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## ABSTRACT BOOK

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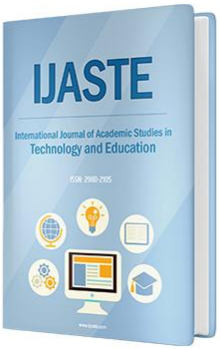


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# DEVELOPMENT AND CHARACTERIZATION OF CELLULAR MATERIALS BASED ON CONSTRUCTION WASTE

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**Abstract:** Construction waste such as plaster, concrete blocks, glass, and concrete is classified as inert mineral waste, non-hazardous, and non-biodegradable. Their accumulation causes significant visual and environmental nuisances. Recycling and valorization of these materials constitute the most appropriate solution to address this genuine problem. This research work aims to develop an innovative cellular material through the valorization of flat glass and mortar waste. The cellular material was fabricated using 1% calcium carbonate, cullet (recycled glass), and varying percentages of mortar waste. The powdered mixture was thoroughly homogenized and then pressed at 100 kN to form 40 mm diameter pellets, which subsequently underwent sintering at 900°C. Various physicochemical and mechanical characterization techniques were employed, including density and porosity measurements, flexural and compressive strength tests, chemical resistance analysis, as well as X-ray diffraction (XRD) and scanning electron microscopy (SEM) examinations. The results demonstrate remarkable lightweight properties (density ranging from 0.214 to 0.610 g/cm³), high porosity (62.20 to 89.05%), and an amorphous nature confirmed by XRD. These promising findings highlight the potential for mortar waste valorization in producing cellular glass materials intended for building thermal insulation applications.

**Keywords:** glass waste, mortar waste, cellular material, valorization, recycling

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# SYNTHETISIS AND CHARACTERIZATION OF $COFE_2O_4$ NANOMATERIALS PREPARED BY THE ULTRASONICSPRAY PYROLYSIS TECHNIQUE

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**Abstract:** Cobalt ferrite ($CoFe_2O_4$) nanomaterials are attractive due to their magnetic behavior as well as their excellent structural, morphological, optical, and electrical properties. These characteristics make them suitable for a wide range of applications, including environmental remediation, energy conversion, and energy storage. In this study, thin films of cobalt ferrite ($CoFe_2O_4$) nanoparticles were successfully synthesized using the ultrasonic spray pyrolysis (USP) technique. This method is notable for its simple experimental setup, low cost, and ease of use. A precursor solution composed of ferric nitrate and cobalt nitrate was sprayed onto a glass substrate preheated to 450 °C. X-ray diffraction (XRD) analysis confirmed the formation of a single-phase cubic spinel structure. Using the Scherrer equation and the most intense diffraction peak ((311) plane), the average crystallite size was estimated to be approximately 26 nm, confirming the nanocrystalline nature of the deposited films. Scanning electron microscopy (SEM) revealed a well-developed surface morphology characterized by agglomerated fine spherical particles of uniform size. This agglomeration behavior indicates the magnetic nature of the synthesized $CoFe_2O_4$ thin films. Energy-dispersive X-ray spectroscopy (EDAX) confirmed that the USP technique enables the deposition of homogeneous and highly stoichiometric $CoFe_2O_4$ layers. Electrical characterization showed relatively high resistivity, on the order of $5.08 \times 10^3$ Ω·cm. The optical analysis demonstrated a high absorption coefficient, close to $10^4$ $cm^{-1}$, and an estimated optical band gap of 2.18 eV. Photoluminescence (PL) measurements at room temperature indicated visible light emission with three distinct peaks attributed to violet, blue, and green emissions. Finally, vibrating sample magnetometry (VSM) analysis revealed that the prepared $CoFe_2O_4$ thin films exhibit soft ferromagnetic behavior.

