless greenhouse: A numerical study

O. Zghal, H. Abid, Z. Driss, S. Zouari, G. Gugliuzza, M. Mejri, E. Arrabito

In this paper, we thoroughly examine the interior conditions of a soilless greenhouse in Tunisia through a combination of numerical modeling and experimental setups. The primary goal of the study is to predict the effects of design modifications on the microclimate of the Manouba soilless greenhouse. Previous research has detailed various adjustments to the greenhouse's architecture. This investigation focuses mainly on adjusting the height of an above-ground tunnel greenhouse. To account for the dynamic impacts of current tomato and basil crops on airflow, heat, and mass exchanges, climatic studies are based on numerical simulations using the CFD model.

ID : 119 Energy harvesting effectiveness of flag-based systems in the wake of modified cylindrical structures

W. Khan, E. Uddin, A. Abdelkefi

Finding ways to capture the natural available energy is the need of the day. This work is based on the investigation of wake dynamics of different bluff bodies to point out the improved structure for capturing the wake vibrational energy. This study's findings can be utilized to develop systems for small-scale energy harvesting. Four various cylindrical structures have been compared based on the wake dynamics both experimentally and numerically, including a simple circular cylinder as a reference for comparison with three modified structures. The most favorable proposed by these investigations is the structure with four columns of semi-circular extrusions

FOLLOWED BY THE FIVE, AND THREE COLUMNS, RESPECTIVELY. THE STUDY SHOWS THAT THE MODIFIED CYLINDRICAL STRUCTURES CAN ALTER THE WAKE TURBULENCE INTO AN INTENSE STATE, FROM WHICH AN ENHANCED AMOUNT OF ENERGY CAN BE HARVESTED. THE RESULTS ARE SUPPORTED BY THE VARIATIONS IN THE DRAG AND LIFT FORCES, THE WAKE PRESSURE AND VELOCITY DIFFERENCES, FOUND THROUGH NUMERICAL SIMULATIONS, VELOCITY AND VORTICITY VISUALS FROM PARTICLE IMAGE VELOCIMETRY TECHNIQUE, AMPLITUDE AND FLAPPING FREQUENCIES OBTAINED DURING A REAL TIME EXPERIMENTATION IN A WATER TUNNEL.

ID : 121 Investigating seasonal variations and their influence on the microclimate of soilless glass greenhouse

H. ABID, O. ZGHAL, M. LAJNEF, A. KETATA, Z. DRISS

THIS WORK PRESENTS A DETAILED ANALYSIS OF THE INDOOR ENVIRONMENTS IN A SOILLESS GREENHOUSE IN TUNIS AND THEIR RESPONSE TO SEASONAL VARIATIONS. THE STUDY USES A COMBINATION OF NUMERICAL MODELING AND EXPERIMENTS TO ASSESS THE IMPACT OF VARIOUS FACTORS ON THE INDOOR CLIMATE, SUCH AS GLASS, AIR, CROPS, AND CONCRETE. THE NUMERICAL MODEL WAS VALIDATED AGAINST EXPERIMENTAL DATA AND OPTIMIZED TO ACCURATELY REPLICATE REAL CONDITIONS. THE RESEARCH HIGHLIGHTS THE IMPORTANCE OF ACCURATE MODELING AND CONTROL TO OPTIMIZE AGRICULTURAL PRACTICES IN NORTHERN TUNISIA.

ID : 126 Investigating the overlap distance for helical Savonius wind rotor

M. LAJNEF, M. MOSBAHI, H. ABID, Z. DRISS, T. TUCCIARELLI

ABOVE ALL VERTICAL AXIS WIND TURBINES, FOR THEIR LOWER COST AND INDEPENDENT ON WIND DIRECTION, SAVONIUS ROTOR TAKES THE ADVANTAGE TO BE MORE SUITABLE FOR SOME IMPLEMENTATION. THUS, MANY INVESTIGATIONS HAVE BEEN CARRIED OUT TO IMPROVE ITS EFFICIENCY. THIS STUDY EMPHASIZES ON THE EFFECT OF THE OVERLAP DISTANCE ON A HELICAL SAVONIUS WIND TURBINE PERFORMANCE. ASSESSMENT METHODS BASED ON THE FLOW FIELD CHARACTERIZATIONS, THE VARIATION OF TORQUE AND POWER COEFFICIENT ARE PERFORMED. THUS, TRANSIENT SIMULATIONS USING THE SST K-Ω TURBULENCE MODEL ARE CARRIED OUT. THE NUMERICAL MODEL IS VALIDATED USING WIND TUNNEL TESTS. RESULTS INDICATE THAT THE NON-OVERLAPPED HELICAL SAVONIUS ROTOR HIGHLIGHTS HIGHER MAXIMUM POWER COEFFICIENT OF 0.124 AT A TIP SPEED RATIO OF 0.73 OVER ROTORS WITH OVERLAP DISTANCE OF 10 MM, 15 MM AND 20 MM, RESPECTIVELY.

ID : 133 Optimizing greenhouse design for better plant growth in arid zone: Investigating the impact of roof height

H. CHIBOUB, H. ABID, A. KETATA, M. LAJNEF, Z. DRISS

TRADITIONAL GREENHOUSES PROVIDE A STABLE ENVIRONMENT FOR PLANT GROWTH, BUT THERE'S A LACK OF CLEAR GUIDELINES FOR SELECTING OPTIMAL ROOF HEIGHT. THIS STUDY ESTABLISHES NEW RELATIONSHIPS BETWEEN ROOF HEIGHT, TEMPERATURE, AND AIR VELOCITY TO OPTIMIZE CROP PRODUCTION. USING EXPERIMENTAL SETUPS AND SIMULATIONS MODELS, THE RESEARCH FOCUSES ON THE HEIGHT RATIO OF POLYETHYLENE GREENHOUSES IN TUNISIA AND ITS EFFECT ON MICROCLIMATE. THE STUDY FINDS STRONG CORRELATIONS BETWEEN HEIGHT AND MICROCLIMATE VARIATIONS, EMPHASIZING THE IMPORTANCE OF PRECISE MODELING AND CONTROL FOR IMPROVING AGRICULTURAL PRACTICES.

ID : 146 Analysis of 3D MHD fluid flow over a heated rotating disk with Joule heating

S. MAMACHE, F. MENDIL, F. NAIT BOUDA

IN THIS PAPER, THE STAGNATION POINT FLOW OF AN ELECTRICALLY CONDUCTIVE FLUID IMPACTING RADIALLY ON A HEATED ROTATING DISK IS STUDIED IN THE PRESENCE OF A UNIFORM MAGNETIC FIELD AND THE JOULE HEATING EFFECT. THE PROBLEM POSITION REQUIRES FIRST EXAMINING THE BASIC FLOW, WHICH INTERVENES IN THE STABILITY PROBLEM. THE GOVERNING EQUATIONS OF THE PROBLEM ARE CONVERTED INTO A SYSTEM OF NONLINEAR ORDINARY DIFFERENTIAL EQUATIONS, THEN SOLVED NUMERICALLY USING THE FOURTH-ORDER RUNGE-KUTTA METHOD. IN THE SECOND STEP, THE WORK IS ORIENTED TOWARDS LINEAR STABILITY ANALYSIS BY CONSIDERING INFINITESIMAL SMALL DISTURBANCES WITHIN THE BOUNDARY LAYER. BY MAKING USE OF THE NORMAL MODE DECOMPOSITION WITHIN THE GÖRTLER-HAMMERLIN FRAMEWORK, THE RESULTING EIGENVALUE PROBLEM IS SOLVED NUMERICALLY USING THE PSEUDO-SPECTRAL METHOD BASED ON LAGUERRE'S POLYNOMIALS. THE RESULTS OBTAINED ON THE CRITICAL CONDITIONS FOR THE ONSET OF INSTABILITY ARE DESCRIBED AND DISCUSSED IN DETAIL USING MULTIPLE CONFIGURATIONS AND TABLES. IT IS FOUND THAT THE PRESENCE OF A MAGNETIC FIELD AND JOULE HEATING ACT SIMULTANEOUSLY TO INCREASE THE STABILITY OF THE BASIC FLOW, HOWEVER, PRANDTL NUMBER (PR) ACTS TO EITHER INCREASE OR DECREASE IT WHEN IT ASSUMES A SMALL OR LARGE VALUE, RESPECTIVELY. IT IS ALSO FOUND THAT THE JOULE HEATING LEADS TO A CONSIDERABLE INCREASE IN ENERGY DISSIPATION WITHIN THE FLUID AND CONTRIBUTES SIGNIFICANTLY TO IMPROVING ITS STABILITY.

ID : 157 Double-diffusive magnetoconvection of a fluid in a quarter-circle cavity with a baffle

S. JALLOULI, B. BEN BEYA

OUR WORK INVOLVES STUDYING DOUBLE-DIFFUSIVE MAGNETOCONVECTION OF A FLUID IN A QUARTER-CIRCLE CAVITY. THIS STUDY WAS INITIALLY CONDUCTED WITHOUT A BAFFLE, FOLLOWED BY

INTRODUCING A BAFFLE INSIDE THE CAVITY. THE RESULTS PRESENTED IN THIS WORK WERE OBTAINED THROUGH NUMERICAL SIMULATIONS USING THE "NASIM" CALCULATION CODE DEVELOPED BY PROFESSOR BRAHIM BEN BEYA, BASED ON THE FINITE VOLUME METHOD. THE SPATIAL DISCRETIZATION USING FINITE VOLUME METHODS WAS APPLIED TO A TWO-DIMENSIONAL (2D) FLOW. ANALYSIS OF THE EFFECTS OF VARIOUS PARAMETERS GOVERNING THIS TYPE OF FLOW REVEALS THAT THE AVERAGE HEAT TRANSFER RATE IS FAVORED BY AN INCREASE IN THE RAYLEIGH NUMBER (RA), WHILE IT DECREASES SIGNIFICANTLY WITH INCREASING MAGNETIC FIELD INTENSITY (HA). ADDING A BAFFLE AT POSITION D SIGNIFICANTLY ENHANCES HEAT AND MASS TRANSFER IN THIS FLOW. FURTHERMORE, THE PRESENCE OF A MAGNETIC FIELD CAN NOTABLY INFLUENCE THE FLOW'S INSTATIONARITY.

ID : 159 Effect of rotation on natural convection in an enclosure filled with nano-fluid and centred by heated Block

H. GABSI, B. BEN BEYA

THIS STUDY IS TO INVESTIGATE NATURAL CONVECTION IN A ROTATING DIFFERENTIALLY HEATED SQUARE ENCLOSURE CENTERED BY A HOT INNER CIRCULAR CYLINDER AND FILLED WITH WATER-CU, WATER-TIO-2. THE GOVERNING EQUATIONS ARE DISCRETIZED USING FINITE VOLUME METHOD WITH THE QUICK SCHEME AND SOLVED NUMERICALLY BY PROJECTION ALGORITHM FOR THE PRESSURE-VELOCITY COUPLING TOGETHER WITH THE MULTIGRID SOLVER. THE EFFECTS OF ENCLOSURE'S ROTATION ON THE HEAT TRANSFER AND LAMINAR FLUID FLOW FOR A RANGE OF SOLID VOLUME FRACTION $0 \leq \Phi \leq 0.05$, TAYLOR NUMBER $5x10^3 \leq Ta_{bf} \leq 2.7x10^5$ AND HARTMANN NUMBER $0 \leq Ha \leq 40$ AT $Ra = 1.2x10^5$ IS DISCUSSED. RESULTS REVEAL THAT ROTATION AFFECTS ISOTHERMS AND STREAMLINES AND THE AVERAGE HEAT TRANSFER RATE IS DISADVANTAGED WITH THE INCREASE OF TAYLOR NUMBER (TA) AND HARTMANN NUMBER (HA) AT FIXED RAYLEIGH NUMBER (RA) BY CONSIDERING METALLIC NANO-PARTICLES CU WITH $\Phi = 0.05$.

ID : 163 MHD hybrid nanofluid natural convection in a square enclosure with a hot circular fin: analysis of heat transfer and entropy generation

O. BARKOUTI, B. BEN BEYA

IN THIS WORK, WE PRESENT A NUMERICAL STUDY OF THE LAMINAR NATURAL CONVECTION OF ALUMINA-SILICA/WATER HYBRID NANOFLUID INSIDE AN ENCLOSURE EQUIPPED WITH A CIRCULAR FIN AND UNDER A UNIFORM MAGNETIC FIELD. THE NUMERICAL APPROACH IS BASED ON THE FINITE VOLUME METHOD (FVM) AND THE PROJECTION METHOD ALGORITHM. THE DISCRETIZED SYSTEM OF EQUATIONS IS SOLVED BY THE RED-BLACK POINT'S SUCCESSIVE OVER-RELAXATION WHILE THE POISSON EQUATION IS SOLVED USING AN ACCELERATED MULTIGRID METHOD. SIMULATIONS HAVE BEEN PERFORMED USING A FORTRAN IN-HOUSE CODE NAMED NASIM. THE EFFECTS OF HARTMANN NUMBER AND OF NANOPARTICLES' VOLUME FRACTION ON ENTROPY GENERATION AND HEAT TRANSFER ARE BEING INVESTIGATED. THE RESULTS SHOW THAT BY INCREASING HARTMANN

number from 0 to 100, total entropy generation decreases by approximately 71.2% while the average Bejan number and the performance evaluation increase respectively by 17.8% and 15.4%. It was also observed that by adding 2% of nanoparticles, the heat transfer rate decreased slightly by 0.7% on the other hand the contribution of entropy generation due to thermal gradients to total irreversibility of the system is increased by 3.26%. Finally, the thermal efficiency is enhanced by approximately 3% when increasing nanoparticles' concentration from 1% to 3%.

ID : 164 Numerical study of natural convection of ferrofluid in an enclosure containing an obstacle in the presence of internal heat generation or absorption

H. Ghemougui Dridi, B. Ben Beya

This paper presents a numerical study on the laminar natural convection of water-based ferrofluid within a cavity containing a hot obstacle formed by the fusion of two identical ellipses, and three localized cold sources while the floor is insulated. The cavity is filled with Fe3O4-water ferrofluid. Simulations are conducted using a FORTRAN-based code to solve the Navier-Stokes equations. The finite volume method (FVM) and a full multigrid technique are employed to solve the governing equations, with a red-black successive over-relaxation method applied to the system of discretized equations to obtain the solution fields. This study investigates the effects of the Hartmann number (Ha) and the Q number while keeping the Rayleigh number (Ra), Prandtl number (Pr), and the volume fraction of nanoparticles constant (Ra =105, Pr = 6.2, and Φ = 3%). Results indicate an increase in the internal heat generation/absorption coefficient Q number leads to a higher heat transfer rate.

ID : 166 Analytical solution for leak location of frictionless flow in pipes

W. Yaakoubi, L. Ayed, S. Elaoud

Analyzing the behavior of hydraulic systems at resonant frequencies, both with and without leaks, is crucial for effective fault detection and localization. This approach leverages the uniform impact of pipeline components, which consistently induce changes across signal periods, thus making resonant frequencies particularly sensitive to alterations within the system. This sensitivity is pivotal for detecting discrepancies that signify faults. This study demonstrates that most changes in the hydraulic system affect resonant responses in the frequency domain, which are critical to understanding the system's behavior. Through an analytical formulation of the frequency response of a standard tank-pipe-valve system, the research provides a localized study of system behavior with leaks at normalized resonance harmonics and assesses the impact of various dimensionless quantities. Moreover, this work

ADDRESSES GAPS IN EXISTING FAULT DETECTION METHODS BY DERIVING TWO NEW ANALYTICAL FORMULAS: ONE FOR SIZING AND ANOTHER FOR LOCATING LEAKS IN FRICTIONLESS PIPE FLOWS.

ID : 172 Dynamic shear measurements of bitumen using a rotative rheometer between two circular plates without a slip condition

A. KRAIEM, N. ELKISSI, A. AYADI

IN THIS STUDY, A DYNAMIC SHEAR MEASUREMENT OF BITUMEN USING A ROTATIVE RHEOMETER BETWEEN TWO CIRCULAR PLATES HAVE BEEN INVESTIGATED. THE EXPERIMENTAL TEST WAS EXAMINED WITH PURE-BITUMEN AND BITUMEN-MIXED WITH 10% AND 20% OF KAOLIN. IN ORDER TO UNDERSTAND THE BEHAVIOR OF THE SAMPLE, THE RHEOLOGICAL MEASUREMENTS WERE CONDUCTED AT DIFFERENT TEMPERATURE 26°C, 50°C AND 80°C. A STUDY OF THE SLIP CONDITIONS WAS CONDUCTED TO CHOOSE THE APPROPRIATE PLATES TO PREVENT THE SLIP PHENOMENA. THE EFFECT OF THE ROUGHNESS OF THE FACED DISKS ON THE VISCOSITY AND TORQUE WAS STUDIED. FURTHERMORE, THE EVOLUTION OF THE STORAGE AND LOSS MODULUS AS A FUNCTION OF ANGULAR FREQUENCIES WERE EXAMINED. THE EXPERIMENTAL RESULTS REVEAL THAT PURE-BITUMEN AND BITUMEN-MIXED WITH 10% OF KAOLIN AT BOTH 26°C AND 50°C PRESENTED VISCOELASTIC BEHAVIOR. HOWEVER, BITUMEN-MIXED WITH 20% OF KAOLIN AT 26°C BECOMES CONSISTENT AND EXHIBITS ELASTIC SOLID BEHAVIOR. AT 80°C, THE STORAGE MODULUS OF BITUMEN-MIXED WITH 20% OF KAOLIN WAS HIGHER THAN THE LOSS MODULUS, INDICATING AN INTERACTION AND MODIFICATION IN MACROMOLECULAR ELEMENTS WITHIN THE SAMPLE. FINALLY, THE EFFECT OF KAOLIN ADDITION IS DESCRIBED AND ANALYZED.

ID : 179 Numerical Simulation of PCM Melting Process in a Rectangular Enclosure: Application to Buildings

A. AMAMOU, N. M. SAID

THIS PAPER DEALS WITH THE NUMERICAL STUDY OF MELTING PROCESS OF A PHASE CHANGE MATERIAL (PCM) IN A DIFFERENTIALLY HEATED RECTANGULAR ENCLOSURE. SIMULATIONS ARE CARRIED OUT WITH THE COMMERCIAL SOFTWARE ANSYS-FLUENT. THE OVERALL GOAL OF THIS STUDY IS TO INTEGRATE PCM ELEMENTS INTO CONSTRUCTION MATERIALS IN PASSIVE BUILDINGS. IT IS FOUND THAT THE MELTING RATE OF PCM IS DOMINATED BY CONDUCTION IN EARLY TIMES OF THE MELTING PROCESS. THE HEAT TRANSFER BY CONVECTION DECELERATES THE MOVEMENT OF THE SOLID-LIQUID INTERFACE BECAUSE THE PCM MELTING IS CONCENTRATED ONLY IN THE UPPER PART OF THE CAVITY.

ID : 182 Numerical investigation of fluid-structure interaction in flexible rotor systems: Insights into performance and design optimization

M. FAKHFEKH, W. BEN AMIRA, M. ABID, A. MAALEJ

THIS STUDY UNDERTAKES A NUMERICAL EXPLORATION OF FLUID-STRUCTURE INTERACTION, SPECIFICALLY FOCUSING ON INVESTIGATING THE ELASTIC PROPERTIES OF A FLEXIBLE ROTOR. THE RESEARCH UTILIZES A ROBUST TWO-WAY FLUID-STRUCTURE INTERACTION (FSI) METH-OD FACILITATED BY ANSYS WORKBENCH SOFTWARE. THIS APPROACH INTEGRATES THE FLUID DYNAMICS SOLVER WITH THE TRANSIENT STRUCTURAL SOLVER TO STUDY THE ELASTIC BEHAVIOR OF THE FLEXIBLE ROTOR SUBMERGED IN WATER AND ITS CONSEQUENTIAL IM-PACT ON PERFORMANCE. THE ROTOR UNDER SCRUTINY POSSESSES A MODERATE LEVEL OF FLEXIBILITY AND IS REPRESENTED WITH THREE BLADES FEATURING A SIMPLIFIED RECTAN-GULAR GEOMETRY. THE PRIMARY OBJECTIVE OF THIS INVESTIGATION IS TO ASSESS THE IN-FLUENCE OF VARYING FLOW VELOCITIES ON THE BENDING DEFORMATION OF THE BLADES. THE FINDINGS REVEAL THAT THE BLADES UNDERGO DEFORMATION IN THE DOWNSTREAM DIRECTION, WITH THE MAGNITUDE OF THESE DEFORMATIONS AMPLIFYING WITH INCREAS-ING INLET VELOCITIES. FURTHERMORE, THE STUDY ILLUSTRATES HOW FLEXIBILITY CONTRIB-UTES TO A REDUCTION IN DRAG FORCE. IT ALSO ELUCIDATES THE SUBSTANTIAL ROLE FLEXIBIL-ITY PLAYS IN EITHER ENHANCING OR DIMINISHING ROTOR PERFORMANCE, THEREBY PROVIDING VALUABLE INSIGHTS INTO THE OPTIMIZATION OF ROTOR DESIGN.

Industrial Applications and Technology Transfer

ID : 28 Adsorption of pharmaceutical molecules on activated carbon: Interpretation of the adsorption isotherms via advanced model

L. SELLAOUI

AN ADVANCED MODELLING WAS APPLIED TO ANALYZE THE INTERFACIAL PROCESS OF TWO PHARMACEUTICAL POLLUTANTS LIKE PARACETAMOL (PCTM) AND NIMESULIDE (NMSD), ON AN EFFICIENT ADSORBENT SUCH AS ACTIVATED CARBON. PCTM AND NMSD DATA WERE CONDUCTED UNDER DIFFERENT TEMPERATURES FOR A PLAUSIBLE EXPLANATION OF THIS MECHANISM. ACCORDING TO THE MODELLING ASSESSMENT, IT WAS DEDUCED THAT BOTH PCTM AND NMSD POLLUTANTS WERE ELIMINATED VIA THE FORMATION OF TWO LAYERS. THIS MODELLING STUDY INDICATED THAT THE NMSD AND PCTM MAXIMUM ADSORPTION UPTAKES REDUCED WITH TEMPERATURE FROM 260 TO 212 MG/G AND FROM 115 TO 74 MG/G FOR NMSD AND PCTM RESPECTIVELY. THIS BEHAVIOR SHOWS THAT THE APPLIED ADSORBENT IS CHARACTERIZED BY A HIGH PERFORMANCE TO REMOVE NMSD THAN PCTM. THE ASSESSMENT OF MODEL PARAMETERS REFLECTED THAT THIS ADSORPTION PROCESS WAS OCCURRED VIA THE PRESENCE OF AN AGGREGATION PHENOMENON. FOR A BETTER ILLUSTRATION OF THE ADSORPTION MECHANISM, ADSORPTION ENERGIES ARE ESTIMATED, REFLECTING THAT THE REMOVAL PROCESS OF OCCURS VIA PHYSISORPTION.

ID : 69 Integration of Path Finding Algorithm in CAD Environment

A. NHOUCHI, S. BEN SAID, M. A. BEN ABDALLAH, N. AIFAOUI

THIS RESEARCH EXPLORES THE INTEGRATION OF THE A* PATHFINDING ALGORITHM AND ITS ENHANCED VERSION WITHIN THE COMPUTER-AIDED OPTIMIZATION (CAO) ENVIRONMENT, WITH A SPECIFIC FOCUS ON ITS IMPLEMENTATION IN FREECAD. THE ENHANCED ALGORITHM ADDRESSES LIMITATIONS OBSERVED IN THE TRADITIONAL A* ALGORITHM BY REFINING THE HEURISTIC FUNCTION AND INTRODUCING A TWO-STAGE PRUNING PHASE TO REMOVE UNNECESSARY AND REDUNDANT POINTS. SIMULATIONS ARE CONDUCTED IN A 2D ENVIRONMENT WITH SCATTERED UNPREDICTED STATIC OBSTACLES, COMPARING THE PATHFINDING CAPABILITIES OF THE TRADITIONAL AND ENHANCED ALGORITHMS. RESULTS DEMONSTRATE THE EFFICACY OF THE ENHANCED A* ALGORITHM IN IDENTIFYING OPTIMAL PATHS FROM START TO FINISH, THEREBY ENHANCING FREECAD'S FUNCTIONALITY FOR PATH DETERMINATION. FURTHERMORE, THIS ADDED FEATURE IS ANTICIPATED TO BE PARTICULARLY BENEFICIAL IN STREAMLINING THE ASSEMBLY AND DISASSEMBLY PROCESSES WITHIN MECHANICAL SYSTEMS, ESPECIALLY IN ENVIRONMENTS CHARACTERIZED BY A MULTITUDE OF VARIABLES AND CONSTRAINTS.

ID : 123 Mechanical properties characterization of laminated composite when varying architectures

M. HADDAR, S. KOUBAA

THE OBJECTIVE OF THIS STUDY IS TO EVALUATE THE MECHANICAL BEHAVIOR OF LAMINATED COMPOSITES BASED ON ISOPHTHALIC POLYESTER RESIN (ISO) REINFORCED WITH PLAIN WOVEN ROVING AND/OR CHOPPED STRAND MAT GLASS FIBERS (GF) FOR MARINE APPLICATIONS. VARIOUS LAMINATED COMPOSITES WERE FABRICATED USING THE HAND LAY-UP TECHNIQUE. THE RESULTS INDICATED THAT THE LAMINATED COMPOSITE REINFORCED WITH PLAIN WOVEN ROVING GF (ISO/6 LAYERS (R)) EXHIBITS THE HIGHEST VALUES OF TENSILE MODULUS, TENSILE STRENGTH, AND IMPACT STRENGTH COMPARED TO OTHER COMPOSITE MATERIALS (ISO/6 LAYERS (M+R) AND ISO/6 LAYERS (M)). FURTHERMORE, THE STRUCTURE OF THE WOVEN GF IS THE MAIN CONTRIBUTING FACTOR TO THE IMPROVEMENT OF THE MECHANICAL PROPERTIES.

ID : 144 Theoretical study of Stirling engine thermal and mechanical performance with various working fluid

I. MARZOUGUI, H. HACHEM, R. GHEITH, F. ALOUI

THE STIRLING ENGINE OFFERS A PROMISING ALTERNATIVE TO TRADITIONAL INTERNAL COMBUSTION ENGINES, BOASTING HIGH EFFICIENCY AND LOW EMISSIONS. IMPROVING STIRLING ENGINE PERFORMANCE HINGES ON REGENERATOR DESIGN. THIS STUDY INTRODUCES A 2D NUMERICAL INVESTIGATION USING THE MVCEF NUMERICAL METHOD, PRESENTING A NEW NUMERICAL COMPARISON. WE COMPARE FOUR CASES UNDER IDENTICAL THERMAL AND DYNAMIC BOUNDARY

CONDITIONS: A MULTI SUB-REGENERATOR SET WITH DIFFERENT WORKING FLUID (HELIUM, NITROGEN, CARBON DIOXIDE AND AIR). OUR FINDINGS INDICATE THAT THE TYPE OF WORKING FLUID PASSING THROUGH THE REGENERATOR SUB-DIVISION ENHANCES STIRLING ENGINE PERFORMANCE. THE USE OF HELIUM AS A WORKING FLUID YIELDS THE DESIRED EFFICIENCY. REGARDING MAXIMUM MECHANICAL POWER AND A MAXIMUM HEAT CONVECTION AND CONDUCTION FLUX.