**Keywords:** nanomaterials, $cofe_2o_4$, synthesis, environment, ultrasonic spray pyrolysis (usp)

# DYNAMIC PROCESSES IN HYDRAULIC SYSTEMS DURING SIMULTANEOUS OPERATION OF A PRESSURE RELIEF AND PRESSURE REDUCING VALVE

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**Abstract:** The pressure control valves can perform different functions in the hydraulic systems, such as establishing a maximum pressure, reducing pressure in some circuit lines, and establishing sequence movements, among other functions. The pressure control valves are usually named according to their primary functions, and their basic function is to limit or to determine the pressure of the hydraulic system for the attainment of a certain function of the equipment in motion. In order to protect a hydraulic circuit against overloads and limit the work pressure, pressure relief valves are used. The main function of theses valves is to limit the maximum working pressure in the hydraulic system. They are normally positioned after the hydraulic pump. However, many times, there are hydraulic circuits where diverse lines are fed by one same source, but it must work at different levels of pressure. For this reason, pressure reducing valves are used. The main function of these valves is to maintain a preset downstream reducing pressure regardless of changing upstream pressures. This paper deals with modelling and simulation of dynamic processes in hydraulic system with simultaneous operation of a directly operated pressure relief valve and a directly operated three-way pressure reducing valve. A comprehensive nonlinear mathematical model is deduced in order to predict the performance of the studied system. The proposed model takes into consideration most nonlinearities of the studied valves. A computer simulation, based on the proposed model, is performed to predict the transient performance of the system. The validity of the proposed model is assessed experimentally in the transient mode of operation. The results show significant agreement between simulation and experiments.

**Keywords:** pressure relief valve, pressure reducing valve, dynamic process, hydraulic system

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**ANTIOXIDANT AND IMMUNOMODULATORY ACTIVITIES OF PAPAVER RHOEAS**

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**Abstract:** Papaver rhoeas belongs to the family of Papaveraceae and has been used since ancient times for its healing properties. This work aims to evaluate the antioxidant and immunomodulatory activities of P. rhoeas hydromethanolic extract. Total polyphenol and flavonoid contents were determined using Folin-Ciocalteu reagent and aluminium chloride assays, respectively. The antioxidant potential was assessed using free radical scavenging activity against 2,2-diphenyl-1-picrylhydrazyl (DPPH), with BHT as a standard. The effect of P. rhoeas extract on the humoral immune response was evaluated in vivo in mice injected with sheep red blood cells (SRBC). The total phenolic and flavonoid contents of P. rhoeas extract showed 79.64 ± 5.09 µg GAE/mg and 11.07 ± 0.52 µg QE/mg of dry weight of extract, respectively. The hydromethanolic extract of P. rhoeas exhibited a strong scavenging activity against DPPH radical (IC50 = 104.33 ± 3.05 µg/ml) compared to BHT. The immunomodulatory activity showed that the treatment with P. rhoeas extract at the dose of 200 mg/kg demonstrated a significant increase in antibody titre (210.44 ± 24.38), while at the dose of 400 mg/kg showed a decrease in this titre (107.55 ± 13.38). In conclusion, the hydromethanolic extract of P. rhoeas has potent antioxidant and immunomodulatory activities.

**Keywords:** dpph, flavonoids, immunomodulatory, papaver rhoeas, polyphenols

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# INVESTIGATION OF THE DEFORMATION SCHEMES OF DURING ASYMMETRIC ROLLING IN RELIEF ROLLS

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**Abstract:** This paper presents the issue consideration results of obtaining thick-sheet blanks with an increased processing level. Based on the review conducted in this paper, a new technology of thick-sheet rolling was proposed, which consists in deforming the workpiece in rolls with a relief surface that have a geometric or velocity factor of asymmetry. As a result, shear strain in both transverse and longitudinal directions is intensified in one pass. Finite element modeling of the microstructure evolution of a copper billet during asymmetric rolling in relief rolls according to various technological schemes was performed. The following technological schemes of deformation were proposed: 1) the workpiece after the first pass of deformation is re-fed into relief rolls with 180° edging along the axis; 2) the workpiece after the first pass of deformation is re-fed into relief rolls without any changes; 3) the workpiece after the first pass of deformation is re-fed into relief rolls with a transverse shift for the relief period. A comparison of the simulation results showed that deformation with a 180° rotation of the workpiece between passes significantly reduces the influence of the asymmetry factor. This is reflected in the level of grain grinding and its more uniform distribution. Deformation without changing the position of the workpiece between the passes has the opposite effect, such a scheme significantly increases the influence of the asymmetry factor. Deformation with transverse displacement of the workpiece during the unloading period between passes has the effect of a "golden mean".

**Keywords:** rolling, relief rolls, asymmetry, simulation, microstructure evolution

# A VARIANT OF IMPROVING THE EXISTING TECHNOLOGICAL DEFORMATION SCHEME "RADIAL-SHEAR ROLLING WITH BACKPRESSURE"

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**Abstract:** One of the most effective ways to obtain ultrafine-grained materials is severe plastic deformation, which can be realized in metals in various ways, including radial-shear rolling (RSR), or various combined processes based on RSR. One of these combined processes is back-pressure RSR with additional ultrasonic vibration superposition, which was developed as part of the AP26100119 grant project. The purpose of this work was to conduct a comparative analysis of the influence of RSR and various RSR based combined processes on the microstructure evolution. The following processes were modeled: RSR and combined processes: RSR–ECAP; RSR with additional superposition of ultrasonic vibrations. Analysis of the simulation results showed that after the RSR, the initial grain size decreased from 30 to 20 μm in the surface zone and to 28 μm in the central zone. With the combined RSR–ECAP process, due to the implementation of additional shear deformation in the equal-channel step matrix, the initial grain size decreased from 30 μm to: 17 μm (surface), 22 μm (center). In the case of backpressure RSR, due to additional compression in the calibration conical die, the initial grain size decreased from 30 μm to: 18 μm (surface), 23 μm (center). With the back pressure and additional ultrasonic vibration, the grain size decreased from 30 μm to: 19 μm (surface), 23 μm (center). The force required to push the workpiece through equal-channel stepped and conical dies was also analyzed. An analysis of the force measurement results showed that at almost the same level of grain refinement, the value of the force pushing the workpiece through a conical die when ultrasonic vibrations are applied to it is on average 42% less than when using this die without ultrasonic vibrations and almost 205% lower than when pushing the workpiece through an equal-channel step matrix

**Keywords:** radial-shear rolling, combined process, ultrasonic vibrations, equal-channel step matrix, calibrating conical matrix, microstructure

# OPTIMIZATION OF PRODUCTION PROCESSES BY DEFINING PRIORITIES WITH ANALYTIC HIERARCHY PROCESS (AHP)

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**Abstract:** This paper explores the application of the Analytic Hierarchy Process (AHP) as a systematic methodology for optimizing manufacturing processes by defining strategic priorities. The research focuses on addressing the challenge of efficient allocation of limited resources in modern manufacturing environments, where multi-criteria decision-making is becoming increasingly complex. The paper develops a complete AHP model that includes four levels of hierarchical structure: strategic goal, main criteria (cost, quality, time, safety and sustainability), sub-criteria and alternative improvement strategies. Through the application of comparison matrices and mathematical calculations of priorities, the model allows for a quantitative assessment of four key alternatives: process automation, implementation of Lean methods, advanced data analysis and personnel training. The research results indicate that the implementation of Lean methods receives the highest priority (0.372), followed by advanced data analysis (0.285), automation (0.215) and training programs (0.128). These findings reveal the importance of balancing short-term operational improvements with long-term strategic investments. The case study demonstrates how the AHP methodology provides a transparent and demonstrable approach to decision-making, enabling better resource management and reducing subjectivity in the decision-making process. Sensitivity analysis confirms the robustness of the results and their applicability in real production conditions.

**Keywords:** ahp, optimization, production processes, multi-criteria decision making, prioritization

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# APPLICATION OF ARTIFICIAL INTELLIGENCE FOR THEORETICAL PREDICTION OF MECHANICAL PROPERTIES IN FILAMENT-WOUND COMPOSITE TUBES

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**Abstract:** This paper presents a theoretical and analytical framework for predicting the tensile strength of composite tubes manufactured using filament winding technology, by applying Design of Experiments (DoE) and simulated analysis based on artificial intelligence (AI) principles. In the experimental phase, eight composite tube specimens were produced and tested, following a full factorial DoE matrix with three technological parameters: winding speed, fiber tension, and winding angle. Tensile strength was measured for each specimen using standardized mechanical testing procedures. Based on the obtained results, a simulated AI prediction was conducted, proposing theoretical tensile strength values within ±5% variation, as a conceptual representation of a possible machine learning model (e.g., Random Forest or Artificial Neural Network). The purpose of this simulation is to demonstrate the potential of AI-based models to predict mechanical properties for new combinations of input parameters—without the need for additional physical testing. The findings suggest that, with a valid DoE-based dataset, machine learning could significantly reduce the number of experiments, time, and resources required for the development and optimization of composite structures.