ID : 178 Lean and Industry 4.0: Impacts on Performances Production Systems

T. JERIDI, O. AYADI, F. MASMOUDI

MANY COMPANIES HAVE PARTIALLY OR FULLY IMPLEMENTED TOOLS DERIVED FROM THE LEAN APPROACH. THE AIM IS TO ELIMINATE ALL NON-VALUE-ADDED ACTIVITIES AND SUPPORT VALUE-ADDED ACTIVITIES. HOWEVER, IN RECENT YEARS, IN ASSOCIATION WITH LEAN, INDUSTRY 4.0 HAS BEEN PRESENTED AS AN ESSENTIAL STEP TO ENSURE ECONOMIC GROWTH FOR MANUFACTURING COMPANIES. THIS HAS GIVEN RISE TO THE TERM "LEAN 4.0 OR LEAN DIGITAL", WHICH SIGNALS THE NEXT WAVE OF OPPORTUNITIES FOR THE MOST AMBITIOUS COMPANIES SEEKING TO INCREASE THEIR PRODUCTIVITY AND COMPETITIVENESS IN THE MARKET. THIS ARTICLE PRESENTS A BIBLIOGRAPHICAL STUDY SHOWING HOW LEAN MANAGEMENT TOOLS AND INDUSTRY 4.0 TECHNOLOGY CAN BE USED TO DECREASE OPERATIONAL COMPLEXITY AND IMPROVE THE PRODUCTIVITY OF PRODUCTION SYSTEMS.

ID : 180 Ant colony optimization for the single machine scheduling problem with sequence dependent setup times.

A. MELLOULI, C. WAFI, R. MELLOULI

PRODUCTION SCHEDULING IS THE PROCESS OF PROGRAMMING IN TIME THE ALLOCATION OF HUMAN AND MATERIAL RESOURCES, SUCH AS MACHINES, OPERATORS AND MATERIALS TO EFFICIENTLY EXECUTE MANUFACTURING OPERATIONS AND ACHIEVE A PREDEFINED GOAL. THIS PAPER ADDRESSES AN IMPORTANT VARIANT OF PRODUCTION SCHEDULE, CALLED "SINGLE MACHINE SCHEDULING PROBLEM WITH SEQUENCE-DEPENDENT SETUP TIMES". THE OBJECTIVE IS TO DETERMINE THE JOBS SEQUENCE THAT MINIMIZE THE MAXIMUM EXECUTION TIME, CALLED MAKESPAN. FOR THIS NP-HARD PROBLEM, AN ANT COLONY OPTIMIZATION HEURISTIC WAS ELABORATED, IMPLANTED AND TESTED. THE EXPERIMENTAL STUDY SHOWS A GREAT SUC-CESS OF THIS APPROACH TO GENERATE GOOD SOLUTIONS NEAR TO THE OPTIMAL ONES.

ID : 21 Prediction of fatigue life cycle of aged SMC composites

A. Abdessalem, S. Tamboura, H. B. Daly, J. Fitoussi

Sheet Molding compound (SMC) composites were subjected to water immersion tests in distilled water at 25°C – 90°C for different time durations in oder to study their durability. Water diffusion within the material was found to be in a good agreement with the "Langmuir-type" diffusion model developed by Carter and Kibler. In their theory, Carter and Kibler consider the existence of two types of water molecules in the material, «mobile» and «bound». In this study, these two types have been considered separately. The absorbed humidity affects largely the mechanical behavior. Results display clearly that the aging conditions decrease number of cycles to failure under repetitive loads. Furthermore, a model was elaborated to predict the life-end of the used material after different aging time and temperature.

ID : 34 Influence of the number of contours of a specimen manufactured by FFF on the propagation of acoustic waves

M. Ajmi, S. Bernard, S. Souissi, A. Elloumi, P. Marechal

This study explores the impact of walls number on the acoustic properties of 3D printed PLA samples using fused filament fabrication (FFF). The samples are subjected to three infill patterns (line, combined, and concentric) and four infill densities {100%; 90%; 80%; 70%}, with two levels of contours {0; 3} (without contours and with three contours). Variation of these parameters allows for modulation of the volumetric fraction of porosity, thus influencing the acoustic properties of the materials. The results reveal that the addition of contours does lead to a decrease in the velocity of acoustic waves, but rather favors the propagation of waves within the edges of the structure. This phenomenon is identified as guided waves, where contours introduce discontinuities that interfere with wave propagation through the 3D printed material. Additionally, the study highlights the influence of modulation of volumetric porosity fraction on wave propagation through the material, thus emphasizing the capability of additive manufacturing to adjust the acoustic characteristics of 3D printed materials. This research enhances our understanding of the interactions between additive manufacturing and the acoustic properties of materials, revealing the critical role of contours in structural guided wave phenomena.

ID : 35 Characterization and optimization of dielectric materials for MRI RF coil applications: A Focus on sample preparation and electrical evaluation

Z. JEBRI, M. T. ALI

THIS STUDY FOCUSES ON THE CHARACTERIZATION OF DIELECTRIC MATERIALS, PARTICULARLY THOSE USED IN MAGNETIC RESONANCE IMAGING (MRI) APPLICATIONS, WITH A SPECIFIC EMPHASIS ON SAMPLE PREPARATION AND ELECTRICAL EVALUATION [1]. THE DIELECTRIC MATERIALS EXAMINED ARE PART OF CERAMIC PRODUCT RANGE, INCLUDING MULTILAYER CAPACITORS, NOTABLY HIGH-QUALITY FACTOR (HIQ) CAPACITORS, WHICH ARE UTILIZED IN RADIO FREQUENCY (RF) COILS MANUFACTURED BY SIEMENS HEALTHINEERS. THE SAMPLE PREPARATION INVOLVES ADAPTING CERAMIC POWDER, TYPICALLY USED FOR CASTING, TO A CLASSICAL UNIAXIAL PRESSING METHOD. THIS PROCESS INCLUDES VARIOUS STAGES SUCH AS POWDER GRINDING, ADDITION OF BINDERS, ATOMIZATION, SIEVING, AND PRESSING. SUBSEQUENTLY, THE SAMPLES UNDERGO SINTERING TO ACHIEVE DENSE CERAMIC STRUCTURES. ELECTRICAL CHARACTERIZATION INVOLVES NON-DESTRUCTIVE TESTING AND DIELECTRIC STRENGTH TESTING USING AN HF TEST BENCH. SILVER INK IS USED FOR METALLIZATION, ENABLING MEASUREMENTS OF CAPACITANCE, DIELECTRIC CONSTANT, AND LOSS TANGENT OVER A RANGE OF FREQUENCIES. THE RESULTS INDICATE SIGNIFICANT VARIATIONS IN DIELECTRIC PROPERTIES WITH FREQUENCY, WITH SOME MATERIALS EXHIBITING HIGHER STABILITY THAN OTHERS [2]. THE STUDY CONCLUDES BY IDENTIFYING THE MOST SUITABLE DIELECTRIC MATERIAL BASED ON ITS ELECTRICAL PERFORMANCE CHARACTERISTICS. OVERALL, THIS RESEARCH PROVIDES VALUABLE INSIGHTS INTO THE PREPARATION AND CHARACTERIZATION OF DIELECTRIC MATERIALS FOR MRI APPLICATIONS [3].

ID : 36 Development of polymers properties characterisation using statistical signal analysis

N. AL-RAWI, M. Z. NUAWI, A. ELLOUMI

MECHANICAL PROPERTIES SUCH AS HARDNESS, YIELD STRENGTH, POISON RATIO, TENSILE STRENGTH AND THERMAL CONDUCTIVITY ARE VERY IMPORTANT IN DESIGN AND ENGINEERING. THIS PAPER PROPOSES AN IMPLEMENTATION OF ALTERNATIVE STATISTICAL SIGNAL ANALYSIS METHOD IN CHARACTERIZING MATERIAL PROPERTIES OF POLYMER USING IMPULSE EXCITATION TECHNIQUE (IET) IN ACCORDANCE WITH ASTM E1876 STANDARD. FIVE TYPES OF CYLINDRICAL SHAPE POLYMER SPECI-MENS ARE USED, NAMELY ACRYLICS (AC), POLY VINYL CHLORIDE (PVC), POLYETHYLENE (PE), CAST NYLON (MC), AND POLYOXYMETHYLENE (POM). EXPERIMENTAL PROCEDURE IS DONE BASED ON NON-DESTRUCTIVE TESTING (NDT) CONCEPT BY TAPPING THE SPECIMENS USING AN IMPACT HAMMER WITHIN A SPECIFIC RANGE OF IMPACT FORCE. THE DETECTED VIBRATION AND THE IMPACT FORCE SIGNAL WHICH IS TRIGGERED BY IMPACT HAMMER ARE CAPTURED USING NI 9234 DATA AC-QUISITION DEVICE AND COMPUTER. THE VIBRATION SIGNAL OBTAINED FROM THE EXPERIMENT WERE ANALYSED USING AN ALTERNATIVE STATISTICAL ANALYSIS OF INTEGRATED KURTOSIS-BASED ALGORITHM FOR Z-NOTCH FILTER (I-KAZTM) METHOD. THIS PROVES THAT THE CORRELATION PROCESSES CAN BE USED AS STANDARDS FOR DETERMINING THESE MATERIAL PROPERTIES THROUGH

I-kazTM and. Our statistical signal analysis, is very easy to implement. It does not need high-cost equipment; therefore, it is considered as one of the most non-destructive and efficient methods. As a result, Correlation processes between the material properties of (thermal expansion coefficient) and the I-kaz Vibro coefficient of vibration signal that recorded by the accelerometer sensors has been obtained. This new technique also proves that the correlation processes can be used as standards for determining the material properties through I-kaz Vibro, which is efficient, non-destructive and low cost.

ID : 40 Effect of heat treatment on microstructure and mechanical behavior of the dual phase steel

M. Ejday, L. Jaffel, P. Balland, N. Guermazi

This study concerns the effect of heat treatment on the mechanical behavior and martensite morphology of high-strength ferrite–martensite dual-phase (DP) steel. A DP800 steel was subjected to heat treatment to develop different martensite morphologies, i.e., fine and fibrous, blocky and banded, and island types. Analyses of mechanical behavior of the DP steel samples before and after heat treatment have demonstrated that the heat treatment improves hardness and mechanical proprieties. Among different treatments, inter-critical treatment has yielded the best combination of strength, stiffness and ductility. The influence of martensite morphology has been correlated with the observed tensile ductility.

ID : 41 Infrared drying kinetics of a Clay-based composite reinforced with expanded Perlite

I. Boumnijel, C. Kaiba, H. Hachem, D. Mihoubi

Herein, the Infrared (IR) drying kinetic study of Clay-based composites reinforced with expanded Perlite (EP) was performed to optimize drying conditions and minimize energy-related costs during ceramics production. Adding EP to the clay matrix could improve the mechanical, thermal, and physical properties of the manufactured composites while carefully controlling the IR drying process to maintain the quality of the dried product. IR drying experiments were carried out at two temperatures (60 and 90°C), and different EP contents varied from 0% to 10% by weight. To study the IR drying kinetics of the prepared composites, moisture ratio, and drying rate evolutions were considered. Moisture diffusivity and activation energy data, determined from experimental kinetic drying curves, were also reported. Moreover, the effect of particle size distribution and composite sample thickness on the IR drying kinetic was assessed. The effect of the drying process on the dried product quality was recorded in terms of mechanical tests. The results show that temperature and perlite content,

WITH DIFFERENT EXTENTS, POSITIVELY AFFECT THE DRYING KINETICS AND MOISTURE DIFFUSION INSIDE THE COMPOSITE MATERIALS.

ID : 42 Flax-glass hybrid fibers thermoplastic composite: hybridization effect on diffusion and tensile mechanical properties

W.GUESMI, R. M. BOUMBIMBA, A.BENELFELLAH, M.EJDAY, N.GUERMAZI

THIS PAPER AIMS AT INVESTIGATING THE HYBRIDIZATION EFFECT ON THE DIFFUSION KINETIC AND THE TENSILE MECHANICAL BEHAVIOR OF HYBRID UNIDIRECTIONAL FIBERS (GLASS AND FLAX) REINFORCED COMPOSITES WITH THE NEW THERMOPLASTIC MATRIX ELIUM ACRYLIC. FOUR HYBRID LAMINATES OF EIGHT LAYERS ARE OBTAINED WITH DIFFERENT STACKING SEQUENCES USING AN INTER-LAYER CONFIGURATION, THE LATTER ARE ELABORATED BY VACUUM INFUSION. THE OBTAINED RESULTS SHOWED THAT THE HYBRIDIZATION OF GLASS FIBERS WITH FLAX FIBERS AND ASSOCIATED ELIUM RESIN IMPROVED THE MOISTURE RESISTANCE OF THE COMPOSITE COMPARED TO FLAX FIBERS COMPOSITE. HYBRIDIZATION ALSO AFFECTED THE MECHANICAL PROPERTIES OF HYBRID COMPOSITE, WHEN COMPARED TO THE FLAX FIBERS COMPOSITE.

ID : 52 Numerical simulation of fatigue behaviour of a Hip prosthesis

M. BEN ROMDHANE , M. FRIJA, R. FATHALLAH

FOR PATIENTS WHO NEED A HIP REPLACEMENT, THE HIP PROSTHESES ARE CRITICAL TO RESTORING MOBILITY AND GOOD FUNCTIONALITY. IN THIS STUDY, WE INVESTIGATED THE FATIGUE BEHAVIOUR OF A TI-6AL-4V HIP PROSTHESIS USING NCODE DESIGNLIFE SIMULATION SOFTWARE. WE ASSUMED THAT THE APPLIED LOAD FOLLOWED A PERIODIC SINUSOIDAL FATIGUE CYCLE. OUR AIM WAS TO DETERMINE THE FATIGUE LIFE AND POTENTIAL FAILURE LOCATIONS IN ORDER TO IMPROVE THE DURABILITY AND RELIABILITY OF THE IMPLANT. THE RESULTS INDICATE THAT THE HIP PROSTHESIS CAN RESIST FOR A LONG LIFETIME UNDER CYCLIC LOADING. THESE FINDINGS HAVE SIGNIFICANT IMPLICATIONS FOR THE DESIGN AND OPTIMISATION OF ORTHOPAEDIC IMPLANTS, WITH THE POTENTIAL TO IMPROVE PATIENT OUTCOMES AND QUALITY OF LIFE.

ID : 55 Effect of the dimension of the imposed radial flow on the PDMS behavior

M. KETATA, A. AYADI, M. KHLIF

THE RATES OF INDUSTRIAL EXTRUSION PROCESSES ARE OFTEN LIMITED BY THE ONSET OF EXTRUDATE DEFECTS, WHICH CAN AFFECT THE SURFACE OR THE VOLUME OF THE EXTRUDED MATERIAL. THIS WORK AIMS TO EXAMINE, WITH A CAPILLARY RHEOMETER, THE EFFECT OF A RADIAL GEOMETRY ON THE RHEOLOGICAL BEHAVIOR OF A POLYDIMETHYLSILOXANE (PDMS).

ID : 58 Cyclic softening of anisotropic polyurethane foam

D. BEN ABDELJELIL, S. CHATTI

POLYURETHANE FOAMS ARE WIDELY USED IN APPLICATIONS REQUIRING GREAT ENERGY ABSORPTION CAPACITY AND PLAY AN IMPORTANT ROLE IN STRUCTURES SUBJECTED TO CYCLIC LOADINGS. THE PRESENT PAPER STUDIES THE RESPONSE OF AN ANISOTROPIC POLYURETHANE FOAM TO CYCLIC COMPRESSION LOADINGS. AT THE BEGINNING, THE ANISOTROPY OF THE MATERIAL IS DISCUSSED AND STUDIED VIA MICROSCOPIC OBSERVATIONS. IT IS OBSERVED THAT THE POLYURETHANE FOAM PRESENTS A CELLULAR NETWORK WHOSE CELLS ARE ORIENTED ACCORDING TO A SPECIFIC DIRECTION. THEN, THE RESPONSE OF THE FOAM AT CYCLIC CHARGING UNDER VARIOUS DIRECTIONS IS INVESTIGATED. THE RESULTS PROVE THAT THE FOAM LOSES ITS MECHANICAL PROPERTIES FROM ONE CYCLE TO ANOTHER. FURTHERMORE, THE SOFTENING BEHAVIOR IS EVALUATED WITH RESPECT TO THE LOADING DIRECTION.

ID : 61 On a determination of wear resistance and residual stresses of thermally sprayed stainless steel coating

M. LARIBI, A. KASSER

THE AIM OF THIS PAPER IS TO DETERMINE EITHER WEAR RESISTANCE OR RESIDUAL STRESSES DISTRIBUTION OF STAINLESS STEEL COATING THERMALLY SPRAYED ON A CARBON STEEL SUBSTRATE. THE EFFECT OF ANNEALING AND OIL LUBRICATION OF THE OBTAINED MATERIALS ARE ALSO STUDIED. WEAR RESISTANCE OF THE COATING HAS BEEN DETERMINED USING A BALL-ON-PLATE TRIBOMETER. FRICTION COEFFICIENT IS INSTANTANEOUSLY MEASURED DURING THE TRIBOLOGICAL TEST. INTERNAL STRESSES DETERMINATION WAS PERFORMED USING AN EXTENSOMETRIC METHOD IN COMBINATION WITH A SIMULTANEOUS PROGRESSIVE ELECTROLYTIC POLISHING. VERY THIN LAYERS OF THE DEPOSITS ARE REMOVED BY ELECTROCHEMICAL POLISHING ACROSS THE SAMPLE SURFACE. MICRO-DEFORMATIONS ARE INSTANTANEOUSLY MEASURED, LEADING TO RESIDUAL STRESSES CALCULATION AFTER EACH REMOVAL. FRICTION COEFFICIENT HAS AN AVERAGE VALUE OF 0.3 AND 0.4 RESPECTIVELY FOR NON ANNEALED AND ANNEALED SPECIMEN. IT IS RATHER OIL LUBRICATION WHICH IS REALLY BENEFIT SO THAT FRICTION COEFFICIENT IS DECREASED TO ABOUT 0.06. THE INTERNAL STRESSES ARE IN COMPRESSION IN THE COATING. THEY ARE MORE OR LESS SCATTERED BETWEEN -50 AND -270 MPA AND DECREASED MORE AT THE INTERFACE AND THEN ON THE SUBSTRATE. THE VALUE AT THE SURFACE OF THE SUBSTRATE IS ABOUT –700 MPA, MAINLY DUE TO INITIAL GRIT BLASTING AND ALSO TO MOLTEN PARTICLES IMPACT WITH THE SUBSTRATE DURING SPRAYING. THE POST ANNEALING HAS GLOBALLY REDUCED THE RESIDUAL STRESSES IN BOTH COATING AND SURFACE OF THE STEEL SUBSTRATE SO THAT THE HOLE MATERIAL BECOMES MORE RELAXED.

ID : 65 Mechanical performance of hybrid antibacterial dental composite with micro-particles of S. persica and Hydroxyapatite as fillers

R. CHAABEN, A. AYEDI, K. ELLEUCH

THE AIM OF THIS WORK WAS TO EVALUATE THE INFLUENCE OF THE REINFORCEMENT OF THE DENTURE BASE RESIN PMMA, USING ANTIBACTERIAL S. PERSICA PARTICLES AND BIO-COMPATIBLE HYDROXYAPATITE HA POWDER, WHERE DIFFERENT WEIGHT FRACTIONS (10% AND 20%) FOR S. PERSICA AND (5% AND 10%) FOR HA WERE USED. THE VALUES OF WEAR RATE, COMPRESSION STRENGTH, BENDING STRENGTH AND BENDING MODULUS WERE MEASURED. THE RESULTS SHOWED THAT THE INCORPORATION OF S. PERSICA PARTICLES GENERALLY DECREASES WEAR RESISTANCE AND MECHANICAL PROPERTIES. NEVERTHELESS, THE ADDITION OF HA PARTICLES IMPROVES MATERIAL PERFORMANCES. THUS, THE BEST COMBINATION OF PROPERTIES APPEARS AT 10% OF EACH FILLER ENHANCING WEAR RESISTANCE AND MAINTAINING VALUES OF COMPRESSIVE STRENGTH, BENDING STRENGTH, AND BENDING MODULUS ABOVE THE LIMIT INDICATED BY THE STANDARD NORM FOR DENTAL COMPOSITES.

ID : 66 Effect of compression process parameters on the flexural behavior of recycled PA6 derived from fishing nets

N. HERMASSI, Y. GROHENS, Y. M. CORRE, N. GUERMAZI

THIS STUDY AIMS TO ASSESS HOW COMPRESSION PROCESS PARAMETERS (TEMPERATURE AND PRESSURE) AFFECT THE FLEXURAL PROPERTIES (INCLUDING MODULUS, STRENGTH, AND STRAIN) OF RECYCLED POLYAMIDE 6 (RPA6) SOURCED FROM FISHING NETS. BY SUBJECTING THE RECYCLED POLYMERS TO VARIOUS TEMPERATURE AND PRESSURE CONDITIONS, THIS EXPERIMENTAL STUDY ALLOWS US TO UNDERSTAND THE INFLUENCE OF THESE FACTORS ON THE MECHANICAL BEHAVIOR OF THE RESULTING MATERIALS. THIS INVESTIGATION PROVIDES EQUALLY VALUABLE INSIGHTS INTO THE PERFORMANCE AND POTENTIAL APPLICATIONS OF RECYCLED PA6 BASED ON THE FISHING NETS WASTE. THE OBTAINED RESULTS SHOW THAT THE USE OF VARIOUS TEMPERATURE AND PRESSURE VALUES HAS REVEALED A COMPROMISE BETWEEN THE STRENGTH AND DUCTILITY OF THE MATERIALS AFTER THE MOLDING PROCESS.

ID : 70 Assessing fatigue strength in material with hole defect based on affected depth approach

M. YOUSSEF, A. NASR

IN THIS WORK, WE PROPOSE A STUDY OF FATIGUE ASSESSMENT OF ARTIFICIAL SURFACE DEFECTS BASED ON AFFECTED DEPTH (AD) APPROACH. AN ELASTIC-PLASTIC MODEL IS IMPLANTED IN ABAQUS TO SIMULATE THE CYCLIC FINITE ELEMENT (FE) CALCULATIONS. IN ORDER TO VALIDATE THE APPLICABILITY OF THE SUGGESTED MODEL IN DESCRIBING THE EFFECT OF THE SHAPE OF THE DEFECT, AN AD MODEL WITH A HOLE DEFECT IS ADOPTED. THE CROSSLAND EQUIVALENT STRESS IS EMPLOYED TO ANALYZE THE STRESS DISTRIBUTION SURROUNDING TO THE HOLE SUBMITTED TO TORSION

loadings at a load ratio Rσ=-1. The affected depth model is exploited with Crossland criterion to determine Kitagawa diagrams. The experimental data of the defective material C45 steel are used for model validation and comparison. The proposed study of fatigue assessment provides interesting results.

ID : 71 Mechanical behavior of Ti-6Al-4V alloy with equiaxed microstructure under cyclic loading

M. A. Ghazel, N. Hfaiedh, J. Petit, A. Znaidi

During last decades the use of titanium and titanium alloys has increased. This is due to their high strength-to-weight ratio and knowledge established for their processing. Nowadays Ti-6Al-4V alloy is widely used especially in aeronautical and biomedical fields. It is composed by alpha (HPC) and beta phases (BCC), the microstructure can be lamellar, bimodal or equiaxed depending on the thermomechanical treatment it undergoes. Researchers are interested by the mechanical behaviour of the material in the steps of processing, machining. The design of machine parts requires a good knowledge of the mechanical behaviour under monotonic as well as cyclic loading to estimate the fatigue life. The knowledge of the mechanical behavior of Ti-6Al-4V with equiaxed microstructure needs more improvement. In this work the mechanical behaviour of the Ti-6Al-4V with equiaxed microstructure under monotonic and cyclic loading is investigated. Specimens were cut on a 5 mm thick plate according to the standards and subjected to monotonic and tension-compression tests with a load ration R=-1, at room temperature. The cyclic softening the material is proven. The cyclic behavior is modeled by the Ramberg-Osgood law, and the parameters of the material are determined.

ID : 73 Variation of swelling and shrinkage of concrete in response to sand variations

M. L. K. Khouadja, S. Bensalem

For a long time, Algeria was able to offer affordable housing thanks to the availability of aggregation. However, due to the neglect of certain aspects, the concrete used in these houses does not always meet today's standards. Among the neglected aspects are dimensional changes, which are delicate and important parameters in concrete, as they lead to the appearance of cracks that can affect the durability of the concrete. These variations can result from concrete shrinkage or swelling. Therefore, the use of local materials, such as dune sands and Oued sands, must be focused on, with the aim of combining them with crushed sands to produce concrete that will be less subject to dimensional changes. The aim of this work was to evaluate the shrink and swell variability of concrete with different blends of quarry,

dune and oued sands. It was concluded that the shrink and swell of concrete was influenced by the type of sand and its characteristics.

ID : 74 Destructive and non-destructive testing for concrete, and their effectiveness for fiber concrete

O. Temami, C. Belebchouch, M. Khouadjia, K. Lyes

The quality of concrete in Algerian construction sites is often poor. In the case of quality control by low-strength specimens, non-destructive sclerometrical and ultrasonic tests shall be used to confirm or validate these results. Contradictions were observed with the tests showing the need to have specific correlations to the materials used and the type of its materials. The main objective of this work is to propose simple correlations between destructive and non-destructive tests, for control concretes and fiber concretes. After this study it is found that the results obtained by destructive tests and non-destructive tests very close for ordinary Concrete, but for the fiber concretes, we observed a great difference. This is what leads us that non-destructive methods are not effective for fiber concrete.

ID : 76 Improvement of constitutive model for thermomechanical behavior of PC/ABS blend

F. Hentati, R. Mnif, N. Hfaiedh, J. Petit

The experimental analysis and application of analytical prediction model was employed to study the thermomechanical behavior of PC/ABS blend. The impact of temperature on the tensile response was examined, with a range of 20 °C to 150 °C, at strain rates 1.25×10−2 s-1. Experimental results show the sensitivity of the PC/ABS blend to the temperature. As the temperature increases, the yield stress decreases significantly, while the Young's modulus decreases slightly. The "Zhu et al" model shows the best ability to predict the tensile response. However, it exhibits limitations in representing material behavior under high temperatures. An improvement of the "Zhu et al" model was proposed by introducing a well-chosen temperature effect on two key parameters. Findings demonstrate that the proposed improvement HMHP model is capable to precisely predict the tensile behavior under various temperatures.

ID : 78 Effect of normal load on tribological behaviour of nano-sized beta phase silicon nitride

A. Charfi, M. Kharrat, M. F. Wani, M. Dammak

Tribological behaviour of nano-sized silicon nitride in beta phase (β-Si3N4) was studied. Samples were prepared by the means of spark plasma sintering method and

sliding tests were performed using reciprocating ball-on-flat tribometer. The morphology of the worn surfaces was analysed by scanning electron microscopy. Experimental results have shown that friction coef-ficient increases from 0.15 to 0.36. Whereas, specific wear rate decreases with the increase of normal load.

ID : 81 Fatigue crack propagation in crankshaft steel: comparative analysis in air and oil environments

F. Hentati, L. Chalbi

42CrMo4 steel is a high strength steel containing Chromium (Cr) and Molybdenum (Mo) content, that is extensively employed due to its favourable mechanical properties. Its typical applications include oil and gas, offshore and marine industry in power and propulsion applications. Crankshaft fatigue problem has long been a headache and frequent phenomenon in combustion engine which attracts various efforts especially including fundamental fatigue experimental data. In this study, we analyze the impact of a lubricant environment on fatigue-driven crack propagation in 42CrMo4 steel, a martensitic steel that is tempered and used to make car crankshafts. Pre-cracked Single Edge Notched Bending (SENB) specimens were tested using experimental three-point bending tests to investigate the behavior of crack propagation in ambient air and lubricating oil at room temperature. The experimental results reveal that, when compared to the ambient air environment, lubricating oil enhances fatigue life by 30% and decreased the pace at which cracks form.

ID : 82 Influence of annealing on the mechanical and metallurgical behavior of HC260Y IF steel

L. Arfaoui, A. Samet, A. Znaidi

The main objective of this paper is to study the influence of annealing heat treatment on the mechanical properties of the cold-rolled Interstitial Free Steel HC260Y and to characterize the fracture mechanisms of this material in its different states. Tensile samples were then cut in different orientations in accordance with the rolling direction. They were subsequently subjected to an annealing heat treatment followed by off-axis tensile tests. The main characteristics of cold-rolled and annealed specimens, in particular the hardening exponent and the Lankford coefficient, were compared. This study is based on a behaviour model that respects the structure of the material as well as its anisotropy. This model is represented by a behavior law, a hardening law and an evolution law. The fracture surfaces of different specimens were examined using the scanning electron microscope (SEM). The results indicate that the annealing treatment is an essential process for obtaining a steel with superior mechanical properties, suitable for industrial use mainly for deep drawing applications.

ID : 83 Time dependent study of corroded underground pipeline X100

M. S. Feki, S. Zghal, S. Koubaa, Z. Bouaziz, R. Abdelmoula

In this work, a time-dependent study on corrosion defect evolution of steel pipelines of grade X100 is presented. Due to the symmetry of the pipeline geometry, a 2D finite element model was used to quantify the temporal behavior of this pipeline. The Multiphysics interactions equations are first provided where the mechanical part is included with elasto-plastic stress equation, the electrical part is introduced via potential and current densities of anode and cathode of the electrolyte and the time-dependent property is implemented via a deformed geometry tool in COMSOL interface to predict the pipeline failure as function of time. Results demonstrated that the anodic, cathodic current densities, as well as, the Von Mises stress are influenced by the change of corrosion defect dimensions over a period of time of 20 years.

ID : 84 Experimental analysis of quasi-static crack propagation in brittle materials

Y. Kriaa, Y. Hersi, F. Chaari, B. Zouari

The present research work concerns the experimental study of crack propagation in brittle materials under quasi-static tensile loading. These tests were carried out to visualize the effect of the geometry and the nature of the material's microstructure of the specimen on the crack trajectory. Images correlation technics with a high-speed camera was used to identify the instance of crack initiation, propagation and crack arrest in some configurations.

ID : 86 Compressive properties of esparto fibre rein-forced mortar

A. El Oudiani, Y. Glouia, A. Brinsi, R. Ben Sghaier

The objective of this research work is to investigate the compressive behavior of esparto fibres reinforced cement mortar and to study the influence of certain criti-cal factors, in particular the length and the volume of fibres introduced in the ma-trix.The incorporation of the fibers avoids brittle breakage of the composite mate-rial and induces a more resilient behavior. The breaking energy of all fibre-reinforced mortars is significantly higher than that of non-reinforced cement mortar. The response of fibre reinforced mortar to compressive test reveals that for a constant fibre rate, the compressive strength increases proportionally with the fibre length. Whereas, for a constant fibre length, the compressive strength increases when fibre content passes from 1% to 2% and then it decreases at 3 %.

ID : 89 Effect of enzyme treatment on the mechanical properties and durability of date palm fibers/PBS composites

R. CHAARI, M. WERCHEFANI, M. KHLIF, C. BRADAI, C. LACOSTE, P. DONY

THE FIELDS OF POLYMER COMPOSITES INTEGRATING NEW NATURAL FIBERS, AS WELL AS THE DEVELOPMENT OF MORE SOPHISTICATED FIBER TREATMENT METHODS, COULD PROMOTE THE EXPANSION OF THE PRODUCTION OF NATURAL REINFORCEMENTS WITH MORE DESIRABLE PROPERTIES AND BROADEN THEIR APPLICATION TO NEW USES. THE PRESENT WORK AIMS TO STUDY THE CHEMICAL PROPERTIES OF TWO LIGNOCELLULOSIC FIBERS EXTRACTED FROM THE DATE PALM TREE USING AN ENVIRONMENTALLY FRIENDLY TECHNIQUE AND TO EVALUATE THE THERMAL, RHEOLOGICAL, MECHANICAL, AND LONG-TERM BEHAVIOR OF THE RESULTING COMPOSITES. THE ENZYMATIC FIBER TREATMENT METHOD LED TO A REDUCTION IN THE LEVELS OF EXTRACTIVES, LIGNIN AND HEMICELLULOSE, AS INDICATED BY FTIR MEASUREMENTS. THE RESULTING COMPOSITES EXHIBITED GOOD THERMAL STABILITY AND A MUCH HIGHER LEVEL OF CRYSTALLINITY THAN THE VIRGIN POLYMER, PARTICULARLY WITH TREATED DATE PALM FIBERS, AS SHOWN BY DSC AND RHEOLOGICAL ANALYSIS. TENSILE TESTING REVEALED THAT ENZYME-TREATED FIBERS INDUCED GREATER STIFFNESS AND STRENGTH IN THE ELABORATED COMPOSITES COMPARED TO RAW FIBERS. AFTER AGING, THE TREATED PALM FIBER COMPOSITES MAINTAINED THEIR STRENGTH AND EXHIBITED GOOD RETENTION OF FLEXIBILITY COMPARED TO COMPOSITES WITH TREATED TRUNK FIBERS AND EVEN MORE SO COMPARED TO THE VIRGIN POLYMER. HOWEVER, COMPOSITES BASED ON TREATED TRUNK FIBERS EXHIBITED GREATER UV STABILITY REGARDING THE STIFFNESS PROPERTY.

ID : 91 Fatigue strength of AlSi10Mg alloy made by laser fusion of powder bed

I. K. CISSÉ, A. NASR

THE OBJECTIVE OF OUR STUDY IS TO ANALYZE THE IMPACT OF MANUFACTURING DEFECTS ON THE FATIGUE LIMIT OF AS-BUILT ALSI10MG OBTAINED USING A LASER BEAM ON A POWDER BED.THE INVESTIGATION FOCUSED ON SEMI-SPHERICAL SURFACE VOIDS AS A REPRESENTATION OF A DEFECT INDUCED BY MANUFACTURING. THE ANALYSIS OF THE STRESS STATE, AROUND THE DEFECT, WAS BASED ON FINITE ELEMENT METHOD. THE CROSSLAND CRITERION WAS USED TO COMPUTE THE FATIGUE LIMIT BY USING THE AFFECT-ED DEPTH APPROACH. FATIGUE CHARACTERISTICS WERE DETERMINED BY UTILIZING S-N CURVES FOR NON-DEFECTIVE SPECIMENS UNDER TENSILE STRESS AT R= -1, BOTH WITH AND WITHOUT T6 THERMAL TREATMENT. KITAGAWA-TYPE DIAGRAMS WERE UTILIZED TO ESTABLISH A RELATIONSHIP BETWEEN THE FATIGUE LIMIT AND THE DEFECT SIZE. THE PRO-POSED METHODOLOGY STRONGLY ALIGN WITH THE EXPERIMENTAL DATA.

ID : 92 Biaxial characterization of PLA biocomposite film using bulge test and 3D-DIC

F.KHARRAT, M.KHLIF, L.HILLIOU, J.A. COVAS, M. HABOUSSI, C. BRADAI

THE BULGE TEST STANDS AS A VERSATILE MECHANICAL TESTING METHOD EXTENSIVELY EMPLOYED ACROSS MATERIALS SCIENCE, ENGINEERING, AND BIOMEDICAL FIELDS TO COMPREHEND MATERIAL AND STRUCTURAL MECHANICAL BEHAVIORS. IN THIS INVESTIGATION, A BIOCOMPOSITE BLOWN FILM MADE OF PLA AND 2WT.% OF DATE PALM LEAF POWDER (PLA_2%) UNDERWENT CHARACTERIZATION VIA THE BULGE TEST, WITH SUBSEQUENT PROPERTY COMPARISONS TO UNIAXIAL TESTING RESULTS. EMPLOYING 3D DIGITAL IMAGE CORRELATION (3D-DIC) ENSURED MORE PRECISE AND ACCURATE DEFORMATION MEASUREMENTS, OFFERING SUPERIOR CAPABILITIES IN TESTING WHILE DETECTING DEFECTS LIKE CRACKS, VOIDS, AND DELAMINATION. THROUGHOUT BULGE TESTING, 3D-DIC ENABLED ANALYSIS OF STRAIN FIELD EVOLUTION WITHIN THE SAMPLE, PINPOINTING AREAS OF REDUCED FILM THICKNESS, NOTABLY IDENTIFYING ZONES WITH STRAIN CONCENTRATION ALIGNED PARALLEL TO THE FILM'S MACHINE DIRECTION, INDICATIVE OF LOCALIZED THICKNESS REDUCTION IN THOSE REGIONS.

ID : 95 Characterization of mechanical strength of clay/seashell powder bio-composite material during drying and firing processes

H. HACHEM, F. SLOULI, I. BOUMNIJEL, D. MIHOUBI

THIS STUDY AIMS TO EXPLORE THE MECHANICAL STRENGTH PROPERTIES OF A NEW ECO-FRIENDLY BIO-COMPOSITE MATERIAL COMPOSED OF CLAY AND SEASHELL POWDER. THE MATERIAL HAS POTENTIAL APPLICATIONS IN THE CONSTRUCTION INDUSTRY DUE TO ITS SUSTAINABLE COMPOSITION. THE STUDY FOCUSES ON THE MATERIAL'S MECHANICAL BEHAVIOR DURING ITS DRYING AND FIRING PROCESSES. THE RESEARCH EMPLOYS COMPREHENSIVE TECHNIQUES TO ANALYZE THE MATERIAL'S MECHANICAL BEHAVIOR UNDER VARYING TEMPERATURE AND MOISTURE CONTENT CONDITIONS. THE TESTING INCLUDES COMPRESSIVE AND FLEXURAL STRENGTH TESTS CONDUCTED AT DIFFERENT STAGES OF DRYING AND FIRING. ADDITIONALLY, SCANNING ELECTRON MICROSCOPY (SEM) IS USED TO ANALYZE THE MATERIAL'S INTERNAL STRUCTURE AND ITS EVOLUTION DURING THERMAL PROCESSING. THE MATERIAL'S CHEMICAL COMPOSITION IS ANALYZED USING FOURIER TRANSFORM INFRARED SPECTROSCOPY (FTIR) AND X-RAY DIFFRACTION ANALYSIS (XRD) AT DIFFERENT FIRING STAGES. THE RESULTS PROVIDE VALUABLE INSIGHTS INTO THE MECHANICAL PROPERTIES OF THE CLAY/SEASHELL POWDER BIOCOMPOSITE, WHICH ARE CRUCIAL FOR OPTIMIZING MANUFACTURING PROCESSES AND ENHANCING ITS PERFORMANCE IN REAL-WORLD APPLICATIONS SUCH AS CONSTRUCTION AND SUSTAINABLE PACKAGING.

ID : 97 Applying numerical simulation to vacuum-assisted resin infusion procedures

H. Cherif, S. Abdelghani, K. Essassi, A. El Hami, A. Bouguecha, M. Haddar

Composite infusion processes have garnered significant interest for their performance benefits, yet a notable lack of understanding persists. These processes promise to mitigate void formation and reduce costs associated with storage, labor, and tooling expenses. Moreover, they present avenues for functional integration and decreased tooling expenditures. One such technique involves infusing resin, pre-stressed under vacuum conditions, throughout the thickness of a fibrous preform. Notably, the Vacuum Resin Infusion (VARI) process is a cost-effective approach within the liquid composite molding (LCM) realm, particularly in infusion manufacturing. In the VARI process, a fibrous preform is positioned in a mold cavity, enveloped in a vacuum bag, and sealed with tape to prevent resin leakage. Subsequently, a vacuum pump evacuates air from the cavity, compacting the preform. Upon opening the inlet gate, pressurized resin permeates the preform. Various manufacturing pathways emerge based on resin compaction and infusion phase initiation, influencing process duration, resin pressure distribution, and preform uniformity. This study employs numerical simulation utilizing the finite difference method to investigate the effects of the VARI process on the parameters above. By delving into these intricacies, we aim to enhance understanding and optimize composite infusion practices for improved performance and cost efficiency.

ID : 101 Gun nozzle geometry effects on High Velocity Oxygen-Fuel (HVOF) of nickel-alloy coatings

F. Harabi, B. Ben Difallah, M. Kharrat, M. Barletta, Y. M. El Sayed, S. Lionetti

With the evolution of spraying processes, thermal spraying technology is widely used in industrial applications to improve corrosion, erosion and to extend the mechanical and tribological properties of the working parts in different machines. The HVOF technologies are developing day after day as we can find: JP-TAFA HP/HVOF®, the Diamond Jet (DJ) system, OSU, Top Gun K, etc. In this research, HVOF-JP5000 belonging to the industrial partner, RINA COMPANY was used. It is well known that the performances and characteristics of coatings obtained by HVOF processes are directly affected by the process parameters. Different HVOF parameters such as the projection angle and distance, the influence of combustion models and spray gun geometrics and the oxygen and kerosene flows were discussed previously. In this study, the effects of the geometry of the barrel nozzle on NiCrFeSiAlBC thermal spraying coating was investigated. Two configurations of the nozzle were chosen to spray the powder, one with 4'' of diameter and the second with 8'' of diameter. It was found that the diameter of the barrel nozzle had a significant effect on the microstructure,

MECHANICAL AND TRIBOLOGICAL BEHAVIOURS OF THE THERMALLY SPRAYED NI ALLOY COATING DEPOSITED ON STAINLESS STEEL SUBSTRATE.

ID : 102 Investigations on the Influence of the microcrystalline cellulose content on the structure-property relationship of cellulose acetate/polybutylene adipate–co–terephthalate hybrid composites

T. SANGO, M. C. N. YEMELE, M. RAGOUBI, N. LEBLANC, A. KOUBAA

THE GLOBAL ISSUES CONCERNING THE POLLUTION OF FOSSIL-BASED PLASTICS OPEN THE OPPORTUNITY FOR A TRANSITION TOWARDS BIO-BASED ALTERNATIVES FOR THE RIGID PACKAGING INDUSTRY. ONE OF THE SUSTAINABLE SOLUTIONS CONSISTS OF BLENDING HIGH CONCENTRATIONS OF MICROCRYSTALLINE CELLULOSE (MCC) AND CELLULOSE ACETATE (CADS=2.45) WITH A DUCTILE BIOPOLYESTER-LIKE POLY(BUTYLENE ADIPATE–CO–TEREPHTHALATE). IN THIS STUDY, A SUSTAINABLE, COST-EFFECTIVE, AND INDUSTRIALLY SCALABLE METHOD WAS USED TO MIX, USING TWIN-SCREW EXTRUSION, UP TO 30 WT.% OF THE MCC WITH A BLEND OF PBAT AND CA (20 WT.%). NEAT PBAT (N-PBAT) AND HYBRID SPECIMENS WERE PRODUCED THROUGH THERMOCOMPRESSION. THE STRUCTURE-PROPERTY RELATIONSHIPS OF THE MATERIALS WERE INVESTIGATED USING THE FOURIER TRANSFORM INFRARED (FTIR) SPECTROSCOPY, RHEOLOGICAL MEASUREMENTS, SCANNING ELECTRON MICROSCOPY (SEM), AND TENSILE TESTS. THROUGH FTIR, THE SURFACE CHEMISTRY REVEALED HYDROGEN BONDS (H-BONDS) BETWEEN INGREDIENTS. RHEOLOGICAL MEASUREMENTS SHOWED THAT THE COMPLEX VISCOSITY OF HYBRID COMPOSITES WAS INCREASING WITH THE MCC CONTENT THANKS TO THE FORMATION OF MORE H-BOND INTERACTIONS AND TIE-ENTANGLEMENTS THAT BRING MORE STIFFNESS. THIS WAS CERTIFIED BY SEM OBSERVATIONS, WHERE THE SIZE OF THE MICRO-VOIDS DECREASED WITH THE INCREASING MCC CONTENT. THIS INCREASING COHESION WAS CONFIRMED BY UNIAXIAL TENSILE TESTINGS WHERE THE HYBRID STRAIN TO BREAK REDUCED (BY 250%) WHEN AN INCREASING MCC CONTENT OF 30 WT.%.

ID : 105 Comparative study of mollusc shell and squid pen bio-based Fillers on the tribological properties of HDPE bio-composites

B. SIDIA, W. BENSALAH

THIS STUDY INVESTIGATES THE INFLUENCE OF MOLLUSC SHELL (MS) AND SQUID PEN (SP) FILLERS ON THE TRIBOLOGICAL PROPERTIES OF HIGH-DENSITY POLYETHYLENE (HDPE) BIO-COMPOSITES. ROCKWELL HARDNESS, AVERAGE FRICTION COEFFICIENT, AND SPECIFIC WEAR RATE WERE EVALUATED FOR BIO-COMPOSITES WITH VARYING FILLER WEIGHT PER-CENTAGES (0, 5, 10, 15, AND 20 WT. %). THE ADDITION OF MS FILLERS SIGNIFICANTLY INCREASED ROCKWELL HARDNESS COMPARED TO UNFILLED HDPE. SP FILLERS, HOWEVER, SHOWED A DECREASE IN HARDNESS. THE AVERAGE FRICTION COEFFICIENT GENERALLY DECREASED FOR BOTH BIO-COMPOSITES UP TO A CERTAIN FILLER CONTENT. THE SPECIFIC WEAR RATE INCREASED WITH FILLER CONTENT FOR BOTH BIO-COMPOSITES BEYOND 5 WT.%, SUGGESTING POTENTIAL AGGLOMERATION. NOTABLY, 5 WT.% MS FILLER SIGNIFI-

cantly reduced wear rate by 50% compared to unfilled HDPE. These findings demonstrate the potential of MS fillers for enhancing the mechanical performance of HDPE bio-composites, offering improved hardness, wear resistance, and a favorable friction coefficient at moderate filler loadings.

ID : 107 Effect of pressure on elastic properties of gallium nitride via characterization non-destructive

F. Hadjoub, A. Meriki, A. Doghmane

Gallium nitride (GaN) is a very well-known III-V semiconductor and has many unique properties, which can be applied potentially in developing optoelectronic technology. The most remarkable uses of GaN cover photovoltaic, heterostructures, semiconductor lasers, light-emitting diodes and solar cells, etc. Another vital attribute of gallium nitride is that, under ambient conditions, GaN is crystallized in hexagonal wurtzite phase. However, at high pressure the w-GaN is known to transform to rock-salt phase, there by exhibiting different mechanical properties. In this context, we studied the elastic properties of GaN at various pressures. Thus, we applied a technique of nondestructive evaluation to determine the elastic parameters of this material by using the data of the Young modulus, the Poisson's ratio and the density, which vary according to the pressure. In this investigation we calculated reflection coefficients, R (ϴ), acoustic signatures V (z) using the model of Sheppard and Wilson and their treatments via Fast Fourier transformed, FFT. We determined the velocities of propagation of the acoustic waves as well as the critical angles of excitations of GaN. Analytical formulas were deduced for pressure effects on such parameters confirming the linear increases with pressure for P < 32 GPa.

ID : 110 Photocatalytic degradation of methylene blue using copper-doped carbon dots prepared from CCA-treated wood

D. Xing, J. Zhang, S. Magdouli, Y. Tao, P. Li, H. Bouafif, A. Koubaa

Developing eco-friendly, visible light-responsive photocatalysts for dye removal is pressing. This study reports on copper-doped carbon dots (CDs) directly synthesized from chromated copper arsenate (CCA) wood waste for degrading methylene blue. The CDs' properties were extensively characterized. Furthermore, the study analyzed the degradation products of methylene blue photocatalyzed by CDs. This study offers an eco-friendly, facile, and highly efficient approach utilizing waste CCA wood-derived CDs for organic dye photodegradation.

ID : 120 Ballistic impact of composite-ceramic armors for different oblique angles: numerical study

A. HASSOUNA, S. MEZLINI

THE STUDY OF FACTORS INFLUENCING THE BALLISTIC EFFECTIVENESS OF BODY ARMOR IS CRUCIAL TO THE DEVELOPMENT OF RELIABLE BODY ARMOR. NUMERICAL SIMULATION PLAYS A KEY ROLE IN THIS ENDEAVOR. THIS STUDY FOCUSES SPECIFICALLY ON EVALUATING THE BALLISTIC PERFORMANCE OF HARD BODY ARMOR AGAINST AN OGIVAL-NOSED PROJECTILE. THE STUDY AIMS TO DISCERN THE EFFECT OF THE IMPACTHE STUDY OF FACTORS INFLUENCING THE BALLISTIC EFFECTIVENESS OF BODY ARMOR IS CRUCIAL TO THE DEVELOPMENT OF RELIABLE BODY ARMOR. NUMERICAL SIMULATION PLAYS A KEY ROLE IN THIS ENDEAVOR. THIS STUDY FOCUSES SPECIFICALLY ON EVALUATING THE BALLISTIC PERFORMANCE OF HARD BODY ARMOR AGAINST AN OGIVAL-NOSED PROJECTILE. THE STUDY AIMS TO DISCERN THE EFFECT OF THE IMPACT VELOCITY AND THE OBLIQUE ANGLE OF THE PRO-JECTILE ON THE RESIDUAL VELOCITY AND THE TARGET DAMAGE. THE RESULTS SHOWED THAT THE IMPACT VELOCITY HAS A CONSIDERABLE INFLUENCE ON THE TARGET DAMAGE. MOREOVER, IT IS REVEALED THAT THE RESIDUAL VELOCITY AND THE TARGET DAMAGE ARE SENSITIVE TO THE OBLIQUE ANGLE. THE INCREASE IN THE OBLIQUE ANGLE LEADS TO AN INCREASE IN THE RESIDUAL VELOCITY AND A DECREASE IN THE TARGET DAMAGE AND DEFORMATION.T VELOCITY AND THE OBLIQUE ANGLE OF THE PRO-JECTILE ON THE RESIDUAL VELOCITY AND THE TARGET DAMAGE. THE RESULTS SHOWED THAT THE IMPACT VELOCITY HAS A CONSIDERABLE INFLUENCE ON THE TARGET DAMAGE. MOREOVER, IT IS REVEALED THAT THE RESIDUAL VELOCITY AND THE TARGET DAMAGE ARE SENSITIVE TO THE OBLIQUE ANGLE. THE INCREASE IN THE OBLIQUE ANGLE LEADS TO AN INCREASE IN THE RESIDUAL VELOCITY AND A DECREASE IN THE TARGET DAMAGE AND DEFORMATION.

D : 131 Numerical homogenization of the effective mechanical properties of coir fiber reinforced high-density polyethylene

H. BALIT, M. S. BOUTAANI, Y. KHELFAOUI

THIS RESEARCH EXAMINES THE ROLE OF PLASTIC MATERIALS IN THE DEVELOPMENT OF SIM-PLE, RELIABLE AND AESTHETIC MANUFACTURING SOLUTIONS THROUGH THE DIVERSITY OF TRANS-FORMATION PROCESSES SUCH AS INJECTION. THE PHYSICAL AND MECHANICAL PROPERTIES OF THESE MATERIALS ARE IMPROVED BY THE ADDITION OF NATURAL MATERIALS, THUS PROMOTING THE SUSTAINABILITY OF PRODUCTION AND PROVIDING ENVIRONMENTAL BENEFITS. THE WORK USES NUMERICAL HOMOGENIZATION TECHNIQUE TO CALCULATE THE MECHANICAL PROPERTIES OF A HIGH-DENSITY POLYETHYLENE HDPE REINFORCED WITH COIR FIBERS COMPOUND, US-ING A REPRESENTATIVE VOLUME ELEMENT (RVE), WHILE EXAMINING THE IMPACT OF FILL-ERS AND FIBER SIZES ON THESE PROPERTIES. THE NUMERICAL RESULTS WERE VERIFIED USING ANALYTICAL MODELS SUCH AS IROM, CHAMIS ET HALPIN-TSAI FORMULATION. THE RESULTS SHOWED AN INCREASE IN MECHANICAL PROPERTIES WITH AN INCREASE IN THE PERCENTAGE OF FIBERS, WITH NO EFFECT OF FIBER SIZE ON THESE PROPERTIES.

ID : 132 Tensile properties and fracture toughness evaluation of cold rolled AA1050 aluminium alloy

W. TAKTAK, R. ELLEUCH

IN THE CURRENT STUDY, AA1050 ALUMINIUM ALLOY AIMS TO EXAMINE THE EXPERIMENTAL EVALUATION OF TENSILE AND FRACTURE TOUGHNESS PROPERTIES OF THE SHEET OF DURING COLD ROLLING REDUCTION. COLD ROLLING WAS CARRIED OUT ON THE AA1050 ALUMINIUM ALLOY SHEETS AT ROOM TEMPERATURE IN VARIED COLD ROLLING REDUCTION (25%, 50% AND 75%). TENSILE TESTS WERE USED TO INVESTIGATE THE TENSILE PROPERTIES OF THE STARTING AND ROLLED AA1050 ALUMINIUM ALLOY. THESE STUDIES DEMONSTRATED THAT AN INCREASE IN COLD ROLLING REDUCTION IS ASSOCIATED WITH AN INCREASE THE TENSILE STRENGTH AND A DECREASE IN DUCTILITY. ASTME 1820 STANDARD FRACTURE TOUGHNESS TEST ARE UTILIZED TO DETERMINE RESISTANCE J-R CURVES AND FRACTURE TOUGHNESS PARAMETER (J0.2) FOR THE STARTING AND ROLLED AA1050 ALUMINIUM ALLOY THROUGH THE USE OF CENTER-CRACKED PANELS (CCP). ACCORDING TO THE RESULTS, THE FRACTURE TOUGHNESS PARAMETER (J0.2) OF THE MATERIAL SUFFERS A SIGNIFICANT DECREASE AS THE COLD ROLLING REDUCTION INCREASES. THE REASON FOR THESE RESULTS IS THE NOTICEABLE INCREASE IN DISLOCATIONS AND THE CONSIDERABLE STRETCHING OF EQUIAXED GRAINS IN THE ROLLING DIRECTION, WHICH IS CAUSED BY THE HARDENING CREATED DURING COLD ROLLING.

ID : 136 Microscopic investigation of PVD-RF amorphous Al2O3/Ti6Al4V deposits at different substrate polarizations

S. ABDELLI , D. AMARI, Y. KHELFAOUI , S. ZIOUAL

WITH A VIEW TO DEVELOPING A THERMALLY INSULATING MATERIAL FOR DIELECTRICS, AERONAUTICS AND ELECTRONICS, AL2O3 ALUMINA DEPOSITS WERE DEPOSITED ON TI6AL4V-GRADE 5 TITANIUM ALLOY SUBSTRATES BY PVD-RF AT DIFFERENT POLARIZA-TIONS (0V, -50V, -100V AND WITHOUT POLARIZATION). SEM IMAGES SHOW GOOD COVERAGE OF THE SUBSTRATE SURFACE BY THE AMORPHOUS AL2O3 DEPOSIT. EDS ANAL-YSIS REVEALED THE PRESENCE OF THE VARIOUS AL AND O ELEMENTS THAT MAKE UP THE DEPOSIT, AS WELL AS THOSE OF THE TI6AL4V SUBSTRATE. X-RAY DIFFRACTION SPECTRA OF THE AL2O3/TI6AL4V SYSTEM IN 2 MODE IN THE AMORPHOUS STATE SHOWED PEAKS CHARACTERISTIC OF THE PARTIALLY CRYSTALLIZED AL2O3 PHASES AND THOSE OF THE PHAS-ES RESULTING FROM THE INTERACTION OF THE SUBSTRATE ELEMENTS AL0.3TI1.7 AND TI0.7V0.3. FINALLY, THE AFM IMAGES SHOWED A VERY GOOD HOMOGENEITY OF THE FILM SURFACE WITH A LOW ARITHMETIC ROUGHNESS RANGING FROM 3.45 TO 4.75 NM.