**Keywords:** composite tubes, filament winding, artificial intelligence, design of experiments, tensile strength

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# EXPERIMENTAL DATA AND THERMODYNAMIC MODELING OF THE LIQUID-LIQUID EQUILIBRIUM TERNARY SYSTEM (WATER + 2-PROPANOL + FLUOROBENZENE) AT SEVERAL TEMPERATURES

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**Abstract:** Liquid–liquid equilibrium (LLE) plays a central role in the understanding and optimization of separation processes involving immiscible or partially miscible liquids. Accurate LLE data are required for the design of efficient extraction and purification operations, particularly when dealing with ternary mixtures that include alcohols and aromatic hydrocarbons. In this work, new experimental solubility and LLE data for the ternary system (water + isopropanol + fluorobenzene) were determined at three temperatures, T = (288.15, 298.15, and 308.15) K, under atmospheric pressure (P = 101.2 kPa). The equilibrium compositions of the coexisting liquid phases were measured using a thermostated glass cell, and the concentrations were analyzed by gas chromatography. The internal consistency of the data was verified through the Hand and Othmer–Tobias correlations. Phase diagrams and binodal curves were established, and the distribution coefficients and selectivity of fluorobenzene were assessed. The experimental results were correlated with activity coefficient models (NRTL and UNIQUAC), providing good agreement with the measured data. These findings contribute to a deeper understanding of phase behavior in ternary aqueous–organic mixtures and offer valuable information for the design of industrial separation processes involving fluorinated aromatics.

**Keywords:** lle, solubility, water, fluorobenzene, isopropanol, nrtl model, uniquac model

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# STATISTICAL REFINEMENT OF LANTHANUM RECOVERY INNITRATE MEDIUM BY NANOFILTRATION PROCESS

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**Abstract:** Thenanofiltration experiments of lanthanum recovery in nitrate medium by using the nanofiltration pilot were carried out. The experimentaldata were treated by using experimental designs namely the basic$3^3$ factorial designand the industrial designs as Box-Behnken and Taguchi. The data treatment was achieved by using statistical tools (Fisher and Student) for the understanding between accuracy and precisely in the results obtained experimentally. Also, to determine the controllable (signal) and uncontrollable (noise) experimental factors which influence the nanofiltration process and to predict the optimum conditions of lanthanum recovery with the best response. In fact, the statistical refinementshowed that the Box-behnken model is the most appropriate model to describe our experimental results of lanthanum recoveryby the nanofiltration process. Thus, the reduced cubic Box-Behnken model gave a predicted optimum retention (98.55%) with adesirability of 100% close to that obtained experimentally (98.44%) taking into account transmembrane pressure, metal ion concentration and counter-ion concentration as the most tree experimental factors. Modeling by basic$3^3$factorial designs showed that the maximum retention expected is 98.74%. This result is close to that found experimentally (100%) considering the experimental deviation (±1.15), obtained in the absence of the counter-ion. Whereas, Taguchi's designshowed that the used model (L4) is significant and that there is no chance thatmodel occurring due to noise (low F-value). However the error variance due to uncontrollable factors was1.24% < 5% of riskbutthe percentage of error contribution (11.61%) was greater than 5% (admissible risk). This shows that the model chosen (L4) will not enable us to describe our experimental results accurately and precisely.

**Keywords:** nanofiltration, la(iii), modeling, basic design 33, box-behnken, taguchi

# INSTITUTIONAL AND CULTURAL CONSTRAINTS ON BUSINESS AND COMPETITIVE INTELLIGENCE ADOPTION IN ALBANIA'S ENERGY SECTOR

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**Abstract:** Albania's energy sector is undergoing rapid transformation driven by market liberalization, EU compliance obligations, climate-related risks, and digital modernization. In this shifting landscape, Business Intelligence (BI) and Competitive Intelligence (CI) represent vital tools for improving operational efficiency, regulatory oversight, forecasting accuracy, and strategic resilience. Despite this, BI and CI adoption across Albanian institutions such as OSHEE Group, KESH, OST, ERE, private renewable developers, and energy service providers remains fragmented and inconsistent. This paper provides a comprehensive evaluation of the structural, cultural, technological, regulatory, financial, and human-capital challenges inhibiting the development of intelligence-led systems. Through comparative analysis with EU and regional best practices and detailed assessment of Albania's institutional realities, the article identifies critical gaps and proposes actionable policy, governance, and technological reforms to accelerate BI/CI integration. The paper concludes that BI and CI maturity in the Albanian energy sector requires coordinated institutional commitment, significant investment in digital transformation, standardized data governance, strong regulatory incentives, and a sustained cultural shift toward evidence-based decision-making.

**Keywords:** business intelligence (bi), competitive intelligence (ci), energy sector, private renewable developers.

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**MICROSTRUCTURAL AND MECHANICAL PROPERTIES OF THE BALL MILLED AND CONSOLIDATED AL- MN-CU ALLOY**

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**Abstract:** Abstract: The effect of severe plastic deformation during milling and conventionel and Spark Plasma Sintering (SPS) on the microstructural and mechanical properties of the Al-Mn-Cu alloy was studied a milling process fo up to 24h (A24) leads to microstructural refinement and the presence of Al, Mn and Cu solid solutions. The energy dispersive spectroscopy (EDS) analysis reveals the existence of Cu-Al, Mn-Al, and Al-Mn enriched particles. The crystal structure of the A24 powders heated up to 900°C consists of a dual-phase microstructure of Al20Cu2Mn3 nanoprecipitates (~28%) and Al Matrix (~72%), the sintering of the A24 powders at 500°C for one hour (A24S) leads to precipitation of $Al_6Mn$, $Al_2Cu$ and the $Al_{20}Cu_2MnT$-Phase into the enriched matrix the consolidation by SPS (A24SPS) leads to mixture of an Al solid solution, $Al_6Mn$, T-Phase and Mn with an increasing fraction of the T-Phase and $Al_6Mn$. A higher microhardness value about 581 Hv is achieved for the A24 SPS sample compared to those of the A24 (68Hv) and A24S (80Hv) samples.

**Keywords:** ball milling, spark plasma sintering, microstructure, mechanical properties.

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# NEURAL NETWORK-BASED PI CONTROL MODEL FOR A VOLTAGE INVERTER WITH AN OUTPUT LC FILTER: STUDY OF THD IN RESPONSE TO LOAD VARIATION

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**Abstract:** This paper focuses on the design of an adaptive controller based on artificial neural networks (ANNs) for the management of a three-phase inverter within a stand-alone photovoltaic system. The aim is to improve output current quality. The proposed control scheme is based on the use of pulse width modulation (PWM) in conjunction with a conventional PI controller to generate the required input and output data. This data is then used to set up the neural network. Once the network has been established, the adaptive controller based on artificial neural networks (ANN) becomes operational to supervise the inverter. A comparison is made with the pulse-width modulation (PWM) control method in conjunction with a conventional PI controller. Simulation results show that the proposed method leads to higher quality sinusoidal currents when varying the RL load, compared to the PWM control method in conjunction with a conventional PI controller. In short, this approach based on artificial neural networks offers superior performance in inverter management within the stand-alone photovoltaic system, leading to output currents more in line with an ideal sinusoid and thus reducing harmonic distortions.

**Keywords:** inverter, artificial neural networks, pi controller, harmonic, passive filter

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# INVESTIGATION OF LIQUID FILM DYNAMICS RESULTING FROM VERTICAL JET IMPINGEMENT ON A HORIZONTAL SURFACE

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**Abstract:** This numerical study investigates the turbulent axisymmetric water jet impinging perpendicularly on a flat plate, analyzing the liquid film thickness in both supercritical, subcritical regions along with the hydraulic jump position, and validated against experimental data. The numerical prediction of a two-phase air–water mixture was performed using the Volume of Fluid (VOF) method for interface capturing, enhanced by the CIAM algorithm for accurate interface reconstruction. Turbulence was modeled using the k–ω SST approach, applied to an axisymmetric, two-dimensional unsteady flow with phase-weighted physical properties. The analysis focuses on key dimensionless parameters, notably the Reynolds number (Re) and the normalized impingement distance (H/d), where d represents the jet diameter. These parameters play a crucial role in characterizing the behavior of the impinging jet and its associated flow patterns. The numerical results demonstrate a high level of accuracy in predicting the onset and structure of hydraulic jumps across a wide range of operating conditions. The simulations show strong agreement with available experimental measurements, thereby validating the robustness of the modeling approach. These findings not only enhance the understanding of complex two-phase flow phenomena but also provide practical insights for optimizing industrial processes involving jet impingement, such as cooling, cleaning, and mixing operations.