ID : 137 Stress-strain behaviour of an IN100 cylinder under cyclic loading

M. SAIDANE, S. KOUBAA , Z. BOUAZIZ, R. ABDELMOULA

THIS STUDY INVESTIGATES THE MECHANICAL BEHAVIOUR MODELLING OF IN100 CYLINDER WHEN SUBJECTED TO CYCLIC LOADING. TO PREDICT DAMAGE, A VARIATIONAL APPROACH OF PHASE FIELD

DAMAGE IS COUPLED WITH PLASTIC DEFORMATION. NUMERICAL SIMULATIONS WERE CONDUCTED USING COMSOL MULTIPHYSICS FINITE ELEMENT SOFTWARE. NUMERICAL RESULTS OF THE CONSIDERED TEST ASSESS THE COUPLING BEHAVIOR OF DAMAGE ACCUMULATION AND PLASTIC DEFORMATION.

ID : 149 Optimizing mechanical properties: Experimental study of fired kaolin/eggshell powder bio-ceramic materials

Y. HFAIEDH, H. HACHEM, D. MIHOUBI

THIS STUDY AIMS TO EXPLORE THE MECHANICAL STRENGTH PROPERTIES OF A NEW ECO-FRIENDLY BIO-COMPOSITE MATERIAL COMPOSED OF KAOLIN AND EGGSHELL POWDER. THE MATERIAL HAS POTENTIAL APPLICATIONS IN THE CONSTRUCTION INDUSTRY DUE TO ITS SUSTAINABLE COMPOSITION. THE STUDY FOCUSES ON THE MATERIAL'S MECHANICAL BEHAVIOR DURING ITS FIRING PROCESSES. THE RESEARCH EMPLOYS COMPREHENSIVE TECHNIQUES TO ANALYZE THE MATERIAL'S MECHANICAL BEHAVIOR UNDER VARYING FIRING TEMPERATURE AND TIME CONDITIONS. THE TESTING INCLUDES COMPRESSIVE AND FLEXURAL STRENGTH TESTS CONDUCTED AT DIFFERENT FIRING CONDITIONS. ADDITIONALLY, SCANNING ELECTRON MICROSCOPY (SEM) IS USED TO ANALYZE THE MATERIAL'S INTERNAL STRUCTURE AND ITS EVOLUTION DURING THERMAL PROCESSING. THE MATERIAL'S CHEMICAL COMPOSITION IS ANALYZED USING X-RAY DIFFRACTION ANALYSIS (XRD) AT DIFFERENT FIRING STAGES. THE RESULTS PROVIDE VALUABLE INSIGHTS INTO THE MECHANICAL PROPERTIES OF THE KAOLIN/EGGSHELL POWDER BIOCOMPOSITE, WHICH ARE CRUCIAL FOR OPTIMIZING MANUFACTURING PROCESSES AND ENHANCING ITS PERFORMANCE IN REAL-WORLD APPLICATIONS SUCH AS CONSTRUCTION AND SUSTAINABLE PACKAGING.

ID : 152 Flat and cylindrical indentation for brittle fracture using phase-field modeling

Y. KRIAA, Y. HERSI, B. ZOUARI

THE PRESENT RESEARCH WORK UNDERTAKES THE STUDY OF THE INITIATION AND PROPAGATION OF CRACKS IN BRITTLE MATERIAL EMANATING FROM INDENTATION LOADING BY MEANS OF PHASE-FIELD METHOD (PFM) WITH STAGGERED ALGORITHM AND HYBRID FORMULATION. AMONG NUMEROUS METHODOLOGIES, PFM IS AN ENCOURAGING TOOL FOR TACKLING PROBLEMS OF CRACKS INITIATION AND PROPAGATION FROM AN ORIGINALLY UNDAMAGED SOLID SUBMITTED TO COMPRESSION INDUCED BY THE CONTACT OF A RIGID INDENTER. THE SIMULATION INDICATES BOTH THE LOCATION OF THE CRACK INITIATION AND ITS PROPAGATION DIRECTION IN THE CASES OF SLIP AND ROUGH CONTACTS FOR TWO INDENTER GEOMETRIES.THE OBTAINED RESULTS ACCORD WELL WITH THOSE EXPERIMENTALLY MENTIONED IN THE LITERATURE.

ID : 153 Fatigue behavior investigations of 3D-printed specimens under rotary bending through analysis of variance and fractography inspections

L. ALLEGUE, E. FTOUTOU, H. MAROUANI

14 PARAMETERS AFFECT THE QUALITY AND THE MECHANICAL PERFORMANCES OF 3D-PRINTED PARTS BY FUSED FILAMENT FABRICATION. THIS STUDY ANALYZES THE IMPACT OF INFILL DENSITY ON FATIGUE BEHAVIOR IN PLA SPECIMENS USING ROTARY BENDING TESTS. DOG SAMPLES ARE PRINTED VERTICALLY AT A 90° RASTER ANGLE. VARIOUS PEAK BENDING STRESSES (14, 35, 49, AND 70 MPA) ARE APPLIED TO DIFFERENT DOG-BONE SPECIMENS WITH INFILL DENSITIES OF 25%, 50%, 75%, AND 100%. S-N CURVES ARE THEN PLOTTED TO VISUALIZE THE RELATIONSHIP BETWEEN THE NUMBER OF CYCLES UNTIL FAILURE AND THE EXPERIMENTAL CONDITIONS. TO ACCOUNT FOR INHERENT RESULT VARIABILITY, ANOVA ANALYSIS IS EMPLOYED TO QUANTIFY THE INFLUENCE OF APPLIED STRESSES AND INFILL DENSITY ON SPECIMEN SERVICE LIFE. THE ANALYSIS REVEALS THAT STRESS IS THE PRIMARY CONTRIBUTOR, ACCOUNTING FOR 23% OF THE RESPONSE MODEL. FURTHERMORE, FRACTOGRAPHY ANALYSIS IS CONDUCTED TO EXAMINE FRACTURE MODES UNDER DIFFERENT TEST CONDITIONS. FRACTURES ALIGN WITH THE DIRECTION OF FILAMENT DEPOSITION, WITH SMOOTHER SURFACES INDICATING STRONG FILAMENT BONDING. NOTABLY, VOIDS BETWEEN LAYERS ACT AS STRESS CONCENTRATORS, ADVERSELY AFFECTING MECHANICAL PROPERTIES. FATIGUE CRACK INITIATION PRIMARILY STEMS FROM THESE VOIDS RATHER THAN SURFACE DEFECTS, LEADING TO PROGRESSIVE CRACK PROPAGATION. THE PROCESS LEAVES CHARACTERISTIC BEACH MARKS AND FATIGUE STRIATIONS ON FRACTURE SURFACES. ADDITIONALLY, THE PLASTIC NATURE OF PLA IS EVIDENT IN THE FORMATION OF CRAZE STRUCTURES, INDICATING A COMBINATION OF BRITTLE AND PLASTIC FAILURE MECHANISMS.

ID : 155 Mechanical properties of short alfa fibre reinforced polypropylene biocomposites using Taguchi method: Anhydride Maleic effect

I. JELLID, R. KESSENTINI, O. KLINKOVA, A. BOUGUECHA, I.TAWFIQ, M. HADDAR

IN THIS RESEARCH, A NEW APPROACH TO PREDICT THE MECHANICAL PROPERTIES OF ALFA FIBERS REINFORCED THERMOPLASTIC BIO-COMPOSITES HAS BEEN PRESENTED. MALEIC ANHYDRIDE COUPLING AGENT IS USED AT DIFFERENT FIBER MASS FRACTION (0%, 15% AND 30%) FOR BETTER BONDING WITH POLYPROPYLENE MATRIX. THE SHORT FIBERS AND MATRICE ARE EXTRUDED AND THEN INJECTION MOLDED UNDER SPECIFIC CONDITIONS. ISO 3167-A STANDARD SAMPLES ARE MADE AND TESTED UNDER STATIC LOADS PREVIOUSLY. THE FINDINGS REVEAL THAT HIGHER CONTENT OF FIBERS INCREASES TENSILE STRENGTH AS WELL AS YOUNG'S MODULUS. THIS WORK AIMS AT ESTABLISHING EMPIRICAL EQUATIONS BASED ON TENSILE TESTS WHICH CAN BE USED AS TOOL FOR BIOCOMPOSITES PROCESS ELABORATION.

ID : 158 The impact of pistachio shell powder on the thermal and mechanical properties of a bio composite

Y. Chelbi, F. Kallel, N. Haddar

"Natural Fiber Reinforced Polymer Composites" has been used in a wide variety of applications in the automotive components, construction sectors and packaging. The present study investigated the effect of chemical treatment of natural fibers on the mechanical and the thermal properties of Polylactic acid/Pistachio shell powder bio-composites. In this project, the Natural Fibers and Polylactic acid polymer are used for producing composite material due to their low cost of production, availability and superior strength of the natural fibers. The ultimate aim of our project is to study and analyse the Mechanical Properties (Hardness, Compressive strength, and Impact strength) of the bio-composite after chemical treatment on Pistachio shell powder.

ID : 161 The physico-chemical, mechanical and tribological properties of ZrO2 coatings deposited via DC sputtering using the oblique angle deposition technique

A. Gzaiel, K. Aouadi, C. Nouveau, A. Besnard, Y. Pinot, F. Bouchoucha

Oblique Angle deposition (OAD-PVD) was used to synthesize zirconium oxide thin films (ZrO2) with different out-of-the-plane substrate/target angle (from 0° to 85°). The main objective of this work is to develop and characterize a biocompatible coating for hip prosthesis implants (that have a « complex » shape). The OAD method is dedicated in deposing thin films with a specific geometry and helps understanding how the incidence angle of the particles affects the final surface morphology and microstructure of ZrO2 thin films. This study is based on both experimental (DC magnetron sputtering) and multi-scale numerical (Monte Carlo codes SRIM [1], SIMTRA [2], and Virtual Coater NASCAM [3]) approaches. Structure and texture of the ZrO2 coatings are studied by XRD. The microstructure and surface morphology were observed by SEM, while EDS provided coating composition. AFM profiles are conducted to study coatings properties at the nanometric scale, as well as adhesion measurements. Hardness and elastic modulus of ZrO2 thin films are evaluated by nano-indentation. The experimental and numerical results complement each other, offering a comprehensive understanding of the phenomena that occur during the growth of the films and their influence of film properties like thickness evolution and column tilt angle.

ID : 175 Study of copper alloy formability at high temperatures using the Environmentally Friendly Formability Test (EFForT)

S. Hammami, P. Moreau, J. G. La Barbera-Sosa, F. Chaari, T. Sadat, B. Zouari, L. Dubar, R. Elleuch

Hot forging is an industrial process that requires careful control of various forming parameters. As part of an eco-responsible approach aimed at minimizing forging effort, the objective of this study is to investigate the formability of a copper alloy, CuZn40Pb2 brass, across a range of temperature and forging velocity parameters encountered industrially in forming processes. Experimental tests are carried out using the EFForT test at temperatures ranging from 650°C to 850°C and forging velocities from 10 mm/s to 29 mm/s. The results show that temperature has a significant impact on the material flow process, and that increasing forging temperature and velocity can reduce the effort and energy required during the forging process. Within these temperature and forging velocity ranges, the optimum conditions are determined for producing components with minimum effort.

ID : 176 Hygrothermal effects on adhesively bonded CFRP-to-concrete systems

Z. Namourah, A. Koubaa, J. Sena-Cruz, L. Correia

In the context of strengthening existing structures, the use of fibre-reinforced polymer materials has been continuously increasing as an alternative to traditional materials, due to their superior durability (absence of corrosion), lightweight, low maintenance cost, and rapid installation. Adhesive bonding techniques for strengthening existing structures, such as near-surface mounted (NSM) and externally bonded reinforcement (EBR) are usually preferable. Despite the increasing knowledge, the long-term performance of these strengthening techniques under hygrothermal ageing conditions is still not clearly understood, limiting their use. This work aims to give new insights for reliable predictions of the long-term performance of these strengthening techniques, supported by advanced and innovative numerical modelling, properly calibrated with a refined experimental program that will be developed in this work. These outcomes will provide new knowledge on the most influencing parameters, serving as a basis for the development of simplified design recommendations.

ID : 181 Optimizing Extraction Methods for Enhanced Mechanical and Chemical Properties of Date Palm Fibers

I. Dhaou, R. Mnif, S. Zannen, A. Gargouri

In this study, we investigate the mechanical and chemical properties of date palm fibers (DPF) extracted from the petiole and leaflet waste of the date palm tree (Phoenix

dactylifera). Our primary objective is to optimize and identify the most effective method for obtaining DPF with superior mechanical and chemical properties. To achieve this goal, we systematically explore various extraction methods and treatment processes, including enzymatic and alkali treatments. Our comprehensive analysis encompasses evaluations of weight loss, moisture absorption, chemical composition, and reducing sugar content of the extracted fibers. By rigorously examining these factors, we aim to discern the extraction method that yields DPF with the highest performance potential. Remarkably, our findings highlight the pivotal role of alkali treatment, which when coupled with enzymatic treatment, demonstrates significant improvements in the mechanical and chemical properties of the extracted fibers. This underscores the importance of considering synergistic effects between different treatments to optimize the properties of date palm fibers for diverse industrial applications.

ID : 183 Anisotropic Thermal Conductivity of FRP Composites: Experimental Investigation and Insights

W. Nasri,S. Ifa, S. Frikha, P. Reis, A. Bezazi,Z. Driss

Because of their low weight and exceptional mechanical qualities, fiber reinforced polymer composites (FRPC) have been widely used in a variety of structural applications. However, the poor out-of-plane thermal conductivity of laminated fibers contained in a low conductivity polymeric resin has prohibited them from being used in situations where heat must be extracted. In any nonisothermal environment, knowing the thermal characteristics of composites is essential, and these characteristics are linked to the material's thermal properties. Since thermal responses from applied heat loads can cause thermal stresses, which can lead to structural collapse, thermal responses are critical. Therefore, precise thermal conductivity measurements are needed for thermo-mechanical optimization. In this paper, the thermal conductivity along the thickness direction of plain-woven composites laminated in Carbon, Glass, and Kevlar fabrics was investigated experimentally. Nine combinations were tested and compared using the PTC 100 heat transmission study bench under various temperatures. The dependence of thermal conductivity on temperature and heat direction are deduced from the observed data. This demonstrates the composites' anisotropic heat behavior.

ID : 184 Influence of wood fiber fraction on the mechanical behavior of low-density polyethylene matrix composite

M. Frikha, I. Hadriche, M. Khlif

Composite materials with a polymer matrix and vegetal fibers reinforcement have become increasingly important in recent years thanks to the combination of

INTERESTING PROPERTIES SUCH AS MECHANICAL RESISTANCE, LOW DENSITY AND BIODEGRADABILITY. IN THIS WORK, WE STUDY THE EFFECT OF THE REINFORCEMENT RATE ON THE MECHANICAL STRENGTH OF COMPOSITES WITH A LOW-DENSITY POLYETHYLENE MATRIX AND WOOD FIBER REINFORCEMENT. TENSILE TESTS WERE CARRIED OUT ON SPECIMENS OBTAINED BY INJECTION. THE REINFORCEMENT RATES STUDIED ARE 0%, 5%, 10%, 20% AND 30%. THE RESULTS SHOWS THAT WHEN WE INCREASE THE FIBER REINFORCEMENT RATE IN THE COMPOSITE, THE YOUNG'S MODULUS AND THE YIELD STRESS INCREASE BUT THE DUCTILITY DECREASES. A REINFORCEMENT RATE OF 10% OF WOOD FIBER ALLOWS AN IMPROVEMENT IN STRENGTH AND RIGIDITY WITHOUT LOSING THE DUCTILITY OF THE MATERIAL.

ID : 185 Improvements of the energy absorption capacity of 304 stainless steel tubular structures under complex conditions buckling

H. BELGUEBLI, Y. KHELFAOUI, R. BALEH, A. BENSLIMANE

THIS ARTICLE DEALS WITH THE ENERGY ABSORPTION AREA IN CONNECTION WITH ALL TYPES OF MOBILITY VEHICLES. SO, CRASH TUBES ARE USED AS AN ENERGY ABSORBTION SYSTEM (EAS). THE LITERATURE SHOWS THAT THIN-WALLED METALLIC TUBES, WITH A CIRCULAR CROSS SECTION, ARE COMMONLY USED. ACTUALLY, IT'S KNOWN AS ONE OF THE GEOMETRICAL STRUCTURES OFFERING THE BEST RESISTANCE/DUCTILITY RATIO, DUE, IN ADDITION TO THEIR SIMPLICITY OF MACHINING, TO THE MAXIMUM PLASTIC WORK GENERATED BY THE TUBE WALL AND THEIR STABLE AVERAGE STRENGTH. IN THIS EXPERIMENTAL INVESTIGATION, THE IMPROVEMING OF THE ENERGY ABSORPTION CAPACITY OF TUBULAR STEEL STRUCTURES, MAINLY, WHEN USED AS A MECHANICAL FUSE. USING A SPECIFIC DEVICE, INTITLED ACTP GENERATING COMPLEX SOLLICITATIONS (COMBINED COMPRESSION-TORSION) IS USED TO REPRODUCE THE MECHANICAL BEHAVIOR OF TUBES IN STEEL 304 AND THEN TO CHARACTERISE THE EVOLUTION OF MATERIEL PROPERTIES AND THE ENERGY ABSORPTION OF SUCH EAS. THE AVERAGE STRENGTH AND, SPECIFIC ENERGY ILLUSTRATED, INCLUDING AND ENERGY ABSORBING CAPACITY. IN TERMS OF THE DISTINCT CONFIGURATION OF PLASTIC BUCKLING ADOPTED, ONE OF WHICH ARE BIAXIAL VIA THE ACTP BI53° AND A CLASSIC UNIXIAL CONFIGURATION BY WAY OF REFERNCE, THE MAIN EXPERIMENTAL RESULTS REVEAL A SIGNIFICANT INFLUENCE OF THE DEGREE OF COMPLEXITY OF THE LOADING APPLIED COMPARED WITH THE CONVENTIONAL UNIAXIAL REFERENCE CONFIGURATION. BY WAY OF EXAMPLE, AN INCREASE IN THE AVERAGE LOAD AND ENERGY DISSIPATED BY THE EAS OF THE ORDER OF 27 % ARE OBTAINED IN FAVOUR OF THE BI53 CASE.

ID : 190 Methodology enhancement of resonant ultrasound spectroscopy (RUS) to identify effective elastic properties of an aluminum sample

M. BOUZID, S. BERNARD,S. SOUISSI, P. MARECHAL

THIS WORK AIMS TO ENHANCE THE METHODOLOGY FOR CHARACTERIZING THE ELASTIC PROPERTIES OF MASSIVE SAMPLE. A NOVEL METHODOLOGICAL APPROACH IS COUPLED TO THE RESONANT ULTRASONIC SPECTROSCOPY (RUS). THE INNOVATION CONSISTS IN A FIND-PEAKS FUNCTION USED TO AVOID THE FALSE RESONANT PEAKS, COMBINED TO A CLUSTERING FUNCTION (K-MEANS) TO POOL THE SIGNIFICANT DATA FROM MULTIPLE RESONANCE SPECTRA MEASUREMENTS. THE ACOUSTIC

RESONANCE MEASUREMENTS ARE MADE BY TWO SHEAR TRANSDUCERS WITH 2.25 MHZ. IN VIEW TO SOLVE THE INVERSE PROBLEM, TWO HYPOTHESES ARE IMPLEMENTED, EITHER ISOTROPIC OR ORTHOTROPIC. THE OBTAINED RESULTS SHOW THE VALIDITY OF THE PROPOSED METHODOLOGY FOR BOTH ASSUMPTIONS AND ARE IN AGREEMENT WITH THE LITERATURE.

ID : 193 Rheological Properties of Cellulose Biocomposites

A. KHOUAJA, A. KOUBAA, H. BEN DALY

THIS STUDY INVESTIGATES THE RHEOLOGICAL PROPERTIES OF PLASTICIZED CELLULOSE ACETATE (PCA) BIOPOLYMER AND ITS KRAFT AND MICROCRYSTALLINE CELLULOSE (MCC) REINFORCED BIOCOMPOSITES. THE IMPORTANCE OF STUDYING THE CELLULOSE BIOCOMPOSITES PROPERTIES STEMS FROM THE RENEWABLE, NON-TOXIC, FLEXIBLE, AND MECHANICALLY ROBUST NATURE OF CELLULOSE-BASED MATERIALS. RHEOLOGICAL ANALYSES REVEALED MOLECULAR INTERACTIONS IN PCA:KRAFT AND PLA:MCC BLENDS FACILITATED BY THE HYDROXYL GROUPS OF CELLULOSE ACETATE AND CELLULOSE FIBERS, RESULTING IN HIGH THERMAL STABILITY OF THE BIOCOMPOSITES. THE ADDITION OF CELLULOSE FIBERS SIGNIFICANTLY INCREASED THE VISCOSITY OF THE BIOCOMPOSITES AT 180 °C, EXHIBITING A SHEAR THINNING BEHAVIOR WITH COMPLEX VISCOSITY MULTIPLIED BY 570 AND 100 TIMES THAT OF NEAT PCA FOR BIOCOMPOSITES WITH 50 WT% KRAFT AND MCC FIBERS, RESPECTIVELY.

ID : 195 Fe2O4 Ni0.5Cd0.5 pellet-doped iron oxyde's hydrogen storage

S. BELKHIRIA, A. JEMNI

THE MAIN OBJECTIVE OF THIS WORK IS TO STUDY EXPERIMENTALLY THE HYDROGEN PROPERTIES UNDER CONDITIONS OF SECURITY, PROFITABILITY, MASS AND HIGH KINETICS VERSUS ROOM TEMPERATURE. THESE ALLOYS HAVE A HIGH HYDROGEN STORAGE VOLUMETRIC DENSITY. THUS, THE SOL-GEL PROCESS WAS USED TO CREATE A TERNARY FERRITE-SPINEL MATERIAL FOR HYDROGEN STORAGE, FE2O4NI0.5CD0.5. THE MORPHOLOGICAL AND STRUCTURAL CHARACTERISTICS OF THE CREATED SAMPLE WERE FIRST IDENTIFIED. SCANNING ELECTRON MICROSCOPY (SEM) AND X-RAY DIFFRACTION (RX) ARE USED TO EXAMINE THE MORPHOLOGICAL AND STRUCTURAL CHARACTERISTICS OF THIS MATERIAL. ADDITIONALLY, THE EXPERIMENTAL STORAGE CHARACTERISTICS OF HYDROGEN WERE INVESTIGATED IN RELATION TO TEMPERATURES AND PRESSURES. FIRSTLY, THE STRUCTURAL PROPERTIES OF THE FE2O4NI0.5CD0.5 IRON OXIDE WERE STUDIED USING THE X-RAY TECHNIQUE WITH A 2Θ SETUP IN BRAGG-BRENTANO GEOMETRY. THE EXPERIMENTAL CHARACTERIZATION OF HYDROGEN STORAGE IS CARRIED OUT USING A SIEVERT APPARATUS THE FINDINGS DEMONSTRATED THAT FERRITE PERFORMS WELL AS A HYDROGEN STORAGE MATERIAL AT TEMPERATURES AND PRESSURES THAT ARE SIMILAR TO AMBIENT.

ID : 202 Morphological characterization of Zn-Co coatings: effect of additive and baths' parameters

F. NASRI, D. TRABELSI, M. KHARRAT, M. DAMMAK, F. VACANDIO, M. EYRAUD

ZN-CO ALLOY COATINGS WERE ELECTRODEPOSITED FROM SULPHATE-BASED BATH. SO AS TO ELABORATE HOMOGENEOUS AND FINE GRAINED DEPOSIT ON MILD STEEL, THE EFFECT OF ADDITIVE AND BATHS' PARAMETERS ON THE COATINGS' MORPHOLOGY WERE STUDIED AND DISCUSSED. THE EXPERIMENTAL RESULTS LAID OUT THAT SODIUM AS ADDITIVE HAD A SIGNIFICANT EFFECT ON THE CO CONTENT AND COATING'S MORPHOLOGY. MOREOVER, DECREASING APPLIED POTENTIAL FROM -1.05V TO -1.2V CHANGED REMARKABLY THE LAYERS' SURFACE FROM CRACKED TO UNIFORM AND WELL COVERED SURFACE. INORDER TO ENHANCE FURTHER THE ZN-CO COATINGS' DEPOSITION, PH ADJUSTMENT SEEMED TO BE A SOLUTION. IN FACT, ADJUST PH FROM 4.6 TO 3 TO 1.7 ALLOWED TO MODIFY SIGNIFICANTLY THE COATING'S MORPHOLOGY TO TYPICAL NODULAR NANOCRYSTALLINE STRUCTURE. THE BATHS' PARAMETERS EFFECT WAS ACHIEVED AT TWO DISTINCT AMBIENT TEMPERATURES (17°C AND 24°C). HENCE, TEMPERATURE WAS A MAJOR FACTOR TO MODIFY THE LAYERS' MORPHOLOGY.

ID : 203 Free Volume from nanoindentation test : Numerical approach

M. A. YOUSFI, H. ZBIDI, K. HAJLAOUI

IN THIS WORK WE FOCUS ON THE NEW NUMERICAL METHOD TO ESTIMATE THE FREE VOLUME (FV) OF METALLIC GLASSES. THIS METHOD IS BASED ON A SIMPLE NANOINDENTATION TEST AND COULD BE USED TO PREDICT THE EVOLUTION OF FV UNDER LOADING. THIS NUMERICAL APPROACH COULD BE USED TO SELECT THE BEST COMPOSITION OF METALLIC GLASSES FOR HYDROGEN STORAGE APPLICATION.

ID : 204 Investigation of the influence of graphite content on scratch resistance of electrodeposited Nickel-graphite composite coatings

D. TRABELSI, F. NASRI, M. KHARRAT, M. DAMMAK, M. EYRAUD, F. VACANDIO

THIS STUDY INVESTIGATES THE SCRATCH RESISTANCE OF ELECTRODEPOSITED NICKEL- GRAPHITE COATINGS WITH VARYING GRAPHITE CONCENTRATIONS (0-20 G/L) IN THE PLATING BATH. SUR-FACE MORPHOLOGIES, MICROHARDNESS, AND SCRATCH BEHAVIOR WERE ANALYZED TO UNDER-STAND THE EFFECTS OF GRAPHITE CONTENT ON COATING PROPERTIES. RESULTS REVEAL THAT IN-CREASING GRAPHITE CONCENTRATION LEADS TO A DECLINE IN SCRATCH RESISTANCE DUE TO THE FORMATION OF MATERIAL RIDGES AND REDUCED MECHANICAL STRENGTH.

ID : 211 The examination of hydrothermal effect on aged SMC composites

A. ABDESSALEM, S. TAMBOURA, H. BEN DALY, J. FITOUSSI

THIS PAPER PRESENTS A STUDY OF THE HYDROTHERMAL EFFECT ON AGED SHEET MOLDING - COMPOUND (SMC) -COMPOSITE. TWO TECHNIQUES WERE USED TO EVALUATE THE MICROSTRUCTURE OF THE CONCERNED MATERIAL. THE- X-RAY MICRO COMPUTED TOMOGRAPHY (XMCT) WAS FIRSTLY USED TO EXAMINE THE CHANGES USING- TRIDIMENSIONAL IMAGES. THE RESULTS SHOWED CRACKS IN ALL THE COMPOSITE STRUCTURE AS A RESULT OF THE GENERATION OF OSMOTIC PRESSURE IN MICROCAVITIES, WHICH IS PROPORTIONAL TO WATER SORPTION. HOWEVER, THE STUDY OF THE DIFFERENT HYDROTHERMAL-INDUCED DAMAGE SEPARATELY WAS NOT POSSIBLE. THEREFORE, SCANNING ELECTRON MICROSCOPY (SEM) WAS SUPPLEMENTED TO THE FIRST STUDY IN ORDER TO STUDY SEPARATELY THE CRACK EVOLUTION IN TERMS DENSITY. THE RESULTS SHOWED THAT THE DAMAGE INCREASES WITH TEMPERATURE AND EXPOSURE TIME. THE DAMAGE WAS FOUND TO BE LOCATED IN THE VOIDS CONTAINED IN THE MATRIX. THEN IT IS DEVELOPED INTO THE FIBER INTERFACE.

ID : 214 Fatigue estimation of notched A357-T6 cast aluminium under tension loading based on affected depth

N. MAJED, A. NASR

THIS STUDY AIMS TO DETERMINE THE FATIGUE LIMIT FOR A NOTCHED CAST ALUMINIUM AL-LOY A357-T6. THE ANALYSIS FOCUSES ON THE CROSSLAND EQUIVALENT STRESS NEAR THE CASTING DEFECT USING THE FINITE ELEMENT (FE) METHOD. THE NOTCHED SPECIMEN IS SUBJECTED TO TENSION FATIGUE LOADING. THE AFFECTED DEPTH IS CALCULATED AND REFERRED TO AS THE DISTANCE FROM THE DEFECT'S TIP TO THE INTERIOR OF THE SPECIMEN. BY EMPLOYING THE AFFECTED DEPTH APPROACH, THE KITAGAWA-TAKAHASHI DIAGRAM IS SIMULATED FOR A LOAD RATIO OF = 0.1.

ID : 218 Assessment of fixation stability in tibial fractures osteosynthesized with plates and screws during the resumption of walking

S. KHMIRI, H. KETATA, N. HFAIEDH, M. KANHONOU, M. KHARRAT, M. DAMMAK

TIBIA FRACTURES ARE AMONG THE MAJOR ISSUES INVESTIGATED IN THE FIELD OF BIOMECHANICS. IN THIS STUDY, OUR FOCUS IS SPECIFICALLY ON PLATE AND SCREW OSTEOSYNTHESIS IN THE TREATMENT OF TIBIA FRACTURES. UNDERSTANDING AND EVALUATING POST-OPERATIVE RECOVERY, PARTICULARLY THE TIME REQUIRED FOR PATIENTS TO STAND OR RESUME WALKING, IS CRUCIAL IN THIS AREA. USING THE 3D FINITE ELEMENT METHOD, THIS STUDY SUCCESSFULLY SIMULATED THE INSERTION PROCESS OF SELF-TAPPING SCREWS NEEDED TO IMMOBILIZE FRACTURED FRAGMENTS USING A PLATE. THIS ADVANCEMENT IS MADE POSSIBLE BY IDENTIFYING PARAMETERS OF AN ELASTOPLASTIC BEHAVIOR LAW COUPLED WITH DAMAGE, OBTAINED FROM EXPERIMENTAL TESTING ON A SYNTHETIC BONE SAMPLE INCLUDING BOTH CORTICAL AND CANCELLOUS BONE. THIS ALLOWED

FOR THE EVALUATION OF THE MECHANICAL RESPONSE OF THE SCREW-BONE INTERFACE, THEREBY QUANTIFYING INDUCED STRESSES AND STRAINS. THESE STRESSES, EXCEEDING THE ELASTIC LIMIT, LED TO THREAD FORMATION THROUGH MATERIAL REMOVAL. MAINTAINING A STANDING POSITION FOR THE FIRST FOUR WEEKS RESULTED IN WIDENING OF THE DRILL HOLES. DURING THIS PERIOD, LOAD TRANSFER OCCURRED THROUGH THE PLATE DIRECTLY LINKED TO THE SCREWS. BETWEEN THE FOURTH AND TWELFTH WEEKS, MAINTAINING A STANDING POSITION RESULTED IN PERMANENT DEFORMATIONS AT THE CALLUS FORMATION SITE. A DURATION OF SUPPORT THREE TIMES LONGER LED TO EVEN MORE PRONOUNCED DEFORMATIONS, DOUBLING, WHICH IS DETRIMENTAL TO PROPER WEIGHT-BEARING RECOVERY. WALKING RESUMPTION, SIMULATED BY APPLYING FIVE SUCCESSIVE STEPS, KEPT MAXIMAL DEFORMATIONS BELOW THE BONE'S ELASTIC LIMIT AT THE CALLUS THROUGHOUT THE LOADING PERIOD. IT IS NOTEWORTHY THAT AT 16 WEEKS, MAXIMAL DEFORMATIONS ARE APPROXIMATELY TEN TIMES LESS SIGNIFICANT COMPARED TO THOSE RECORDED AT FOUR WEEKS, BOTH IN CORTICAL AND TRABECULAR BONES. THIS FINDING UNDERSCORES SIGNIFICANT PROGRESS IN THE RECOVERY PROCESS OVER TIME AND DEMONSTRATES THAT APPLYING GRADUAL AND NON-SUSTAINED PRESSURE MAY NOT LEAD TO PERMANENT DEFORMATIONS AT THE CALLUS LEVEL.

ID : 221 Improvements in mechanical and tribological properties of thermoplastic composites by the incorporation of metal microparticles

M. AKROUT, B. BEN DIFALLAH, M. KHARRAT, A. PEREIRA, FILIPE J. OLIVEIRA, ISABEL DUARTE

THE ADVENT OF POLYMER REINFORCED BY FILLERS HAD WIDENED THE ENVIRON MENTS OF NEAT POLYMERS BY IMPROVING THEIR MECHANICAL AND TRIBOLOGICAL BEHAVIOR AS WELL AS OTHER FUNCTIONAL PROPERTIES. THE SELECTION OF MATERIALS PLAYS AN IMPORTANT ROLE AND DETERMINES THE WORKING EFFICIENCY TO INCREASE THE PRODUCTIVITY. THEREFORE, MECHANICAL AND TRIBOLOGICAL PROPERTIES OF MICRO-POWDERED COPPER (CU) REINFORCED ACRYLONITRILE BUTADIENE STYRENE (ABS) OR POLYAMIDE 6-6 (PA66) ARE INVESTIGATED IN THIS WORK. THE COMPOSITES ARE ELABORATED BY THE INCORPORATION OF CU MICROPARTICLES TO THE UNSATURATED ABS AND PA66POLYMERS, RESPECTIVELY. IT IS OBSERVED THAT ME CHANICAL PROPERTIES LIKE TENSILE STRENGTH ARE HIGHER IN CASE OF 5 PERCENT CU FOR BOTH ABS AND PA66 COMPOSITES. THE YOUNG MODULUS DECREASES WITH THE INCREASE OF COPPER CONTENT IN BOTH ORGANIC MATERIALS. DUE TO THE LUBRICATION ABILITY OF COPPER PARTICLES, ABS-CU COMPOSITES AND PA66-CU COMPOSITES SHOW A SIGNIFICANT DE CREASE IN COEFFICIENT OF FRICTION. TRENDS OF WEAR LOSS IN BOTH COMPOSITE MATERIALS ARE SIMILAR, A SHARP DECREASE OF THE WEAR RESISTANCE ABILITY IS OBSERVED IN CASE OF 5 WT.% CU.

ID : 225 Evaluation of dielectric and mechanical properties of 3D printed polylactic acid / cellulose acetate blends for electrical insulation application

M. LECOUBLET, M. RAGOUBI, N. LEBLANC, A. KOUBAA

THE 3D PRINTING MARKET IS PROMISING AND IN FULL EXPANSION, BUT INDUSTRIES ARE STILL LOOKING FOR THE RIGHT FORMULATION TO OBTAIN ORIGINAL 3D PRINTED MATERIALS FOR

ELECTRICAL INSULATION APPLICATION. THE AIM OF THIS STUDY IS TO BETTER UNDERSTAND THE DIELECTRIC BEHAVIOR OF 3D PRINTED BIOPOLYMERIC BLENDS. WE PROPOSE AN ORIGINAL WORK BASED ON THE FORMULATION OF 3D PRINTED BLENDS OF POLYLACTIC ACID (PLA) AND CELLULOSE ACETATE (CA) AND THE OPTIMIZATION OF THEIR DIELECTRIC AND MECHANICAL PERFORMANCES FOR AN ELECTRICAL INSULATION APPLICATION. THE INCORPORATION OF CA IN PLA HAS A DUAL EFFECT. FIRSTLY, THE MECHANICAL PROPERTIES SHOW A DECREASE OF THE COMPLEX MODULUS WITH THE INCORPORATION OF CA IN THE BLEND, DUE TO THE PLASTICIZER CONTAINED IN THE CA. THE CA ALSO HINDERED THE MECHANICAL LOSS OF PLA DURING THE GLASS TRANSITION RELAXATION. IN ADDITION, THE DIELECTRIC CONSTANT INCREASED WITH THE PROPORTION OF CA IN THE BLENDS. IT WAS ASSOCIATED TO BOTH THE POLAR NATURE OF CA AND THE MORPHOLOGY OF THE BLEND, RESPECTIVELY INCREASING THE DIPOLAR POLARIZATION AND INTERFACIAL POLARIZATION. A SLIGHT INCREASE IN ELECTRICAL CONDUCTIVITY WITH THE ADDITION OF CA WAS ALSO NOTED, PROBABLY DUE TO THE PRESENCE OF THE CA PLASTICIZER, INCREASING THE FREE VOLUME BETWEEN MACROMOLECULAR CHAINS AND THUS FACILITATING THE MOBILITY OF THE IONIC CHARGE CARRIERS. HOWEVER, THIS SLIGHT INCREASE IN POLARITY DOES NOT COMPROMISE THE SUITABILITY OF THESE MATERIALS. AFTER A SLIGHT PHASE OF ARCHITECTURAL OPTIMIZATION BY 3D PRINTING, PLA/CA BLENDS SHOWED A SIMILAR STORAGE MODULUS AND DIELECTRIC CONSTANT TO LDPE, A COMMON POLYMER IN ELECTRICAL INSULATION APPLICATION.

Dynamics of Systems

ID : 26 Dissection of the pressure field near the onset of vortex-induced Vibrations using the pressure mode decomposition

H. FAROOQ, I. AKHTAR, M. R. HAJJ

VORTEX-INDUCED VIBRATION (VIV) OF A CIRCULAR CYLINDER IS A WELL-OBSERVED AND EXTENSIVELY STUDIED PHENOMENON IN FLUID MECHANICS. THE POTENTIAL APPLICATION OF INDUCED STRUCTURAL MOTION DUE TO VORTEX SHEDDING IN ENERGY HARVESTING HAS FURTHER INCREASED THE SIGNIFICANCE OF THE PHENOMENON. FLOW ANALYSIS TECHNIQUES, SUCH AS PROPER-ORTHOGONAL DECOMPOSITION (POD), ARE OFTEN EMPLOYED TO PROVIDE INSIGHT INTO FLOW PHYSICS. IN THE PRESENT STUDY, WE SIMULATE THE FLOW PAST AN ELASTIC CYLINDER AND ANALYZE THE DISTRIBUTION OF PRESSURE POD MODES OVER THE SURFACE IN THE VICINITY OF THE VIV BIFURCATION POINT TO IDENTIFY THE DOMINANT MODES RESPONSIBLE FOR THE GENERATION OF LARGE-AMPLITUDE OSCILLATIONS. IN PRESSURE MODE DECOMPOSITION (PMD), WE DECOMPOSE THE SURFACE PRESSURE MODES INTO THE SINE AND COSINE COMPONENTS AND INTEGRATE THEM OVER THE SURFACE TO COMPUTE THE LIFT AND DRAG DECOMPOSITION COEFFICIENTS. THESE DECOMPOSITION COEFFICIENTS CAN BE USED TO EXPRESS HYDRODYNAMIC FORCE COEFFICIENTS IN A GALERKIN EXPANSION INDEPENDENT OF SPATIAL MODES. THEN, WE ANALYZE THE SIGNIFICANCE OF EACH DECOMPOSITION COEFFICIENT FOR THE GENERATION OF PRESSURE BASED LIFT AND DRAG COEFFICIENTS AND PROVIDE INSIGHT INTO HOW THIS ANALYSIS CAN

HELP TO DETERMINE THE ENERGY HARVESTING POTENTIAL OF FREELY OSCILLATING STRUCTURES AND THEIR USAGE AS MICRO-POWER GENERATORS.

ID : 32 Analyzing the influence of an innovative stringer grid on bulging factor and stress intensity factor in pressurized aircraft fuselage skin cracks

M. BOUAZIZI, M. SOULA, T. LAZGHAB

THE BULGE AROUND A CRACK IS A COMMON FEATURE IN MANY FATIGUE DAMAGES AND CAN HAVE A SIGNIFICANT EFFECT ON THE STRESS INTENSITY FACTOR (SIF) DUE TO THE STRESS REDISTRIBUTION AROUND THE CRACK. THE BULGE CAN BE CAUSED BY A VARIETY OF FACTORS, SUCH AS MATERIAL PROPERTIES, LOADING CONDITIONS, AND THE GEOMETRY OF THE COM-PONENT. THIS WORK INVESTIGATES THE IMPACT OF A HEXAGONAL GRID PATTERN ON THE BULG-ING FACTOR AND STRESS INTENSITY FACTOR FOR CRACKS OF VARYING LENGTHS IN THE SKIN OF A FUSELAGE. THE RESULTS OBTAINED ARE COMPARED TO THOSE OF A CONVENTIONAL ORTHOGONAL GRID STIFFENING PATTERN.

ID : 37 Galloping-based energy harvesting in a 2DOF system under two aerodynamic forces

M.HAMDI, M. BELHAQ, M. KARAMA

GALLOPING-BASED PIEZOELECTRIC ENERGY HARVESTING (EH) IS INVESTIGATED IN A LINEAR TWO-DEGREE-OF-FREEDOM (2DOF) MECHANICAL SYSTEM COUPLED TO AN ELECTRICAL CIRCUIT THROUGH A PIEZOELECTRIC MECHANISM. THE HARVESTER SYSTEM CONSISTS OF MOUNTING A PIEZOELECTRIC SYSTEM ON THE SECONDARY STRUCTURE. A COMPARATIVE STUDY IS CARRIED OUT BY EXAMINING TWO CONFIGURATIONS. IN THE FIRST CLASSICAL CONFIGURATION, ONLY THE PRIMARY STRUCTURE (WITH A BLUFF BODY) IS EXCITED BY AN AERODYNAMIC FORCE. THE SECOND CONFIGURATION CONSIDERS THAT THE PRIMARY AND SECONDARY STRUCTURES (BOTH WITH A BLUFF BODY) ARE SIMULTANEOUSLY EXPOSED TO AERODYNAMIC FORCES. THE SO-CALLED COMPLEXIFICATION-AVERAGING (CX-A) METHOD IS APPLIED TO APPROXIMATE THE AMPLITUDE OF VIBRATIONS AND THE OUTPUT POWER FOR THE TWO CONFIGURATIONS. TO VALIDATE THE ANALYTICAL RESULTS, NUMERICAL SIMULATIONS ARE PERFORMED. THE ENERGY HARVESTED FROM THE SECOND CONFIGURATION (WITH TWO BLUFF BODY BEAMS) AND THAT HARVESTED FROM THE FIRST CONFIGURATION (WITH ONE BLUFF BODY BEAM) ARE CALCULATED AND COMPARED. IT IS SHOWN THAT THE PRESENCE OF TWO AERODYNAMIC FORCES ENABLES THE SYSTEM TO HARVEST HIGHER POWER COMPARED TO THE SYSTEM UNDER A SINGLE AERODYNAMIC FORCE. IT IS ALSO DEMONSTRATED THAT THE EH SYSTEM MAY HAVE A LOW CRITICAL WIND GALLOPING SPEED AND HIGH OUTPUT POWER IN THE SECOND CONFIGURATION.

ID : 39 Energy harvesting in a 2DOF galloping and vortex-induced vibrations-based system

M. HAMDI , Y.E. MOSSATI , M. BELHAQ

COMBINED GALLOPING AND VORTEX-INDUCED VIBRATIONS-BASED ELECTROMAGNETIC ENERGY HARVESTING (EH) IS INVESTIGATED IN A LINEAR TWO-DEGREE-OF-FREEDOM (2DOF) MECHANICAL SYSTEM COUPLED TO AN ELECTRICAL CIRCUIT THROUGH A ELECTROMAGNETIC MECHANISM MOUNTED ON THE SECONDARY STRUCTURE, WHILE THE PRIMARY BLUFF BODY BEAM IS EXPOSED TO AERODYNAMIC FORCES. A COMPARATIVE STUDY IS CARRIED OUT BY EXAMINING TWO CONFIGURATIONS. IN THE FIRST CONFIGURATION, ONLY THE PRIMARY STRUCTURE (WITH A BLUFF BODY) IS SUBMITTED TO AN AERODYNAMIC FORCE. THE SECOND CONFIGURATION CONSIDERS THAT THE PRIMARY STRUCTURE IS EXPOSED SIMULTANEOUSLY TO GALLOPING AND VORTEX-INDUCED VIBRATIONS. THE HARMONIC BALANCE METHOD IS APPLIED TO APPROXIMATE THE AMPLITUDE OF VIBRATIONS AND OUTPUT POWERS FOR THE TWO CONFIGURATIONS. TO VALIDATE THE ANALYTICAL RESULTS, NUMERICAL SIMULATIONS ARE PERFORMED. THE ENERGY HARVESTED FROM THOSE CONFIGURATIONS IS CALCULATED AND COMPARED. OUR FINDINGS SHOW THAT COMBINING GALLOPING AND VORTEX-INDUCED VIBRATIONS IN THE SECOND CONFIGURATION ENABLES THE SYSTEM TO HARVEST HIGHER ENERGY THAN THE FIRST CONFIGURATION AT LOW WIND SPEEDS.

ID : 46 Vibration analysis of a wheelset with coaxiality defect

E. KHECHINE, M. GRAA, A. KORBI, F. ZEMZEMI

THE STUDY OF THE GEOMETRIC TOLERANCES EFFECT ON NATRUAL FREQUENCIES OF A SYSTEM IS A CRUCIAL STEP WHEN DESIGNING MECHANISMS IN DIFFERENT INDUSTRIES. THIS PAPER INVESTIGATES THE VIBRATION OF A RAILWAY WHEELSET CONSIDERING THE COAXIALITY DEFECT. THE DEVIATED MODEL IS CREATED USING A COUPLING SOLIDWORKS AND EXCEL SOFTWARE THROUGH THE CONCEPT OF THE REGRESSION LINE. IN ORDER TO ESTIMATE THE FREE VIBRATION OF THE RAILWAY WHEELSET AN ANALYSIS OF THE REAL MODEL IS CARRIED OUT WITH ANSYS. FINALLY, A COMPARAISON OF NATRUAL FREQUENCIES BETWEEN THE IDEAL AND THE DEFORMED MODEL IS PRESENTED CONSIDERING THE BENDING MODE.THE RESULT SHOWS THAT THE DIFFERENCE PERCENTAGE GOES HIGHER AS THE GEOMETRIC GOES HIGHER TOO. THE NATRUAL FREQUENCIES OF THE WHEELSET WITH DIFFERENT COAXIALITY TOLERANCES ARE SLIGHTLY DIFFERENT.

ID : 50 Surface texture algorithm for complex 2D profiles

A. BACHIR, R. BRAULT, N. ANWER, H. NOUIRA

A NOVEL METHODOLOGY IS INTRODUCED FOR THE COMPUTATION OF SURFACE TEXTURE PARAMETERS TAILORED FOR COMPLEX PROFILES DERIVED FROM COMPONENTS PRODUCED THROUGH ADDITIVE MANUFACTURING TECHNOLOGIES. THE PROPOSED METHOD, TARGETED FOR APPLICATION IN INDUSTRIAL CONTEXTS WITHIN MECHANICAL ENGINEERING AND MECHANICS, OFFERS AN APPROACH BY EXTENDING THE DEFINITION OF AREAL SURFACE TEXTURE (AST) PARAMETERS GIVEN

IN THE ISO 25178. UNLIKE TRADITIONAL METHODS, THIS METHOD UTILIZES AN EXPANDED CONCEPTUALIZATION OF SURFACE TEXTURE PARAMETERS, ENHANCING THEIR APPLICABILITY TO COMPLEX PROFILES. IT IS BASED ON A PARAMETRIC REPRESENTATION FOR THE PROFILE, ASSUMED TO BE REPRESENTED BY A PARAMETRIC FUNCTION DENOTED AS R(T), WHERE 'T' SERVES AS AN ABSTRACT PARAMETER. BY EMPLOYING A B-SPLINE CURVE FOR PROFILE RECONSTRUCTION, THE METHOD ACCOMMODATES A BROAD SPECTRUM OF PROFILE COMPLEXITIES, ENSURING VERSATILITY ACROSS VARIOUS APPLICATIONS. THE EFFECTIVENESS OF THE PROPOSED METHOD IS DEMONSTRATED THROUGH COMPREHENSIVE TESTING ON TWO DISTINCT PROFILES. COMPARATIVE ANALYSIS WITH PARAMETER VALUES OBTAINED FROM MOUNTAINS SOFTWARE UNDERSCORES THE METHOD'S ROBUSTNESS AND RELIABILITY.

ID : 51 NanocylTwin: Enhancing uncertainty assessment for nanocyl machines through a digital twin system.

R. BENNOUN, M. DAMAK , N. ANWER , L. BOUAZIZI, H. NOUIRA

A COMPREHENSIVE APPROACH TO ENHANCE UNCERTAINTY ASSESSMENT IN NANOCYL MACHINE CYLINDRICITY MEASUREMENTS THROUGH A HYBRID DIGITAL TWIN (DT) STRATEGY IS INTRODUCED. CURRENTLY, THE NANOCYL ACHIEVES A 40 NM UNCERTAINTY, WHICH COULD BE REDUCED DRASTICALLY BY IMPLEMENTING AN ORIGINAL HYBRID DT. THIS APPROACH SEAMLESSLY INCORPORATES ERROR MODELS FOR PROBES AND THERMAL DRIFT AND INCLUDES ALL IDENTIFIED SOURCES OF ERRORS. FURTHERMORE, THE ERROR SEPARATION TECHNIQUE BASED MULTI-STEP METHOD ALLOWS TO SEPARATE THE FORM ERRORS OF THE CYLINDRICAL PARTS UNDER CALIBRATION FROM THE FORM ERRORS OF THE REFERENCE CYLINDER. HENCE, THE ACCURACY OF THE NANOCYL IS NOT INFLUENCED BY THE QUALITY OF PRECISION MOTION SYSTEMS (BEARING SPINDLE AND LINEAR GUIDANCE SYSTEMS), BY ONLY BY THE LINEARITIES, SENSITIVES AND ACCURACIES OF THE MULTIPLE PROBES INTEGRATED IN THE MACHINE. THOSE PROBES WILL BE EXPLOITED FOR DEVELOPING THE HYBRID DIGITAL TWIN BASED PHYSICAL MODEL AND DATA DRIVEN MODELS. THIS SOLUTION WILL PROVIDE AN EFFICIENT SOLUTION FOR REAL-TIME DECISION-MAKING AND PERFORMANCE OPTIMIZATION.

ID : 59 Restitution and viscoelastic collision e ffects on piezoelectric energy harvesters

K. ALLUHYDAN, F. NAJAR, A. ABDELKEFI

THE EFFECTIVENESS AND DYNAMICAL CHARACTERISTICS OF A CANTILEVERED-PIEZOELECTRIC ENERGY HARVESTER WITH A TIP MASS IS INVESTIGATED. THE HARVESTER IS CONNECTED TO AN ELECTRICAL LOAD RESISTANCE AND IS SUBJECTED TO HARMONIC EXCITATIONS. A ONE-SIDED STOPPER WITH A NONLINEAR VISCOELASTIC CONTACT FORCE MODEL IS USED TO REPRESENT THE VIBRO-IMPACT DYNAMICS DURING COLLISION. THE COEFFICIENT OF RESTITUTION IS CONSIDERED IN ORDER TO MODEL THE ENERGY DISSIPATION IN THE FORM OF VISCOELASTIC EFFECTS. TWO DIFFERENT DISCRETIZATION TECHNIQUES, WHICH ARE THE LONG-TIME INTEGRATION AND FINITE DIFFERENCE

METHODS, ARE EMPLOYED IN ORDER TO ESTIMATE THE DYNAMICAL RESPONSES OF THE SYSTEM AND ITS LEVELS OF HARVESTED POWER. THE MATHEMATICAL MODEL IS FIRST VERIFIED WITH EXISTING EXPERIMENTAL DATA IN THE LITERATURE. THE NONLINEAR COLLISION STIFFNESS WAS PARAMETERIZED FROM SOFT TO RIGID, IN ORDER TO INVESTIGATE ITS EFFECTS ON THE MAXIMUM OUTPUT POWER AND BANDWIDTH FREQUENCY. THE INFLUENCES OF THE BASE ACCELERATION AND RESTITUTION COEFFICIENT ON THE VIBRO-IMPACT DYNAMICS OF THE ENERGY HARVESTING SYSTEM ARE INVESTIGATED. THE RESULTS INDICATE THE PRESENCE OF PERIOD DOUBLING, CHAOTIC, AND MULTI-STABLE RESPONSES WITH HIGHER BASE ACCELERATION VALUES.

ID : 77 VINES dynamics and energy transfer characteristics

R. KUMAR, R. KUSKE, D. YURCHENKO

TARGETED ENERGY TRANSFER (TET) IS ONE OF THE PASSIVE APPROACHES FOR THE ATTENUATION OF VIBRATION BY MEANS OF IRREVERSIBLE ENERGY TRANSFER FROM THE PRIMARY LINEAR OSCILLATOR (LO) TO THE AUXILIARY SYSTEM. RECENT STUDIES ON TET THROUGH VIBRO-IMPACT (VI) BASED NES HAVE SHOWN IMPROVED PERFORMANCE OVER A BROAD SPECTRUM. IN VINES, WHERE A BALL OSCILLATES INSIDE THE LO, ENERGY TRANSFERS THROUGH THE IMPACTS AND MITIGATES THE VIBRATION OF THE LO. PREVIOUS STUDIES OF VINES CONSIDER LIMITED PARAMETER RANGES WITH A SMALLER MASS RATIO AND EXTERNAL EXCITATION PREDOMINANTLY NEAR THE RESONANT FREQUENCY. IN THIS STUDY, WE ARE CONSIDERING A FULLY NON-SMOOTH SYSTEM, APPLYING NOVEL ANALYTICAL AND NUMERICAL ANALYSES OF EXTERNALLY EXCITED VINES OVER A BROAD RANGE OF PARAMETERS FOR DIFFERENT PERIODIC DYNAMICS.