**Keywords:** hydraulic jump, impinging jet, turbulence, volume of fluid method, computational fluid dynamic

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# FINITE ELEMENT MODELING OF THE THERMAL FRICTION CUTTING OF TI-5553 TITANIUM ALLOY

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**Abstract:** The article presents the results of mathematical modeling of the thermo-friction cutting process of the Ti-5553 titanium alloy using the DEFORM-3D software package, conducted within the grant project AP26100423. An analysis was carried out to evaluate the influence of various process parameters on changes in the stress state and hardness distribution through the depth of the surface layer of workpieces subjected to thermo-friction cutting with the simultaneous application of pulsed cooling. The range of stress variation was established, and the distance over which these stresses dissipate within the workpiece volume was identified. The modeling demonstrated that equivalent and octahedral stresses arise at the moment of contact with the cutting disc, reach their maximum at the end of the contact arc, and then rapidly decrease to zero as the disc continues to rotate and the workpiece enters the cooling zone. This cycle subsequently repeats. It was found that the periodic heating–cooling cycle of the processed surface prevents heat from spreading deep into the workpiece, causing intensive heat accumulation directly at the “disc–workpiece” contact zone. It was shown that, depending on the cutting conditions, the temperature penetration depth into the workpiece ranges from 0.74 to 1.02 mm. Meanwhile, the thickness of the contact layer is 0.0112 to 0.076 mm, and the temperature within this layer varies between 1500 and 1900°C. An analysis of surface layer strengthening was performed by determining hardness and identifying the patterns of its variation along the depth of the heat-affected zone, depending on temperature conditions and cutting speed. It was established that the presence of pulsed cooling promotes the stabilization of thermal processes, reduces tensile stress levels, and expands the compression zone, which has a beneficial effect on the quality of the machined surface.

**Keywords:** modeling , hermo-friction cutting, titanium, alloy

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# ESTABLISHMENT AND VALIDATION OF STERILITY TEST OF LEVOFLOXACIN LACTATE PERFUSION USING MEMBRANE FILTRATION

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**Abstract:** A validation study was conducted to confirm the suitability of the sterility testing method for levofloxacin lactate perfusion, with specific emphasis on overcoming the antimicrobial activity of the drug during the test. Levofloxacin, a broad-spectrum fluoroquinolone, can inhibit microbial growth and potentially lead to false-negative sterility results if not adequately neutralized. Magnesium sulphate was evaluated as a chemical inactivator due to its ability to complex with fluoroquinolones and reduce their antimicrobial effect. The validation followed the principles of the harmonized pharmacopeial sterility test (USP <71>, EP 2.6.1), including method suitability trials using representative challenge microorganisms. Test samples containing levofloxacin lactate perfusion were treated with magnesium sulphate prior to inoculation into Fluid Thioglycollate Medium (FTM) and Soybean–Casein Digest Medium (SCDM). Growth promotion, inhibition, and neutralization controls were performed to assess the effectiveness of the inactivator. Results demonstrated that magnesium sulphate 0,5 M solution and Fluid D successfully neutralized the antimicrobial activity of levofloxacin lactate, allowing recovery and robust growth of all test organisms within acceptable timeframes. No inhibition of microbial growth was observed in the presence of the drug–inactivator mixture. The study confirmed that magnesium sulphate is an effective and reliable inactivator for sterility testing of levofloxacin lactate perfusion. The validated method ensures accuracy, sensitivity, and compliance with regulatory sterility requirements, supporting its routine use for quality control of the product.

**Keywords:** levofloxacin lactate, perfusion, sterility test

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# SPATIAL AND TEMPORAL VARIATION OF $CO_2$ LEVELS IN DIFFERENT TERMINALS OF DURRES PORT

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**Abstract:** Port of Durrës is the largest port in Albania. It handles mainly cargo traffic and passenger service. These activities contribute to Albania's economic growth and development, but also have an adverse impact on air quality, mainly deriving from $CO_2$ emitted by fossil fuel combustion. Despite several rules and design standards to reduce air emissions, the growth in volume of traffic for ships moving in and out of ports still has an impact on air quality. $CO_2$ is one of the main pollutants in port regions, and there is also a direct connection to climate change. In light of the potential severe environmental consequences, the shipping industry is required to put into effect changes that would nearly halve the GHG emissions as well as lessen the climate-related effects. This research paper summarizes the outcomes of the carbon dioxide gas measurements in the cargo, container, ferry, freight, and Porto Romano terminals, which were conducted for ten months from January to October 2024. The objective was to find pollution hotspots and assess the effectiveness of measures in lowering the $CO_2$ concentrations in these localities. The finding revealed that carbon dioxide levels varied between 357.5 and 644,02 ppm, with an average concentration being 447.22 ppm. This figure is quite close to the World Meteorological Organization's estimate of global $CO_2$ concentration in 2024, 423.9 ppm, indicating the large share of port emissions in the total atmospheric $CO_2$ levels.