ID : 94 Time response and bifurcation diagram of Rott's pendulum with a rotating base for energy harvesting applications

E. ZAOULI, F. NAJAR

A ROTT'S PENDULUM WITH TWO DEGREES OF FREEDOM HAVING A TWO-TO-ONE INTERNAL RESONANCE IS USED TO TRANSFER KINETIC ENERGY BETWEEN A ROTATING DISK AND AN ELECTROMAGNETIC GENERATOR. THE HARVESTED ENERGY IS INTENDED TO BE USED FOR ONBOARD SENSING APPLICATIONS SUCH AS TIRE PRESSURE MONITORING SYSTEM. AN ANALYTICAL MODEL IS USED TO SIMULATE THE DYNAMIC RESPONSE OF THE PENDULUM UNDER DIFFERENT ROTATION SPEEDS OF THE DISK CARRYING THE DEVICE. A CONSTANT VARIABLE SPEED IS ALSO USED TO LOOK AT THE BEHAVIOR OF THE PENDULUM WITH A FREQUENCY RESPONSE-LIKE SOLUTION. BIFURCATIONS DIAGRAMS ARE ALSO USED TO DETECT PERIODICITY CHANGES OF THE SOLUTIONS.

ID : 125 Electromechanical modeling and performance analysis of L-shaped-based piezoelectric energy harvesting system

A. MAGDICH, S. BAROUDI, F. NAJAR , AND A. ABDELKEFI

PIEZOELECTRIC ENERGY HARVESTERS USING CANTILEVER BEAMS ARE WIDELY USED TO TRANSFORM ENVIRONMENTAL KINETIC EXCITATIONS INTO STRAIN APPLIED DIRECTLY TO THE PIEZOELECTRIC MATERIAL. L-SHAPED DESIGN IS ONE OF THE MOST PROMISING CONFIGURATIONS THAT CAN IMPROVE THE PERFORMANCE OF THE HARVESTER WITHOUT A SIGNIFICANT INCREASE OF ITS SIZE. THE RESULTS DEMONSTRATE THAT THE DEVICE CAN GENERATE UP TO 15.4 μW OF AVERAGE POWER BETWEEN 2 AND 200HZ

ID : 141 Study of the geometric and kinematic similarities between the GBCM and the Standard crankshaft mechanism engines

A. SAKHRAOUI , M. SAGGAR , F. AYARI , R. NASRI

IN THIS PAPER, A CONTRIBUTION TO AIDED DESIGN IS PRESENTED THROUGH THE STUDY OF GEOMETRIC LINKS TO MAKE THE CONDITIONS THAT MEASURE THE ANALOGY OF THE EXTRINSIC GEOMETRIC AND KINEMATIC BEHAVIOR OF THE GEAR-BASED CRANK MECHANISM (VCR_MCE-5 VARIABLE COMPRESSION RATIO ENGINE) TO THE CONVENTIONAL MECHANISM OF THE CURRENT FIXED CRANKSHAFT COMPRESSION RATIO (FCR ENGINE). TO THIS AIM, A MECHANICAL APPROACH BASED ON PROJECTIVE COMPUTATIONAL METHODS IS APPLIED, TO WHICH A PARAMETRIC STUDY HAS ALLOWED A CONCLUSION ON THE KINEMATIC BEHAVIOR AND GEOMETRICAL TRANSFORMATIONS OF THE MOVING LINKS. THE RESULTS REVEAL THAT TO ENSURE EQUIVALENT EXTRINSIC BEHAVIOR PROVIDING THE SAME INPUTS-OUTPUTS OF THE TWO ENGINES, THE INTRINSIC GEOMETRICAL PARAMETERS MUST BE WELL ADJUSTED, IN THIS CASE, THE SAME CRANKSHAFT RATIOS, THE SAME STROKES, AND THAT THE LENGTHS OF THE CONNECTING RODS AND CRANK RADIUS MUST BE HALF THE LENGTHS FOR A VCR CONFIGURATION COMPARED TO THE FCR CONFIGURATION REGARDLESS THE COMPRESSION RATIO AND THE RADIUS OF THE GEARWHEEL.

ID : 156 Overshooting Stick-Slip Waves Induced by Friction Instability

A. OUESLATI

THE PAPER FOCUSES ON NOVEL SURFACE WAVES GENERATED BY FRICTION INSTABILITY ALONG THE INTERFACE BETWEEN AN ELASTIC THICK-WALLED TUBE AND A ROTATING RIGID SHAFT, SIMULATING A BRAKE-LIKE SYSTEM. CONTACT AND DRY COULOMB FRICTION WITH A CONSISTENT COEFFICIENT OF FRICTION OCCUR ALONG THE SOLID INTERFACE. A SEMI-ANALYTICAL METHOD, BASING UPON A GALERKIN REDUCTION OF THE ELASTODYNAMIC EQUATIONS, RESULTS IN A SET OF NON-SMOOTH REDUCED EQUATIONS. EXAMPLES OF STICK-SLIP AND OVERSHOOTING STICK-SLIP WAVES ARE PRESENTED HERE.

ID : 168 Dynamic Behaviour of Gearbox System in the Presence of Uncertain Parameters

A. GHORBEL, M. HADL KACEM, N. FEKI, L. WALHA, A. EL HAMI, M. HADDAR

IN THIS PAPER, WE ADDRESS THE CHALLENGE OF UNCERTAINTIES INTERACTING WITHIN THE DESIGN PARAMETERS OF A TWO STAGE GEARBOX FOR WIND TURBINES. THE DYNAMIC ANALYSIS AIMS TO REDUCE LINEAR DISPLACEMENTS TO ENHANCE STABILITY. BY INCORPORATING UNCERTAINTY THROUGH A SINGULAR PARAMETER, WE WERE ABLE TO DISCERN ITS IMPACT ON THE DYNAMIC RESPONSE, INCLUDING ITS EXTREME VALUES. THE INVESTIGATION ADOPTS A COMPREHENSIVE METHODOLOGY TO ASSESS THE DYNAMIC RESPONSES OF THE SYSTEM, CONSIDERING UNCERTAINTIES IN CRITICAL PARAMETERS SUCH AS WIND SPEED AND GENERATOR INERTIA. TO ACHIEVE THIS OBJECTIVE, WE DEVELOPED A LUMPED DYNAMIC MODEL WITH 12 DEGREES OF FREEDOM (DOFS). THE GOVERNING EQUATION OF MOTION FOR THE MODEL WAS FORMULATED USING LAGRANGE FORMALISM. SUBSEQUENTLY, WE EMPLOYED THE GENERALIZED POLYNOMIAL CHAOS APPROACH (GPC) TO SIMULATE THE DYNAMIC BEHAVIOUR OF THE WIND TURBINE GEARBOX. SUBSEQUENTLY, THE RESULTS WERE VALIDATED THROUGH MONTE CARLO SIMULATIONS (MC) AND COMPARED WITH THE RUNGE KUTTA METHOD (RK) WITHOUT UNCERTAINTY PARAMETER.

ID : 215 Optimizing piezoelectric patch placement for vibration control in Jeffcott rotor system

M. BRAHEM, M. CHOUCHANE

PIEZOELECTRIC PATCHES HAVE GAINED SIGNIFICANT ATTENTION IN ENGINEERING FOR THEIR ABILITY TO CONVERT MECHANICAL STRAIN INTO ELECTRICAL ENERGY. IN THIS STUDY, THEY ARE INTEGRATED WITH AN LQR CONTROLLER AND SENSORS TO ACTIVELY CONTROL VIBRATIONS IN A JEFFCOTT ROTOR BEARING SYSTEM. THE PATCHES ARE STRATEGICALLY MOUNTED ON THE ROTOR SHAFT. THIS PAPER EXAMINES THE OPTIMAL NUMBER AND PLACEMENT OF PIEZOELECTRIC PATCHES TO ACHIEVE THE BEST PERFORMANCE. CONVENTIONAL ITERATIVE METHODS ARE USED TO DETERMINE THE OPTIMAL CONFIGURATION. FINITE ELEMENT ANALYSIS (FEA) SIMULATES THE ROTOR SYSTEM'S DYNAMIC BEHAVIOR, PROVIDING INSIGHTS INTO OPTIMAL PATCH ALLOCATION. THE RESULTS IDENTIFY THE IDEAL NUMBER OF PATCHES AND KEY AREAS FOR THEIR PLACEMENT, ENHANCING THE PERFORMANCE OF JEFFCOTT ROTOR SYSTEMS.

ID : 217 Numerical simulation of a hybrid sandwich panel subjected to landmines explosion

S MANSOURI, R. NASRI, B. TAHENTI

IN THIS PAPER, THE DYNAMIC RESPONSE OF A SANDWICH STRUCTURE WITH A COMBINATION OF CONVENTIONAL AND AUXETIC REENTRANT HONEYCOMB CELLS IS NUMERICALLY INVESTIGATED TO EXPLORE THE EFFECTIVENESS OF ITS USE AS A NEW CORE TOPOLOGY IN SANDWICH PANELS AS WELL

AS ITS DYNAMIC PERFORMANCE TO RESIST UNDER BLAST LOADING. THE RESULTS OF THE HYBRID STRUCTURE ARE COMPARED WITH CONVENTIONAL AND RE-ENTRANT HONEYCOMB CORE STRUCTURES TO EXAMINE THEIR EFFECTIVENESS IN MITIGATING BLAST EFFECTS. THE NUMERICAL MODELING STRATEGY, BASED ON THE EMPIRICAL CONWEP APPROACH IMPLEMENTED IN THE FINITE ELEMENT SOFTWARE - ABAQUS, IS ADOPTED AND VALIDATED ON THE BASIS OF DATA AVAILABLE IN THE LITERATURE. THE RESULTS SHOW THAT THE PROPOSED STRUCTURES HAVE THE BEST ENERGY DISSIPATION CAPACITY COMPARED WITH THE OTHERS. IN ADDITION, THE HYBRID STRUCTURES INCREASED BLAST WAVE RESISTANCE AND REDUCED REAR SKIN DEFLECTION. EXPLICIT NON-LINEAR ANALYSIS DEMONSTRATED THE NEW CONFIGURATION'S SUPERIOR ABILITY TO DISSIPATE AND ATTENUATE TRANSMITTED ENERGY MORE EFFECTIVELY. THE RESULTS SHOW A SIGNIFICANT REDUCTION IN TERMS OF MAXIMUM DISPLACEMENT COMPARED WITH OTHER STRUCTURES.

ID : 226 Discrete element model to simulate a cylindrical roller bearing NJ 328 ECNML

J. JABEUR, W. YANGUI, M. GUESSAMA, K. ELLEUCH

BEARINGS ARE ONE OF THE KEY COMPONENTS OF MANY ROTATING MACHINES AS THE WIND TURBINE.

MONITORING THE CONDITION OF BEARINGS CAN PROVIDE VALUABLE INFORMATION ABOUT MACHINE PERFORMANCE, SUCH AS DETECTING A LOCAL FAULT, IMBALANCE OR MISALIGNMENT. THE MAIN OBJECTIVE OF THIS RESEARCH WAS TO STUDY A TYPE OF CYLINDRICAL ROLLER BEARING THE NJ 328 ECNML MOUNTED IN THE WIND TURBINE USING THE DISCRETE ELEMENT MODEL. THE ADVANCED MODEL WAS VALIDATED BY COMPARING THE SIMULATION RESULTS WITH THE HAMROCK AND HARRIS THEORIES. BOTH LOAD AND DEFORMATION DISTRIBUTION WERE CONSIDERED IN DIFFERENT LOAD DISTRIBUTION FACTOR (0.5 AND 1.35). WHEN THE LOAD DISTRIBUTION FACTOR INCREASES, THE LOAD AND DEFORMATION HAVE INCREASED.

Thermal Sciences and Renewable Energy

ID : 24 Thermal performance of structured 3D polysty- rene panel walls containing rubber aggregates: Experimental case study and modeling

I. ZARRAD, M. TURKI, C. BRADAI

THIS RESEARCH FOCUSES BOTH ON THE INSULATION EFFICIENCY OF REUSING RECYCLED RUBBER WASTES SHREDDED FROM WORN TIRES AND THE 3D POLYSTYRENE PANELS IN HOUSING OF WESTERN SAUDI ARABIA PROVINCE. THE 3D CORE ELEMENT PROMISE FOR A VARIETY OF PANELIZED STRUCTURAL APPLICATIONS, SUCH AS IN RESIDENTIAL BUILDING WALLS OR SLABS. OTHERWISE, THIS PAPER ATTEMPTS TO ASSESS THE PERFORMANCE FACTORS OF 3D SANDWICH SYSTEM AS AN ALTERNATIVE TO REPLACE CONCRETE HOLLOW WALLS AND SLABS WITH A PARTIAL SUBSTITUTION OF SAND IN CONCRETE BY-PRODUCTS SUCH AS RUBBER AGGREGATES. ENVIRONMENTAL PRODUCTS IN

CONSTRUCTION TECHNOLOGY OFFER AN INTEGRATED APPROACH FOR BUILDING SUSTAINABILITY AND GIVE A BETTER SYNERGY WITH THE ECONOMICAL HOUSING. COMPARED TO CURRENTLY CONSTRUCTIONS ORIENTED CONCRETE HOLLOW BLOCK, WHICH REPRESENTS THE MAJORITY OF THE MARKET, THE LIGHTWEIGHT SANDWICH 3D PANELS WITH POLYSTYRENE PROVIDE SEVERAL ADVANTAGES LIKE: ENERGY CONSUMPTION REDUCTION Q (Q IS AROUND 73%) AND KEEP ALMOST THE DESIRED MECHANICAL PROPRIETIES OF THE ANALYZED STRUCTURE (FLEXURAL STRENGTH IS RANGING FROM 3 TO 6 MPA, COMPRESSIVE STRENGTH IS RANGING FROM 19 TO 37 MPA). EVENTUALLY, MODELING IS INVESTIGATED BY LOGIC FUZZY METHOD TO QUANTIFY ENERGY CONSUMPTION REDUCTION (Q) FOR AIR CONDITIONING OF HOUSING CONTAINING BOTH 3D PANELS AND RUBBER AGGREGATES.

ID : 25 Experimental and numerical investigation on the convective heat transfer in a helically coiled tube under constant heat flux

S. MISSAOUI, Z. DRISS, M. CHRIGUI, R. BEN SLAMA, B. CHAOUACHI

THE HELICAL COIL TUBE FOR HEAT TRANSFER ENHANCEMENT IS A PROMISING METHOD IN HEAT TRANSFER APPLICATIONS. WHILE, THE EFFECTS OF THE TUBE GEOMETRIES ON HEAT TRANSFER PERFORMANCE REMAINS THE COIL'S ONLY PROBLEM. FOR THIS PURPOSE, THE EFFECTS OF THE CONDENSER COIL GEOMETRIES ON THE THERMAL PERFORMANCES HAVE BEEN INVESTIGATED EXPERIMENTALLY AND NUMERICALLY. BASED ON THE CFD SIMULATION, THREE DIFFERENT HELICAL COIL STRUCTURE DESIGNS ARE COMPARED TO OBTAIN THE OPTIMAL COIL STRUCTURE TO IMPROVE THE HEAT FLUX WHICH IS THE MAIN OBJECTIVE FOR THIS MANUSCRIPT. THE EFFECTS OF THE HELICAL COIL STRUCTURE DESIGNS ON THE THERMAL CHARACTERISTICS ARE STUDIED AND COMPARED AND THE RESULTS INDICATED THAT, IN HELICAL COIL WITH VARIABLE-PITCH, THE HEAT TRANSFER RATE CAN INCREASE UP TO 40%. ALSO, THE SMALL PITCH IN THE LOWER PART OF THE OPTIMUM HELICAL COIL WILL RESULT IN THE THERMAL STRATIFICATION ENHANCEMENT. FURTHERMORE, THE PERFORMANCE EVALUATION OF THE THREE HELICAL COIL STRUCTURE STUDIED IN THIS PAPER SHOWS THAT APPLYING HELICAL COIL WITH VARIABLE-PITCH INSTEAD OF THE HELICAL COIL WITH CONSTANT OR VARIABLE DIAMETER IS A MORE EFFECTIVE WAY TO ENHANCE THE CONVECTIVE HEAT TRANSFER IN THE CYLINDRICAL TANK.

ID : 31 Hybrid piezoelectric and triboelectric energy harvesting using the same source of vibration

A. BEN ALAYA, CH. MRAD, F. KOURDA

ELECTRICITY PRODUCTION HAS BECOME A GLOBAL ISSUE AT DIFFERENT SCALES, FROM POWER-ING ELECTRONIC DEVICES TO ELECTRIC MACHINES. THE PURPOSE OF THIS STUDY IS TO EXPLORE A NEW ENERGY HARVESTER. IT CONSISTS ON COMBINING PIEZOELECTRIC AND TRIBOELECTRIC EF-FECTS TO INCREASE THE HARVESTED ELECTRICAL ENERGY, FROM THE SAME SOURCE OF VIBRA-TION. THE USED TRANSDUCER TO PRODUCE PIEZOELECTRITY IS A PZT-5H DISC, AND THE USED MATERIALS PAIR TO PRODUCE TRIBOELECTRICITY IS MICA-PTFE. THE OPERATING VIBRATION FREQUENCY VARIES FROM

20Hz to 30Hz. The experimental setup contains a harvest-ing electric circuit, a fixing device on which the Mica is mounted, a vibration ex-citer on which the PTFE and the piezoelectric disk are mounted, a frequency regu-lator to adjust the vibration frequency, an amplitude amplifier to set the vibration amplitude to the Mica-PTFE distance, and an oscilloscope to note the harvested voltage. The electric circuit is to rectify the harvested current and to store the pro-duced energy in three capacitors, reserved respectively to triboelectric generation, piezoelectric generation, and combined piezoelectric and triboelectric generation. The harvested electrical energy for each electricity generator is determined for dif-ferent vibration frequencies. The obtained results should help investigating hybrid generators to supply low consumption devices, in replacement of batteries.

ID : 54 A novel wind speed forecasting method based on Deep Learning Method

N. Brahmi, L. Haj Meftah, M. Chaabene

Wind speed prediction is a challenging task due to its inherent uncertainties and fluctuating nature. Previous studies have explored various techniques to improve wind speed estimation. The aim of this study is to investigate the performance of deep learning algorithms in predicting wind speed using data from Ensit's SIME lab acquisition chain. By implementing a deep learning model, specifically a deep neural network (DNN), we sought to address the limitations of traditional wind speed prediction methods and achieve higher accuracy and better reliability. Results of this study demonstrate the efficacy of a deep neural network for wind speed prediction. The DNN model outperformed traditional forecasting algorithms, exhibiting lower mean absolute error, lower root means square error of 0.08, achieving a high R-squared value of 0.92, and higher coefficient of determination. These findings support the deployment of DNN-based models in various domains reliant on accurate wind speed predictions, including renewable energy management, environmental monitoring, and disaster preparedness.

ID : 60 3D numerical simulation of a two-bladed Savonius wind turbine

A. Ayadi, N. Rabeh, Z. Driss

Wind power is widely embraced as a significant contributor to renewable energy, thanks to its accessibility and straightforwardness. In harnessing wind energy to generate electricity, the selection of rotor types plays a crucial role. Among the array of rotor options available, Savonius rotors stand out as a preferred choice for electricity generation. Their simple design and operational efficiency make them particularly well-suited for harnessing wind power and converting it into green electricity. This paper introduces a numerical model of a 3D twobladed Savonius wind turbine using the commercial CFD code Ansys-Fluent. Specially, the study focuses on

analyzing the aerodynamic characteristics, particularly velocity, pressure, and turbulence distributions. The present paper, which aims to establish a thorough comprehension of the interaction between the turbine and the airflow, serves as an interesting resource for designers to understand the behavior of airflow around the Savonius wind turbine.

ID : 90 Performance investigation of trigeneration system for an industrial building: A Thermodynamic Study Using EES and ASPEN- PLUS

D. Sioud, R. Garma, A. Bellagi

In this paper, a theoretical investigation of an absorption-based trigeneration system under the climate conditions of Tunisia has been performed. The system is intended to provide the required cooling, electricity and hot water (HW) loads for an industrial building in Tunisia throughout the year. The system comprises commercial electrical engine for electricity production and. A single stage libr/water pair-based absorption chiller is utilized for cooling production during the summer. Absorption machine is activated by hot water used from between 70 and 90°C, released from the engine. Two configurations were studied based on commercialized machines using water libr at the needed temperature and producing high capacity of cooling water equal to 810Kw. EES simulation and Aspen model were conducted. Parametric study was investigated. Results showed a COP of cycle about 0.7. This absorption system is used to substitute the convention systems already installed in the building. The cooling systems actually used is the vapor compression machine.

ID : 103 Influence of fiber length on the thermal and mechanical properties of maple wood-polypropylene composites

F. Basiji, F. Erchiqui, A. Koubaa

Wood-plastic composites (WPCs) have attracted notable attention due to their sustainability and diverse applications. The interest in bio-based composites with suitable mechanical and thermal properties for cutting-edge applications is in high demand at both academic and industrial levels. This study examines the effect of varying lengths of Maple fibers, a bio-based constituent, on WPCs' mechanical and thermal performance. Our formulations include polypropylene with MAPP as a coupling agent to enhance interfacial adhesion. For the study, we developed 5, 10, 15, and 20 vol.% of mass concentration of bio-composites (PP-Wood) as a function of fiber length (50mm,75mm, and 100mm). Polypropylene (PP) and wood composites were studied for their thermal and mechanical properties. Wood fibers were treated to enhance stability, with 75 mm fibers showing the highest stability. Differential Scanning Calorimetry (DSC) analysis revealed no significant impact of wood fiber characteristics on the melting point (Tm). Flexural strength peaked in composites with

10% fibers at 100 mm length, while tensile strength was highest at 15% content with 75 mm length fibers. Impact strength varied with fiber length, with 75 mm fibers showing the highest resistance.

ID : 106 Experimental investigation of the photovoltaic thermal cells performance using cooling system air jet

M. N. Shaeli, J. M. Jalil, S. Chtourou, M. Baccar

As the world moves toward a more sustainable future, solar energy has emerged as an economically viable alternative to traditional energy sources and it has been widely adopted. This study uses air impingement to im- prove an air-cooled PVT collector system efficiency. An indoor test utilizes a so- lar simulator to evaluate its exergy and energy efficiency. The experiments were carried under a solar radiation ranging from 490 to 950 W/m2 and an air with a mass flow of 0.012, 0.017, and 0.025 kg/s. In terms of energy performance, the so- lar radiation of 490 W/m2 achieved the highest photovoltaic efficiency of 12.54%, while with less than 950 W/m2 the highest thermal efficiency of 60.42% was achieved, both at a mass flow rate of 0.025 kg/s. It delivers the maximum photo- voltaic exergy of 40 W below 950 W/m2. While below 950 W/m2 and at air mass flow of 0.025 kg/s the highest thermal exergy was obtained about 10 W. Overall, more solar radiation is highly desirable for energy performance. Based on the ob- servations, the ideal mass flow rate was 0.025 kg/s.

ID : 109 Comparative study of 2D numerical analysis of forced convection in a square pin heat sink

N. Bouhamri, M. Bouhafs, B. Belkacem, S. A. Reffas, I. Djellid

This modest research work focuses on the comparative numerical study of the thermohydraulic performances of a heat sink used for cooling electronic components. Forced convection, which is a heat transfer phenomenon associated with fluid flows, plays a key role in this process. The main objective of this study is to analyze the effect of the geometric parameters of the heat sink as well as the operating parameters on the dynamic and thermal behavior of the air inside the channel for the enhancement of heat transfer. The numerical simulation is carried out using the Comsol multiphysics software, adopting the k-ϵ model. The results found for different Reynolds values are satisfactory

ID : 111 Thermofluidic Investigation of Color on the Performance of Martian Fixed- wing Drones

L. JOCIPOVIC, Z. ORTIZ, B. SKINNER, A. QUINTANA, S. BEN AYED

THIS STUDY PRESENTS A COMPUTATIONAL FLUID DYNAMICS (CFD) ANALYSIS COMPARING THE PERFORMANCE OF A DRONE IN THE MARTIAN ATMOSPHERE, UNDER VARYING COLOR AND THERMAL CONDITIONS. THE OBJECTIVE IS TO INVESTIGATE THE AERODYNAMIC BEHAVIOR AND THERMAL CHARACTERISTICS OF THE DRONE IN THESE DISTINCT PLANETARY ENVIRONMENTS. THE ANALYSIS SOLVES FULL NAVIER STOKES EQUATIONS COUPLED TO THE ENERGY EQUATION TO SIMULATE AND EVALUATE THE DRONE'S FLIGHT DYNAMICS AND THERMAL RESPONSE. THE STUDY FOCUSES ON TWO KEY ASPECTS: ATMOSPHERIC DIFFERENCES AND DRONE DESIGN CONSIDERATIONS. FIRSTLY, THE CONTRASTING ATMOSPHERIC CONDITIONS OF MARS AND EARTH ARE CHARACTERIZED BY VARIATIONS IN PRESSURE, TEMPERATURE, AND COMPOSITION. SECONDLY, THE DRONE'S DESIGN FACTORS, SUCH AS COLOR AND THERMAL PROPERTIES, ARE INVESTIGATED. TO CONDUCT THE ANALYSIS, A THREE-DIMENSIONAL COMPUTATIONAL MODEL OF THE DRONE IS DEVELOPED, CONSIDERING ITS GEOMETRIC DETAILS AND MATERIAL PROPERTIES. COMMERCIAL CFD SOFTWARE WERE USED TO PERFORM THE SIMULATION OF FLUID FLOW AROUND THE DRONE AND THE EVALUATION OF AERODYNAMIC FORCES, INCLUDING LIFT AND DRAG. THE LOWER ATMOSPHERIC DENSITY AND ALTERED THERMAL CONDITIONS ON MARS REQUIRE ADAPTATIONS IN THE DRONE'S DESIGN TO ENSURE STABLE FLIGHT AND EFFICIENT THERMAL MANAGEMENT. RESULTS SHOW THAT THE CHOICE OF COLORS AND THERMAL PROPERTIES OF THE DRONE HAS AN INFLUENCE ON ITS AERODYNAMIC PERFORMANCE.

ID : 112 Sensitivity analysis of design parameters on the stability of mid-scale wind turbines

W. YOSSRI, S. BEN AYED, A. ABDELKEFI

THIS STUDY COVERS DIFFERENT ASPECTS OF MID-SCALE TURBINE BLADES MODELING FROM FLUTTER ANALYSIS AND STABILITY PERSPECTIVES. SINCE VARIOUS IMPROVEMENTS TOOK PLACE IN THE LARGE-SCALE WIND-FARMS INDUSTRY YIELDING DIFFERENT POWERFUL DESIGNS WHILE THEIR SMALLER SCALE COUNTERPARTS ONLY GAINED A SMALLER SHARE OF RESEARCH INTEREST, THIS STUDY FOCUSES EXPLICITLY ON TURBINE BLADES WITH A LENGTH NOT EXCEEDING 5M. A SENSITIVITY ANALYSIS IS CARRIED OUT IN ORDER TO EVALUATE DIFFERENT STRUCTURAL AND AERODYNAMIC PARAMETERS GOVERNING THE FUNCTIONING OF A MID-SCALE WIND TURBINE AND THEIR IMPACT ON THE BLADES' STABILITY AND FLUTTER PREDICTION. A STOCHASTIC APPROACH IS FOLLOWED WHERE MANY INPUT PARAMETERS ARE SIMULTANEOUSLY VARIED INSTEAD OF THE CONVENTIONAL PARAMETRIC STUDIES WITH SINGLE-PARAMETER VARIATION. THE AIM IS NOT ONLY TO IDENTIFY THE EFFECT OF EACH INDIVIDUAL INPUT PARAMETER ON THE BLADE'S STABILITY TRAITS, BUT RATHER QUANTIFYING THE INSTABILITY OF THE BLADES IN A MORE REAL-WORLD LIKE SCENARIOS THAT ACCOUNT FOR THE CONCURRENT UNCERTAINTY ASSOCIATED WITH VARIOUS INPUT PARAMETERS AT THE SAME TIME. TO THIS END, EACH PARAMETER'S WEIGHT OF INFLUENCE IS COMPARED TO ITS COUNTERPART AND THE

most dominant stability trends are depicted. The utilized turbine blade modeling ensures its continuity in both space and time and the full unsteady aerodynamic representation is used to represent the aerodynamic loads.

ID : 114 Study and simulation of the influence of fins and copper nanoparticle concentration on the melting phenomenon of the latent heat thermal energy storage system (LHTESS).

I. Benyahia, S. H. Mellah, M. Lakhdari

Phase change Materials (PCM) are well known for their poor thermal properties, which result in limited thermal efficiency for latent heat thermal energy storage systems (LHTESS). In this study, we will be attempting to improve the thermal efficiency of the LHTESS numerically by using various cavities with and without fins containing PCM nano-enhanced (NePCM). The NePCM is included inside the LHTESS enclosure, together with its fins and the cylinder in the middle, which serve as heat sources. Three configurations were studied and compared: case 1: without fins, case 2: two fins, and case 3: four fins. The finite element method is used to discretize the system's equations. The effects of the hot source temperature (348.15 K) and the volumetric concentration of nanoparticles (ranging from 0 to 0.04) have also been considered. The evolution of temperature profiles and liquid fractions for three configurations is discussed and analysed. The results showed that using nanoparticles at an 4% volumetric concentration increased thermal conductivity by 9.8% during the fusing process. Finally, the LHTESS with four fins in case 3 proved to be the most effective, reducing the fusion time by 40.5% compared to the reference case (case 1).

ID : 122 Analyzing the unsteady behavior of a 2D Savonius rotor

A. Ayadi, N. Rabeh, Z. Driss

Savonius rotors are extensively studied for their potential applications in renewable energy. Both experimental and numerical methods can be utilized to simulate Savonius rotors. This numerical study delves into comprehending the airflow dynamics surrounding the Savonius rotor using ANSYS Fluent. Prior investigations have highlighted the use of ANSYS Fluent in simulating Savonius rotors. Employing ANSYS Fluent, the airflow characteristics, especially around the rotor, are unsteadily simulated. Special attention was given to velocity magnitude and pressure distributions. Comparative analysis with experimental data revealed good agreement, affirming the reliability of the computational model, such as the choice of time step, meshing, and turbulence model. The comprehension of the behavior of the airflow is crucial for optimizing its performance. These findings contribute significantly to enhancing the design of Savonius rotors for various applications.

ID : 124 A dynamic blade angular offset based on coaxial modified shape gear system of Savonius turbines for an optimal renewable energy harnessing

A. KETATA, L. CHELBI, H. ABID, Z. DRISS

THE OVERUSE OF FOSSIL FUELS HAS LED TO SEVERE ENVIRONMENTAL ISSUES. THUS, ENERGY RECOVERY FROM RENEWABLE SOURCES BECOME MANDATORY TO FURTHER REDUCE CO2 EMISSIONS AND GREENHOUSE EFFECTS. SMALL-SCALE SAVONIUS WIND TURBINES CAN BE SEEN AS A RENEWABLE ALTERNATIVE SOLUTION TO OVERCOME THESE ENVIRONMENTAL ISSUES. HENCE, FURTHER WORKS ARE ESSENTIAL TO ENHANCE THE PERFORMANCE OF SAVONIUS WIND TURBINES. IN THIS CONTEXT, A NEW MODIFIED SAVONIUS WITH A PREVIOUSLY PATENTED BLADE ANGULAR OFFSET MECHANISM WAS SUGGESTED FOR MINIMIZING THE RESISTANT TORQUE GENERATED FROM THE CONVEX SIDE OF THE DRIVEN BLADE. A COMPUTATIONAL FLUID DYNAMICS ANALYSIS HAS BEEN CARRIED OUT TO CHECK THE ABILITY OF THE SUGGESTED BLADE-OFFSET MECHANISM TO IMPROVE THE OVERALL PERFORMANCE OF THE TURBINE. THE NUMERICAL MODEL HAS BEEN VALIDATED WITH TEST DATA. NUMERICAL fiNDINGS confiRMED THAT THE SUGGESTED BLADE-OFFSET MECHANISM HAS LED TO AN IMPROVEMENT BY UP TO 42.6% OF THE POWER COEFFICIENT OF THE SAVONIUS TURBINE.

ID : 128 Experimental investigation of thermal energy storage on the performance of Solar Air Heater

Y. TOUHAMI, R. BOUDHIAF, N. LATRACHE, M. H. ATTIA, A. AISSA, Z. DRISS

THE USE OF SOLAR ENERGY OFFERS A PROMISING SOLUTION FOR SUPPLYING PROCESS HEAT NEEDED IN VARIOUS INDUSTRIES AND FOR HEATING BUILDINGS. THIS APPROACH NOT ONLY MEETS ENERGY DEMANDS BUT ALSO REDUCES THE NEGATIVE ENVIRONMENTAL IMPACTS OF TRADITIONAL ENERGY SOURCES. IN THIS STUDY, A BASIC PASS SOLAR AIR HEATER WAS EXPERIMENTALLY TESTED IN AUTUMN CONDITIONS IN THE SFAX REGION, SOUTHEASTERN TUNISIA. THIS STUDY COMPARED THE PERFORMANCE OF SOLAR AIR HEATERS WITH AND WITHOUT THERMAL ENERGY STORAGE. WE USED WATER A READILY AVAILABLE HEAT-STORING FLUID TO IMPROVE THE THERMAL PERFORMANCE OF THE SOLAR AIR HEATER.

ID : 139 Integration of Dry Cell Electrolyzers in Renewable Energy Systems: Opportunities and Challenges

Z. SOLAANI, R. GHEITH, F. ALOUI

THE INTEGRATION OF DRY CELL ELECTROLYZERS INTO RENEWABLE ENERGY SYSTEMS HOLDS IMMENSE PROMISE FOR ADVANCING THE TRANSITION TOWARDS SUSTAINABLE ENERGY. THIS ARTICLE EXPLORES THE PRINCIPLES, ADVANTAGES, CHALLENGES ASSOCIATED WITH THIS INTEGRATION AND THE INTEGRATION OF A DRY CELL ELECTROLYZER IN OUR CURRENT WORK. DRY CELL ELECTROLYZERS, CHARACTERIZED BY SOLID POLYMER ELECTROLYTE MEMBRANES, OFFER IMPROVED SAFETY, EFFICIENCY, AND OPERATIONAL FLEXIBILITY COMPARED TO CONVENTIONAL WET CELL

COUNTERPARTS. INTEGRATION STRATEGIES ENCOMPASS HYBRID SYSTEM CONFIGURATIONS, OPTIMIZATION OF HYDROGEN PRODUCTION AND DISTRIBUTION, AND MITIGATION OF RENEWABLE ENERGY INTERMITTENCY. ENVIRONMENTAL AND ECONOMIC BENEFITS INCLUDE CARBON EMISSIONS REDUCTION AND DECENTRALIZED HYDROGEN PRODUCTION, WHILE TECHNICAL CHALLENGES INCLUDE ENHANCING ELECTROLYZER EFFICIENCY AND ADDRESSING GRID INTEGRATION BARRIERS.

ID : 142 Evaluating the Efficiency of Double Finned Trombe Walls Through Transient 3D CFD Simulations

N. ESSID, Z. AL ADEL

ACHIEVING THERMAL COMFORT IN BUILDINGS IS ESSENTIAL FOR HUMAN WELL-BEING, BUT OFTEN COMES WITH HIGH ENERGY CONSUMPTION. UTILIZING SOLAR ENERGY FOR BUILDING HEATING IS A SUSTAINABLE APPROACH, WITH TROMBE WALL (TW) SYSTEMS OFFERING AN ECO-FRIENDLY SOLUTION. THIS STUDY AIMS TO IMPROVE TW SYSTEM EFFICIENCY BY INVESTIGATING THE IMPACT OF ADDING FINS TO THE SOLAR RADIATION ABSORBER. ADDRESSING GAPS IN EXISTING LITERATURE, A NOVEL TRANSIENT 3D COMPUTATIONAL FLUID DYNAMICS (CFD) MODEL IS PROPOSED TO ANALYZE THE DAILY THERMAL BEHAVIOR OF A TROMBE WALL WITH DOUBLE FINNED ABSORBERS. TURBULENCE IS SIMULATED USING THE K-OMEGA MODEL, WHILE EXPERIMENTALLY MEASURED SOLAR RADIATION INTENSITIES ARE INTEGRATED USING THE DISCRETE ORDINATES MODEL. THE TRANSIENT ANALYSIS REVEALS THAT ADDING FINS CREATES AIR VORTICES, RESULTING IN A LOWER PRESSURE ZONE AND NON-UNIFORM AIR VELOCITY IN THE EXIT AIR VENT. THE PROPOSED CONFIGURATION ENHANCES HEAT TRANSFER INSIDE THE TW CHANNEL, LEADING TO OUTLET AIR TEMPERATURES UP TO 53°C AT NOON. THIS STUDY CONFIRMS THE EFFECTIVENESS OF UTILIZING PRISMATIC VERTICAL FINS TO ENHANCE TW SYSTEM PERFORMANCE, WITH MINIMAL ADDITIONAL INVESTMENT COSTS.

ID : 143 MPPT control strategy for wind energy conversion system allows for field-oriented control (FOC) of permanent magnet synchronous generator (PMSG)

A. BELABBES, A. YACHIR, O. AMAIEUR, A. LAIDOUNI

THIS PAPER PRESENTS THE MODELING AND SIMULATION OF THE WIND POWER CONVERSION SYSTEM (WECS) USING THE PERMANENT MAGNET SYNCHRONOUS GENERATOR (PMSG), INTEGRATED INTO THE GRID WHICH IS CONNECTED TO TWO BACK-TO-BACK CONVERTERS WITH A COMMON DC LINK. MODELING AND SYNTHESIS OF THE CONTROL LAWS OF A WIND ENERGY CONVERSION SYSTEM INTEGRATING THE DEVICE FOR ORIENTATION. WE FIRST DEAL WITH THE WIND SIDE, CONSISTING OF THE AERODYNAMICS OF THE TURBINE AND THE (MPPT) CONTROL, THE TILT CONTROL SYSTEM AFTER THE FOC CONTROL AND THE ACTIVE AND REACTIVE POWER CONTROL STRATEGY. THE OBJECTIVES ARE: TO EXTRACT THE MAXIMUM POWER FROM THE WIND SPEED BY CONTROLLING THE ELECTROMAGNETIC TORQUE OF THE PMSG, TO KEEP THE VOLTAGE OF THE DC LINK CONSTANT DESPITE VARIATIONS IN THE WIND SPEED AND TO ACHIEVE THE UNIT POWER FACTOR. IN ORDER TO ENSURE HIGH PERFORMANCE REGULATION AND GOOD ROBUSTNESS AGAINST INTERNAL AND

EXTERNAL DISTURBANCES. THE (FOC) STRATEGY AND PI CONTROLLERS ARE DEVELOPED WITH MATLAB / SIMULINK®, THE PERFORMANCE OF THESE CONTROLLERS IS COMPARED IN TERMS OF REFERENCE TRACKING, ROBUSTNESS AND NETWORK FAULTS, RESULTS SHOW EXCELLENT BEHAVIOR

ID : 147 The influence of fin configuration and curvature on a thermal energy storage device

A. BELAZREGA, A. ABDERRAHMANE, S. MOHAMMED, Z. DRISS

PHASE CHANGE MATERIALS (PCMS) HAVE BEEN EXTENSIVELY UTILIZED IN LATENT HEAT STORAGE SYSTEMS (LHSSS) ACROSS A DIVERSE RANGE OF APPLICATIONS OWING TO THEIR EXCEPTIONAL CAPABILITY TO ATTAIN A SUBSTANTIAL HEAT RETENTION AND RECOVERY PERFORMANCE. THE CURRENT STUDY AIMS TO INVESTIGATE THE ENHANCEMENT OF THERMAL EFFICIENCY IN A PARAFFIN WAX SHELL AND TUBE THERMAL ENERGY STORAGE (TES) UNIT VIA THE USE OF SEVERAL TYPES OF ANCHOR FINS. THE PRIMARY PARAMETERS UNDER INVESTIGATION ARE THE MORPHOLOGY OF THE FIN, NAMELY ITS FORM AND CURVATURE. THIS STUDY EXAMINES THREE DISTINCT TYPES OF ANCHOR-TYPE FINS: THE INNER CURVED FIN (CONFIGURATION 1), THE OUTER CURVED FIN (CONFIGURATION 2), AND THE NORMALLY STRAIGHT FIN (CONFIGURATION 3). THE USE OF THE GALERKIN FINITE ELEMENT TECHNIQUE (GFEM) IS APPLIED FOR THE PURPOSE OF MODELING THE STORAGE UNIT AND THE SUBSEQUENT MELTING PROCESS. THE FINDINGS INDICATE THAT ARRANGEMENT 2 DEMONSTRATES THE MOST FAVORABLE ANCHOR-TYPE FIN ARRANGEMENT, AS IT REDUCES THE THERMAL CHARGING TIME BY 47% AND INCREASES THE MEAN NUSSELT NUMBER BY MORE THAN 20% IN COMPARISON TO THE OTHER CONFIGURATIONS. FURTHERMORE, CONFIGURATION 2 ALSO ATTAINED THE LOWEST KNOWN BEJAN NUMBER, WHICH REPRESENTS THE THERMAL IRREVERSIBILITY

ID : 165 Willow Leaf Pattern Plate Heat Exchanger Performance CFD Analysis

S.CHTOUROU, S. HAMMAMI, M. BACCAR

THIS PAPER DESCRIBES A NEW DESIGN METHODOLOGY THAT INCORPORATES BIOMETRIC TECHNOLOGIES INTO THE CREATION OF A PLATE INTENDED FOR APPLICATION IN PLATE HEAT EXCHANGERS (PHES). INSPIRED BY NATURE, THE DESIGN HAS DETAILED PATTERNS OF WILLOW LEAVES THAT RESEMBLE BIONIC RIBS ARRANGED IN A LABYRINTHINE PATTERN ACROSS THE SURFACE OF THE PLATE. USING COMPUTATIONAL FLUID DYNAMICS (CFD) CODE, THE STUDY EXAMINES THE IMPACT OF REYNOLDS NUMBER RE WITHIN THE RANGE OF 500 TO 2500 AS WELL AS VARIATIONS IN OBSTACLE ARRANGEMENT TYPES (A = 90° AND A = 45°) ON THERMAL EFFICIENCY AND FLOW CHARACTERISTICS IN THE PHE. THE STANDARD K-E TURBULENCE MODEL WAS SELECTED. A GRID INDEPENDENCE STUDY WAS CARRIED OUT TO ESTABLISH THE CFD METHOD'S PRECISION AND CORRECTNESS. THE COMPUTATIONAL FINDINGS WERE COMPARED TO EARLIER EXPERIMENTAL STUDIES TO ENSURE THE APPROACH'S CONSISTENCY. THE INNOVATIVE PHE DESIGN IMPROVED ITS THERMAL EFFICIENCY BY 62% COMPARED TO THE STANDARD CHEVRON-TYPE PHE IN TERMS OF THPP FACTOR.

ID : 167 Steady State tests of Pelton Turbine performance: Mathematical modeling and numerical simulation

I. HAMMADI, L. AYED, A. BOUABIDI

THE ELECTRICAL PRODUCTION OF ENERGY IS A PARTICULAR INTEREST BECAUSE NO CURRENT TECHNOLOGY ALLOWS ITS LARGE-SCALE STORAGE. THUS, THE PRODUCTION OF ELECTRICAL ENERGY FROM THE HYDRAULIC SECTOR PLAYS AN ESSENTIAL ROLE IN THE REGULATION OF DAILY ELECTRICITY PRODUCTION. DIFFERENT NATURAL RESOURCES ARE USED SUCH AS OCEANS; RIVERS AND ACCUMULATION BASINS. THE PELTON TURBINE IS CHARACTERIZED COMPARED TO OTHER TURBINES BY THE EXPLOITATION OF RELATIVELY LOW FLOW RATES (0.5 TO 50 3 1 S M) AND LARGE FALLS (100 AND 2000 METERS). AS A TURBOMACHINE, THE PELTON TURBINE IS CHARACTERIZED BY AN ENERGY EFFICIENCY DEPENDING ON THE DESIGN OF THE INJECTOR; THE NUMBER OF BLADES AND THEIR SHAPES (GEOMETRIC ANGLES AND CONCAVITIES) AS WELL AS THE FLOW CHARACTERISTICS AND STRUCTURE OF WALLS, I.E. (ROUGHNESS AND MECHANICAL PROPERTIES). DURING THE LAST CENTURY, MOST TURBINE RESEARCH HAS FOCUSED ON IMPROVING TURBINE COMPONENTS. THE MAIN OBJECTIVE OF THIS PAPER IS TO ANALYZE THE PERFORMANCE OF PELTON TURBINES UNDER DIFFERENT MONITORING CONDITIONS BY VARYING DIFFERENT PARAMETERS SUCH THE FLOW RATE AND THE FRICTION LOSS.

ID : 173 Development of a Hybrid Sun/LED lighting system-Based multimode Fiber optics

T. MAATALLAH, A. MATAR

POWERING LIGHTING SYSTEMS USING RENEWABLE ENERGY TECHNOLOGIES, SUCH AS SOLAR ENERGY, IS A PROMISING SOLUTION TO IMPROVE HEALTH, PRODUCTIVITY AND BUILDING ENERGY EFFICIENCY. IN THIS RESEARCH, A NOVEL DESIGN FOR A HYBRID SUN/LED LIGHTING SYSTEM HAS BEEN NUMERICALLY INVESTIGATED. THE DESIGN INTEGRATES THE FIBER OPTICS, AS A WAVEGUIDE OF THE SUNLIGHT, TO THE EXISTING ELECTRICAL GRID INFRASTRUCTURE, IN ORDER TO OPTIMIZE THE USE OF NATURAL DAYLIGHT DURING SUNLIGHT HOURS AND SEAMLESSLY TRANSITIONING TO ENERGY-EFFICIENT LIGHT-EMITTING DIODES (LED) WHEN THERE IS NOT ENOUGH LIGHT QUANTITIVELY AND QUALITATIVELY. SIMULATION RESULTS SHOWED AN OVERALL OPTICAL TRANSMISSION EFFICIENCY OF 32% ALONG 10M-LENGTH. MOREOVER, THE LUMINOUS EFFICACY OF THE VISIBLE LIGHT TRANSMISSION WAS EVALUATED BASED ON THE AVERAGE ILLUMINANCE LEVELS ACHIEVED WITHIN INTERIOR SPACES INDICATING SUBSTANTIAL INDOOR LIGHTING ENHANCEMENTS RECORDING 92 LUMENS/WATTS. THE LIGHTING CAPACITY OF THE SYSTEM EXCEEDS THE AVERAGE REQUIREMENT OF A STANDARD OFFICE SPACE BY APPROXIMATELY 30%. THE FINDINGS OF THE PRESENT WORK REPRESENT A SIGNIFICANT ADVANCEMENT TOWARDS THE COMMERCIALIZATION OF FIBER OPTIC DAYLIGHT SYSTEMS (FOD)-BASED FRESNEL LENS.

ID : 177 Effect of the rotating domain diameter on the characteristics of a 2D Savonius rotor

N. RABEH, A. AYADI, Z. DRISS

STRATEGIES TO ENHANCE THE UTILIZATION OF POWER FROM VARIOUS RENEWABLE SOURCES ARE ESSENTIAL FOR MEETING OUR ENERGY NEEDS SUSTAINABLY. WIND ENERGY IS ONE OF THE WORLD'S MOST RAPIDLY EXPANDING ELECTRICITY INDUSTRIES AND MOST EXCITING ALTERNATIVE ENERGY SOURCES. THE SAVONIUS WIND TURBINE IS A VERTICAL AXIS WIND TURBINE UTILIZED TO GENERATE GREEN ENERGY. IN THIS PAPER, A NUMERICAL MODEL OF A SAVONIUS TWO-BLADE 2D WIND TURBINE IS GENERATED TO ESTIMATE THE CHARACTERISTICS OF THE SAVONIUS ROTOR USING THE COMMERCIAL CFD SOFTWARE ANSYS-FLUENT. TO VALIDATE THE NUMERICAL MODEL, CHOOSING THE APPROPRIATE ROTATING DOMAIN IS VARIED TO OBTAIN NUMERICAL RESULTS THAT CORRESPOND WITH EXPERIMENTAL DATA. THREE ROTATING DOMAINS ARE STUDIED IN ORDER TO SELECT THE OPTIMIZED ROTATING DOMAIN. THE STUDY SPECIFICALLY FOCUSES ON THE INVESTIGATION OF AERODYNAMIC FEATURES, INCLUDING THE POWER COEFFICIENT, THE PRESSURE AND VELOCITY DISTRIBUTIONS.

ID : 192 Efficient solar tower modeling : A simplified mathematical approach

H. NASRAOUI, A. AYADI, Z. DRISS, H. KCHAOU

IN THIS PAPER, AN THEORETICAL MODEL OF SOLAR TOWER (ST) WAS DEVELOPED. THIS MODEL PURPOSES TO EVALUATE THE RELATIONSHIP BETWEEN THE GEOMETRICAL PARAMETERS OF SCPP BY CONSIDERING THE OPTIMAL POWER OUTPUT. BASED ON NEWTON RAPHSON METHOD, AN ORDINARY DIFFERENTIAL EQUATION WAS SOLVED TO CALCULATE THE TEMPERATURE RISE UNDER THE SOLAR COLLECTOR FOR AN IMPOSED SOLAR RADIATION. THE POWER OUTPUT IS DETERMINED FROM THE COMBINATION OF THE GLOBAL THERMODYNAMIC PARAMETERS OF THE AIRFLOW CHARACTERISTICS. THE PROPOSED MODEL WAS VALIDATED WITH EXPERIMENTAL DATA OF THE MANZANARES PROTOTYPE. RESULTS CONFIRMED THAT THIS MATHEMATICAL MODEL PRESENTS AN ACCEPTABLE CORRESPONDENCE WITH EXPERIMENTAL DATA.

ID : 196 Study of adsorption and desorption kinetics of a silica gel/air couple

I. HRAIECH, S. BELKHIRIA, L. ZILI-GHEDIRA

IN THE ENERGY AND ENVIRONMENTAL CONTEXT AND GIVEN THE GROWING ENERGY DEMAND DURING INDUSTRIAL PROCESSES AND THERMAL COMFORT, THE INTEREST OF IMPROVING THE PERFORMANCE OF THE INVOLVED SYSTEMS AND THE OPTIMIZATION OF THEIR OPERATIONS ARE ESSENTIAL. THE PRESENT PAPER PRESENTS A COMPREHENSIVE ANALYSIS OF THE ADSORPTION AND DESORPTION ISOTHERMS OF SILICA GELS, A WIDELY USED DESICCANT MATERIAL. ACCURATE CHARACTERIZATION OF ADSORPTION AND DESORPTION BEHAVIORS IS PIVOTAL IN ASSESSING PERFORMANCE ACROSS

VARIOUS APPLICATIONS. IN THIS STUDY, WE EXAMINE MULTIPLE ISO-THERM EQUATIONS PERTAINING TO SILICA GEL'S INTERACTION WITH WATER VAPOR. OUR FINDINGS UNDERSCORE THE HEIGHTENED SIGNIFICANCE OF ADSORPTION CAPACITY, PARTICULARLY AT LOWER TEMPERATURES, AS EVIDENCED BY OUR EXPERIMENTAL RESULTS LED WITH A CLIMATIC WIND TUNNEL. FURTHERMORE, WE ELUCIDATE THAT ADSORPTION AND DESORPTION ISOTHERMS FOLLOW DISTINCT PATHS, EMPHASIZING THE GAP WITH THE HYPOTHETICAL APPROACHES. AN EMPIRICAL CORRELATION THAT LINKS WATER CONTENT TO TEMPERATURE AND RELATIVE HUMIDITY IS INTRODUCED AND COMPARED WITH DIFFERENT THEORETICAL APPROACHES. THIS RESEARCH NOT ONLY ENHANCES OUR UNDERSTANDING OF SILICA GEL'S ADSORPTION PROPERTIES BUT ALSO LAYS THE GROUNDWORK FOR ITS EFFECTIVE UTILIZATION IN APPLICATIONS SUCH AS, ATMOSPHERIC WATER GENERATION, AIR CONDITIONING SYSTEMS AND BEYOND.

ID : 212 Mechanical characteristics of clay composites reinforced with expanded perlite during firing

C. KAIBA, I. BOUMNIJEL, D. MIHOUBI

THIS STUDY AIMED AT PREPARING CLAY COMPOSITES REINFORCED WITH EXPANDED PERLITE AND ASSESSING THEIR MECHANICAL CHARACTERIZATION IN TERMS OF FLEXURE AND COMPRESSION AFTER THE FIRING STEP. THE EFFECT OF DIFFERENT PARAMETERS NAMELY THE FIRING TEMPERATURE, MATERIALS PARTICLE SIZE DISTRIBUTION, AND EXPANDED PERLITE CONTENT ON THE MECHANICAL PROPERTIES OF THE FIRED PRODUCT WAS INVESTIGATED TO HIGHLIGHT THEIR SIGNIFICANT IMPACT ON PRODUCING HIGH-QUALITY CERAMIC MATERIALS. AN EXPERIMENTAL STUDY FOUND THAT CLAY-BASED COMPOSITES REINFORCED WITH 5% EXPANDED PERLITE WITH 160μM PARTICLE SIZE DISTRIBUTION EXHIBITED THE BEST COMBINATION OF STRENGTH AND FLEXIBILITY AND WERE MOST SUITABLE FOR IMPROVING CERAMIC CLAY MATERIALS QUALITY IN CONSTRUCTION ACTIVITIES.

Machine Learning and Deep Learning

ID : 47 Neural network model to identify the dynamic characteristics of the human trunk

S. MEHREZ, F. NAJAR, F. MOALLA

THE USE OF ARTIFICIAL INTELLIGENCE IN BIOMECHANICAL APPLICATIONS REMAINS LIMITED BUT PROMISING. THE STUDY OF THE MECHANICAL BEHAVIOUR OF THE HUMAN TRUNK SEEMS TO BE NECESSARY TO ENHANCE THE DIAGNOSIS AND THE TREATMENT OF PATHOLOGICAL CASES. BUT THE MECHANICAL PROPERTIES OF THE TRUNK ARE VARIABLE AND GENERALLY DIFFICULT TO DETERMINE. THE OBJECTIVE OF THIS WORK IS TO DEVELOP A PHYSICS-INFORMED NEURAL NETWORK MODEL (PINN) IN ORDER TO PREDICT THE PARAMETERS OF THE DYNAMIC EQUILIBRIUM EQUATION OF THE HUMAN TRUNK. THESE PARAMETERS ARE THE STIFFNESS K, THE MASS M AND THE DAMPING

coefficient C. An experimental setup was designed to safely extract a very short sequence of the displacement response of the human trunk to a horizontal force. A Python program was developed for a classic neural network model and another for a model with the PINN technique. Experimental data and additional generated data are used in the training and testing of the neural network model. Results of training and testing showed a high success rate and the final model can effectively predict the parameters K, M and C of the human trunk system. The model with PINN gains in terms of performance and accuracy.

ID : 64 Potential of convolutional neural network for prediction of the ring hoop tensile stress-strain curve for anisotropic tubes

Z. Ktari, A. Khalfallah

It has established that the ring hoop tensile test (RHTT) is a valuable technique for assessing the elasto-plastic behavior of anisotropic metallic tubes in the hoop direction. Nevertheless, the mechanical response obtained from this test is influenced by frictional forces between the ring specimen and the RHTT loading device. This paper presents a novel approach, based on machine learning (ML) techniques, to predict both the actual behavior and the coefficient of friction during RHTT tests along the hoop direction. These ML models are trained using datasets populated with numerical simulation results of the RHTT. Specifically, we employed a range of supervised algorithms, including K-Nearest Neighbors (KNN), Support Vector Machine (SVM), Decision Tree (DT), Random Forest (RF), Gradient Boosting Regression (GBR), Multi-layer Perceptron (MLP), Adaptive Boosting (ADAP) to compare their performance in predicting simultaneously behavior parameters and the frictional coefficient. The ML models were trained by macro-scale force–displacement curves, which are generated from Finite Element Analysis (FEA) and standard mechanical tests. The results show accurate identification of mechanical behavior and of the coefficient of friction using RF model.

ID : 68 Surface roughness prediction of deformed parts by SPIF based on improved deep belief network

S. Akrichi , N. Ben Yahia

In this work, the surface quality of finished parts obtained by Single Incremental Forming (SPIF) was investigated. Experiments tests were performed as a function of sheet thickness, tool path direction, step depth, speed rate, feed rate, and wall angle. The operating mode was affected by a hemispheric steel tool, with a diameter of 10 mm, to obtain a truncated double cone part. On the other hand, a deep learning model based on the optimization parameters of SPIF using Deep Belief Network (DBN) coupled with a back-propagation algorithm was launched to predict surface roughness (Ra).

The Deep Belief Network model showed an advantage in giving more precise values related to very high statistical coefficients (R2 = 0.981). These advantages show the efficiency and performance of the model used.

ID : 169 Fault diagnosis of bearings using Deep learning method

A. Ghorbel, S. Eddai, B. Limam, N. Feki, M. Haddar

Monitoring and diagnosing faults in industrial machinery is crucial during the industry 4.0 revolution, yet it is often complex and labour-intensive. The utilization of artificial intelligence (AI) techniques has become integral to condition monitoring of mechanical and electrical machines due to their rapid computation, increased accuracy, and consistent performance, thereby diminishing the reliance on experienced personnel with specialized knowledge. This paper introduces a fault diagnosis model based on one-dimensional convolutional neural networks (1D-CNN). Initially, raw time series training data collected by sensors are employed. Subsequently, the main steps of training the 1D-CNN model are described. In the third section, test data are utilized to evaluate of loss curve and to investigate the classification accuracy of the method through the representation of confusion matrices. Experimental results demonstrate that the classification accuracy of bearing faults can reach 100% with the developed method. The proposed fault diagnosis approach proves effective in identifying the type of bearing faults.

ID : 188 Effect of sliding speed and normal load on friction responses of brake lining materials

A. Sellami, M. Rekik, R. Elleuch

During braking, it is crucial to comprehend and regulate both the sliding speed and normal load to optimize the performance and durability of braking systems. The primary aim of this study is to investigate the influence of sliding speed and normal load on the tribological behavior of brake lining materials. Experimental findings indicate that sliding speed affect the friction coefficient stability. Subsequently, machine learning and explainable algorithms are developed to establish a friction database model, shedding light on the relationship between brake solicitation and the evolution of the friction coefficient. The Shapley Additive explanation (SHAP) model reveals that sliding speed emerges as the most influential factor, positively affecting the friction coefficient and wear rate of brake lining materials. These findings align well with experimental results, underscoring the importance of understanding and managing sliding speed and normal load in optimizing braking system performance.

ID : 198 Design of reinforcement learning agent for adaptive pull production systems

K. ELLOUMI, A. AMMAR, M. BENAISSA

THE INTEGRATION OF DIGITALIZATION IN PRODUCTION SYSTEMS IS NOW A CRUCIAL REQUIREMENT FOR BOTH NEW AS WELL AS EXISTING SYSTEMS. BY UTILIZING DIGITAL TWINS, WHICH ARE VIRTUAL SIMULATIONS OF ACTUAL PRODUCTION SYSTEMS, WE CAN STREAMLINE ANALYSIS PROCESSES, IMPROVE OUR UNDERSTANDING OF THE SYSTEMS, AND UNLOCK NUMEROUS OPTIMIZATION OPPORTUNITIES. IN TANDEM, INTEGRATING MACHINE-LEARNING METHODS ENABLES THE PROCESSING OF DIGITAL DATA, UNVEILING NOVEL PRODUCTION CONTROL STRATEGIES. THIS PAPER AIMS TO DEVELOP A CONTROL METHOD FOR A PRODUCTION SYSTEM OPERATING IN A DYNAMIC ENVIRONMENT USING REINFORCEMENT LEARNING. THE DESIGNED REINFORCEMENT LEARNING AGENT'S ROLE IS TO MINIMIZE PRODUCTION COSTS IN TERMS OF INVENTORY AND BACKORDERED DEMANDS AND THE DYNAMIC BEHAVIOR OF THE SYSTEM IS ACHIEVED THROUGH DISCRETE EVENT SIMULATION.

ID : 220 Implementation of digital twin in dimensional part inspection

B. ZGHAL, H. DARDOURI

FOLLOWING THE ONSET OF THE FOURTH INDUSTRIAL REVOLUTION, THE DIGITAL TWIN HAS BECOME AN ESSENTIAL PILLAR SUPPORTING PREDICTIVE MAINTENANCE, PROCESS QUALITY CONTROL, AND SYSTEM OPTIMIZATION. THIS RESEARCH AIMS TO DEVISE A CONTROL STRATEGY FOR 'DIMENSIONAL METROLOGY' BY HARNESSING THE DIGITAL TWIN CONCEPT, ENABLING RAPID FAILURE DETECTION AND PREEMPTIVE TOOL REPLACEMENT.

Poster presentations

Applied Mechanics

ID : 80 Finite element analysis of hip stem implant biomechanical behavior

S. ELLEUCH, R. NOUIRA, H. JRAD

THE HIP JOINT SERVES AS A CRUCIAL ANCHOR FOR STRENGTH AND STABILITY WITHIN THE HUMAN BODY. FACTORS SUCH AS AGING OR UNEXPECTED INCIDENTS MAY NECESSITATE EITHER PARTIAL OR COMPLETE REPLACEMENT OF THIS JOINT. HIP ARTHROPLASTY (HA) EMERGES AS THE SURGICAL SOLUTION, INVOLVING THE SUBSTITUTION OF A DAMAGED OR FRACTURED HIP. AN ARRAY OF PARAMETERS INCLUDING SIZE, MATERIAL COMPOSITION AND SHAPE MUST BE CAREFULLY CONSIDERED TO DETERMINE THE OPTIMAL IMPLANT THAT SEAMLESSLY FITS THE PATIENT'S NEEDS. IN THIS WORK, FINITE ELEMENT ANALYSIS IS EMPLOYED TO SIMULATE BOTH THE FEMORAL STEM AND THE FEMUR. STRESS AND DEFORMATION SERVE AS CRITICAL MECHANICAL METRICS IN ASSESSING THE EFFICACY OF THE IMPLANT. MEANWHILE, THE DURABILITY AND PERFORMANCE OF THE IMPLANT DEPENDS ON THE DESIGN AND CHOICE OF MATERIALS. THE PRIMARY OBJECTIVE OF THIS RESEARCH IS TO IDENTIFY THE MOST APPROPRIATE MATERIAL FOR THE HIP STEM THROUGH EXPERIMENTATION.

Materials

ID : 27 Mechanical behavior of Fe-TiB2 Steel matrix composite

H. JRAD, A. BOUHAMED, M. DAMMAK

STEEL COMPOSITES REINFORCED WITH TITANIUM PARTICLES (TIB2), PRODUCED THROUGH EUTECTIC SOLIDIFICATION, EXHIBIT A NOTABLY HIGHER SPECIFIC STIFFNESS IN COMPARISON TO TRADITIONAL STEELS. THIS COMPOSITE VARIANT PROVIDES AN INNOVATIVE AVENUE FOR ENHANCING THE MECHANICAL AND MICROSTRUCTURAL PROPERTIES OF MATERIALS, PARTICULARLY BENEFICIAL FOR THE TRANSPORTATION INDUSTRY. COMPONENTS COMPOSED OF LOW-DENSITY STIFFNESS WITH A HIGH YOUNG'S MODULUS CAN LEAD TO SUBSTANTIAL WEIGHT SAVINGS. THIS STUDY SPECIFICALLY FOCUSES ON ANALYZING THE HARDENING BEHAVIOR OF TIB2-REINFORCED STEEL MATRIX COMPOSITES, FEATURING A 12% VOLUME FRACTION OF TIB2, DURING SIMPLE SHEAR TESTS UP TO LARGE PLASTIC STRAINS. REVERSE AND MONOTONIC SIMPLE SHEAR TESTS ARE CONDUCTED, AND AN ELASTOPLASTIC CONSTITUTIVE MODEL INCORPORATING MIXED (ISOTROPIC AND KINEMATIC) HARDENING IS DEVELOPED AND IMPLEMENTED USING THE UMAT SUBROUTINE TO ACCURATELY CHARACTERIZE THE MATERIAL'S RESPONSE. MECHANICAL TESTS ARE PERFORMED ON HOT-ROLLED FE-TIB2 COMPOSITES TO HIGHLIGHT THE MATERIAL'S PROPERTIES DURING SHEAR LOADING TESTS. VALIDATION OF THE NUMERICAL MODEL IS ACHIEVED BY COMPARING STRESS-STRAIN CURVES OBTAINED THROUGH SIMULATIONS WITH EXPERIMENTAL MEASUREMENTS. THE MODEL PREDICTIONS DEMONSTRATE A HIGH LEVEL OF AGREEMENT, PARTICULARLY UNDER REVERSE SHEAR LOADING CONDITIONS.

ID : 75 Numerical investigation of hyperelastic behavior in recycled rubber/aluminum powder composite

A. BOUHAMED, H. JRAD

DEVELOPMENT OF NEW RECYCLED RUBBER/ALUMINUM POWDER COMPOSITES IS GAINING TRACTION DUE TO THEIR POTENTIAL TO COMBINE THE ENVIRONMENTAL BENEFITS OF RE-CYCLED RUBBER WITH THE ENHANCED PROPERTIES PROVIDED BY ALUMINUM. THESE COMPO-SITES OFFER A SUSTAINABLE AND HIGH-PERFORMANCE ALTERNATIVE FOR VARIOUS APPLICATIONS. THE INCORPORATION OF RECYCLED RUBBER AND ALUMINUM POWDER INTO POLYMER MATRICES NOT ONLY ENHANCES SUSTAINABILITY BUT ALSO FOSTERS THE DEVELOPMENT OF DURABLE, ENVI-RONMENTALLY FRIENDLY, AND HIGH-PERFORMANCE COMPOSITE MATERIALS. THESE MATERIALS HOLD PROMISE FOR APPLICATIONS IN CONSTRUCTION AND BEYOND, OFFERING VERSATILE SOLU-TIONS TO VARIOUS ENGINEERING CHALLENGES. IN THIS CONTEXT, THE PRESENT STUDY DELVES INTO THE HYPERELASTIC BEHAVIOR OF THIS ADVANCED COMPOSITE MADE OF RECYCLED RUB-BER MATRIX REINFORCED WITH DIFFERENT VOLUME FRACTIONS OF ALUMINUM POWDER. AN OP-TIMIZATION ALGORITHM IS USED TO IDENTIFY THE HYPERELASTIC PARAMETERS OF RECYCLED RUBBER/ ALUMINUM POWDER COMPOSITE FOR DIFFERENT VOLUME FRACTIONS OF ALUMINUM CONTENT. THEN, THE FOCUS OF THIS STUDY LIES IN ITS APPLICATION TO THREE-POINT BENDING PROCESS, TO ANALYZE THE INFLUENCE OF ALUMINUM POWDER REINFORCEMENT ON VON MIS-ES STRESS DISTRIBUTION.

ID : 115 The difference between phase change materials from the perspective of thermo-physical properties

I. JMAL, Z. DRISS

THE USE OF PHASE CHANGE MATERIALS (PCM) SUCH AS OCTADECANE (C18 (C18H38), RT27...) ENHANCES THE THERMAL STORAGE CAPACITY OF SOLAR THERMAL COLLECTORS DUE TO ITS REMARKABLE ENERGY STORAGE DENSITY, PARTICULARLY IN THE FORM OF LATENT HEAT DURING THE SOLID-LIQUID OR LIQUID-SOLID PHASE TRANSITION AT CONSTANT TEMPERATURE. IN THIS REGARD, THIS STUDY FOCUSES ON THE COMPARISON BETWEEN TWO PCMS: C18 AND RT27 FROM THE PERSPECTIVE OF THEIR THERMO-PHYSICAL PROPERTIES, PRIMARILY THEIR THERMAL CONDUCTIVITY, WITH THE AIM OF SELECTING THE MOST SUITABLE PARAFFIN WITH THE HIGHEST THERMAL CONDUCTIVITY FOR USE IN AN AIR-PCM HEAT EXCHANGER TO STORE OR RE-LEASE MORE THERMAL ENERGY. THE FIRST PART INVOLVES CLASSIFYING PCMS AND THEIR THERMO-PHYSICAL PROPERTIES. ADDITIONALLY, THIS RESEARCH EXAMINES THE RATIONALE FOR CHOOSING RT27 PARAFFIN, FOLLOWED BY A COMPARISON BETWEEN THE TWO PARAFFINS C18 AND RT27, AND CONCLUDES WITH A CONCLUSION.

ID : 135 Study of the sensitivity of a brake lining material to sliding speed and contact pressure

M. Baklouti, A-L. Cristol, Y. Desplanques, R. Elleuch

Frictional brake pads have always a key role in effective and safe braking performance. Thus, brake lining materials have to present some indispensable properties for braking response. In the present work, an automotive brake lining material was characterized using microscopic observations, thermophysical measures, monotonic compression and friction tests. As a result, the material was composed of a large number of ingredients, having different natures and shapes for complementary roles. Two mechanical responses via monotonic compression tests and thermophysical characterization realized on specimens taken from brake lining material in transverse and normal directions were distinguished. This approach aims to highlight the impact of the manufacturing process on the various properties of the brake lining material. Furthermore, friction tests using a pin-on-disc tribometer were conducted to study the sensitivity of the material to sliding speed and pressure. Results show that its sensitivity due to the sliding speed is a little more important than that to the applied loading and it can be impacted with heterogeneous properties in the two directions.

ID : 154 Importance of drying for enhanced quality of recycled PA6 and PA66

I. Ben Amor, M. Baklouti, O.Klinkova, I. Tawfiq, R. Elleuch

Polyamide manufacturing waste is often mechanically grinded and reinjected for economic and environmental purposes. However, the presence of humidity and impurities can cause significant damage leading to a loss of properties. Thanks to expertise carried out as part of this study, manufacturing defects linked to hygroscopicity are among the essential causes of production rejects. Thus, the study of the role and necessity of drying, as an intermediate step in the preparation of the material before injection, is gaining importance. Mechanical and thermal characterization is conducted on dry and wet samples of virgin and recycled polyamide polyamide 6 (PA6) and polyamide 66 (PA66). Results show that moisture significantly affects material properties, leading to decreased mechanical strength and altered thermal behavior. Recycling introduces further complexities, with variations observed in recycled PA compared to its virgin state. Injection molding simulations are performed to assess the impact of PA6 characteristics on the process parameters. Overall, this study emphasizes the importance of proper drying procedures for both virgin and recycled PA6 and PA66 to enhance material quality and sustainability in polymer recycling practices.

ID : 162 Valorization of Grapevine fibers in biocomposites

M. KHLIF, M. FRIKHA, F. TOUNSI

THE ESCALATING ISSUE OF PLASTIC POLLUTION NECESSITATES THE EXPLORATION OF SUS-TAINABLE AND ECO-FRIENDLY ALTERNATIVES. THIS RESEARCH INVESTIGATES THE POTENTIAL OF GRAPEVINE FIBERS, AN ABUNDANT AGRICULTURAL WASTE PRODUCT IN TUNISIA, AS RE-INFORCEMENT IN HIGH-DENSITY POLYETHYLENE (HDPE) BIOCOMPOSITES. THE STUDY ENCOMPASSES A DETAILED ANALYSIS OF THE PHYSICOCHEMICAL PROPERTIES OF GRAPE-VINE FIBERS, THE FABRICATION PROCESS OF HDPE/GRAPEVINE FIBER BIOCOMPOSITES, AND A THOROUGH EVALUATION OF THEIR MECHANICAL, THERMAL, AND MORPHOLOGICAL CHARACTERISTICS. THE INFLUENCE OF FIBER CONTENT AND THE INCORPORATION OF A MA-LEIC ANHYDRIDE GRAFTED POLYPROPYLENE (MAPP) COUPLING AGENT ON THE PERFOR-MANCE OF THE BIOCOMPOSITES ARE ALSO EXAMINED.

ID : 194 Durability of splint arm manufactured by the FFF 3D printing technology

A. GHORBEL, A. TRAORE, A. ELLOUMI

THE OBJECTIVE OF THIS WORK WAS TO EVALUATE AND COMPARE THE DURABILITY OF 3D PRINTING POLYLACTIC ACID AND THE CHANGES IN MECHANICAL AND FRACTURE BEHAVIORS DUE TO SWEAT AND WATER ABSORPTION. BEAM WERE PRINTED IN EDGE DIRECTION WITH DIFFERENT ANGLE (0°,45°,90°) AND 60% OF DENSITY. BEAMS WERE IMMERSED IN WATER AND SWEAT FOR 15 DAYS. THE FFF SPECIMENS' BEHAVIOR ARE INVESTIGATED VIA MECHANICAL TESTING (FLEXURAL TEST), AS WELL AS THROUGH OPTICAL ANALYSES BEFORE AND AFTER AGING. A DIRECT RELATIONSHIP BETWEEN SWEAT AND WATER ABSORPTION AND REDUCTION IN FLEX-URAL PROPERTIES WAS OBSERVED FOR THE PLA SPECIMENS, WITH THE FLEXURAL MODULUS DECREASING AFTER 15 DAYS OF IMMERSION. THE MOST SIGNIFICANT REDUCTIONS WERE OB-SERVED FOR SPECIMENS PRINTED WITH 45° AND IN WATER ENVIRONMENTAL AGING. THE BEST CHOICE OF THE RASTER ANGLE FOR THE SPLINT ARM MANUFACTURING IS 0°.

ID : 197 Relevant parameters for morphological analysis of brake lining surface after friction

M. BAKLOUTI, A. L. CRISTOL, Y. DESPLANQUES, R. ELLEUCH

IN THE CASE OF BRAKING, THE OBTAINED RUBBED SURFACES ARE HIGHLY HETEROGENEOUS. LOAD-BEARING PLATES ARE FORMED AND CONSTITUTE THE SITES OF ENERGY DISSIPATION AND SLIDING VELOCITY ACCOMMODATION. THEIR ARRANGEMENT IN THE CONTACT CONSTITUTES A KEY FACTOR FOR THE UNDERSTANDING OF FRICTION-INDUCED PHENOMENA AND BRAKING PERFORMANCE. WITHIN THIS FRAMEWORK, A MORPHOLOGICAL CHARACTERIZATION METHOD HAS BEEN SET UP BASED ON SEVERAL MEASUREMENT TECHNIQUES TO EXPLORE THE MACROSCOPIC AND MICROSCOPIC CONTACT SITUATION OF THE PAD-DISC SYSTEM. IT CAN BE SEEN THAT THE FLAT PLATES HAVE PREFERENTIAL LOCATIONS WHICH GIVE A PARTICULAR LOAD-BEARING ARRANGEMENT TO THE RUBBED PAD-DISC INTERFACE LINKED TO THE FRICTION AND WEAR MECHANISMS. RESULTS SHOW

THAT MORE SECOND PLATES AND FEWER CAVITIES EXIST IN THE BOTTOM AND THE OUTPUT OF THE DISC-PAD CONTACT. RESULTS REVEAL ALSO THE MORE APPROPRIATE SCALES DESCRIBING THE MORPHOLOGY OF THE RUBBED SURFACE.

ID : 206 Valorization of biomass to develop an eco-friendly packaging film

A. FAJRAOUI, A. GHORBEL, A. ELLOUMI

BIOMASS IS A FUNDAMENTAL ELEMENT OF HEALTHY ECOSYSTEMS, DELIVERING ESSENTIAL SERVICES CRUCIAL FOR LIFE ON OUR PLANET.THIS WORK INVOLVED BLENDING STARCH (S) WITH SPENT COFFEE GROUNDS (SCG), ONE OF THE ABUNDANT BIOMASS IN NATURE, AT CONCENTRATIONS RANGING FROM 10% TO 30% TO PRODUCE BIOFILMS VIA THE CASTING METHOD. INVESTIGATION INTO THE CHEMICAL COMPOSITION, ELEMENTARY COMPOSITION AND STRUCTURE OF THESE FILMS WAS CONDUCTED. RESULTS SHOW THAT SCG WAS RICH IN ORGANIC AND INORGANIC COMPOUNDS. ALSO, THE RESULTS INDICATED THAT HIGHER CONCENTRATIONS OF SCG (30%) SATURATED THE FILMS, WHILE FT-IR ANALYSIS REVEALED NO NOTABLE CHANGES ACROSS VARYING SCG CONCENTRATIONS. VISUAL APPEARANCE OF THE BIOFILMS SHOWS THAT THE SCG WERE DISTRIBUTED UNIFORMLY AT THE SURFACE OF THE FILMS EXCEPT A FILM AT 30%.

ID : 207 Effect of Layer thickness on friction and wear properties of FFF printed PLA samples

B. BEN DIFALLAH, A. GHORBEL, O. GORBEL, A. ELLOUMI, M. KHARRAT

FUSED FILAMENT FABRICATION (FFF) OR FUSED DEPOSITION MODELLING (FDM) IS BETWEEN THE MOST COMMON TECHNIQUES OF ADDITIVE MANUFACTURING PROCESSES. COMPONENTS PROCESSED BY (FFF) MAY BE USED AS PROTOTYPES OF CONCEPT DESIGN AND IN MOST CASES ARE NOT ABLE TO BE USED AS FUNCTIONING PARTS DUE TO THEIR POOR MECHANICAL AND TRIBOLOGICAL PROPERTIES. THE FFF PRINTING PARAMETERS MAY AFFECT THE TRIBOLOGICAL PROPERTIES OF PRINTED MATERIALS DUE TO THE NATURE OF MANUFACTURING TECHNIQUE. IN THIS WORK, THE TRIBOLOGICAL PROPERTIES OF 3D PRINTED SAMPLES, PRINTED AT DIFFERENT LAYER THICKNESS, ARE INVESTIGATED. FFF POLYLACTIC ACID (PLA) SAMPLES ARE PRINTED AT 0.12 MM, 0.20 MM AND 0.28 MM. FRICTION TESTS ARE CONDUCTED ON A BALL ON FLAT RECIPROCATING TRIBOMETER APPARATUS UNDER DRY SLIDING CONDITION AND A NORMAL LOAD OF 7.62N. THE INCREASE IN LAYER THICKNESS INCREASED ROUGHNESS OF SAMPLES AND DECREASED THE FRICTION AND WEAR PARAMETERS. THE BEST TRIBOLOGICAL PERFORMANCES ARE OBTAINED WITH 0.28 MM LAYER THICKNESS.

ID : 208 Development of intelligent biofilm made from starch/curcuma for food packaging

A. Fajraoui, A. Ghorbel, A. Elloumi

This research focused on creating an environmentally friendly food packaging film with pH sensitivity using corn starch and curcumin through the casting method. Curcumin, after being dissolved in ethanol, was combined with various amounts of starch and glycerol (ranging from 2.5% to 12.5%) to produce the smart film. The study examined color changes in the curcumin solution across pH levels (pH 3–11) and conducted structural analysis using FTIR spectroscopy. Mechanical properties and transparency were also evaluated. Results showed that adding curcumin notably improved the mechanical strength of the starch film. Color analysis demonstrated a shift from yellow to reddish hues with increasing pH, while lower curcumin concentrations led to uniform film color, increased transparency, and clear pH sensitivity.

ID : 209 Exploring the hot-diffusion bonding of stainless steel/aluminum/stainless steel-clad plate: Microstructural insights and deep drawing simulation

Y. Gabsi, S. Zouari, M. Abdennadher, L. Dieng, R. Elleuch

A tri-metal stainless-steel/aluminum/stainless-steel (SS/Al/SS) cladding plate, with an aluminum alloy interlayer, was fabricated using hot-diffusion bonding technique. Interface analyses and a deep drawing simulation of the obtained sandwich sheet, providing insights into the efficiency of the bonding and the formability, were investigated. The results reveal that the clad plate has a well-bonded and uniform interface. The simulation study indicates that the modeled clad plate possesses a good formability, suggesting its potential applicability in various industrial application which require deep drawing process.

ID : 228 In vitro study of the tribological properties of an antibacterial dental composite

R. Chaaben, K. Elleuch

This study examines the wear performance of poly(methyl methacrylate) (PMMA) reinforced with Salvadora persica (S. persica) and hydroxyapatite (HA) for dental applications. Various filler percentages were tested to enhance the composite's wear resistance. Wear tests were performed using a pin-on-disc tribometer with artificial saliva, utilizing a 6 mm diameter Alumina ball as the counterface. The tests were conducted under loads of 5 N and 10 N, with a sliding velocity of 300 rpm for 2 hours. Both wear volume and friction coefficient were measured, focusing on the impact of

DIFFERENT FILLER PERCENTAGES. THE RESULTS REVEALED THAT INCORPORATING FILLERS INTO THE PMMA MATRIX SIGNIFICANTLY IMPROVED THE COMPOSITE'S WEAR RESISTANCE.

Thermal Sciences and Renewable Energy

ID : 189 Theoretical and Experimental Study of the Combustion-Incineration of Atmospheric Effluents Generated by Wood Carbonization

T. GARGOURI

A THEORETICAL STUDY OF THE INCINERATION OF WOOD CARBONIZATION SMOKE AND THE ACCOMPANYING PHYSICAL PHENOMENA HAS BEEN CONDUCTED. THE TRANSFER EQUATIONS COUPLED WITH REACTION KINETICS AND RADIATIVE TRANSFERS ARE SOLVED USING AN IMPLICIT FINITE DIFFERENCE METHOD AND THE ZONE METHOD. THE THEORETICAL STUDY HIGHLIGHTED THE INFLUENCE OF RADIATIVE TRANSFERS, EXCESS AIR, AND SMOKE FLOW RATE ON THE EVOLUTION OF TEMPERATURE AND CONCENTRATION FIELDS DURING THE INCINERATION PROCESS. THE RESULTS NOTABLY SHOW THAT THE THERMODESTRUCTION OF POLLUTING EFFLUENTS OCCURS IN THE ENTRY ZONE OF THE INCINERATOR.

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