**Keywords:** co2, ports of durrës, pollution, temporal, emission

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# CAMELLIA JAPONICA-ASSISTED SYNTHESIS OF $WO_3$ NANOPARTICLES: A DUAL APPROACH TO GREEN CHEMISTRY AND CANCER THERAPY

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**Abstract:** Breast cancer remains a leading cause of mortality among women worldwide, prompting the search for innovative and sustainable therapeutic solutions. This study explores a dual approach that integrates green chemistry and cancer therapy through the biosynthesis of tungsten trioxide ($WO_3$) nanoparticles using Camellia japonica flower extract. The phytogenic synthesis method emphasizes environmental compatibility and resource efficiency. Camellia genus, belonging to the Theaceae family, exhibits significant potential as biogenic reducing and stabilizing agents for synthesis of metallic nanoparticle. In this study, flowers of C. japonica L. were harvested from the Botanical Garden of the University of Campania (Caserta, Italy) and subjected to ultrasound-assisted maceration using acidified ethanol. The resulting extract was subsequently purified via chromatography on Amberlite XAD-4 resin to obtain an anthocyanin-rich fraction, designated as Cj2. This fraction underwent preliminary chemical characterization using spectroscopic techniques, including ATR FT-IR and UV-Vis spectroscopy, followed by comprehensive profiling through Ultra-High-Performance Liquid Chromatography coupled with High-Resolution Mass Spectrometry (UHPLC-HRMS). The analysis revealed that Cj2 is composed primarily of anthocyanins, mainly in their acylated forms, as well as procyanidins and flavonols. Subsequently the polyphenolic fraction was utilized for synthesis of $WO_3$ nanoparticles and the resulting nanoparticles were thoroughly characterized using dynamic light scattering (DLS), Scanning elctron microscope (SEM), Energy-Dispersive X-ray Spectroscopy (EDX) and transmission electron microscopy (TEM) confirming their structural integrity and successful bioencapsulation. Cytotoxicity was assessed via the Alamar Blue assay across multiple breast cancer cell lines, revealing that Camellia japonica-mediated $WO_3$ nanoparticles exhibited superior anticancer efficacy compared to conventionally synthesized nanoparticles. These findings underscore the potential of C.japonica-mediated $WO_3$ nanoparticles as a promising candidate for eco-friendly nanomedicine in cancer therapeutics.

**Keywords:** cancer, camellia japonica flower, green synthesis, nanoparticles

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# ANALYTICAL INVESTIGATION OF THE FREE VIBRATION BEHAVIOR OF NANOCOMPOSITE BEAMS RESTING ON ELASTIC FOUNDATIONS

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**Abstract:** Abstract: This study presents an analytical investigation of the free vibration behavior of carbon nanotube (CNT) reinforced nanocomposite beams resting on an elastic foundation. The nanocomposite beam is modeled as a functionally graded CNT-reinforced composite, where the nanotubes are assumed to be either aligned or randomly oriented within the polymer matrix. The Mori–Tanaka homogenization approach is employed to estimate the effective elastic properties of the nanocomposite by considering the influence of CNT orientation, volume fraction, and spatial distribution through the beam thickness. The governing equations of motion are derived based on classical beam theory , taking into account the effects of the elastic foundation stiffness. Analytical formulations are developed to describe the vibration behavior of the beam under various boundary conditions, including simply supported, clamped, free. The proposed analytical model provides a comprehensive theoretical framework for understanding the dynamic characteristics of CNT-reinforced nanocomposite beams on elastic foundations. The results reveal that increasing the foundation stiffness significantly enhances the natural frequencies of the system, particularly for lower vibration modes. Moreover, beams reinforced with aligned CNTs exhibit higher frequencies

**Keywords:** free vibration, beam, natural frequency, elastic foundation, nanocomposite, single-walled.

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**MATERIAL CULTURAL HERITAGE VALORIZATION USING 3D LASERGRAMMETRY "CASE OF THE SIDI BOUMEDIENE MOSQUE"**

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**Abstract:** The main objective of this study is to highlight the role of 3D scanning in preserving material cultural heritage and increasing accessibility through virtual reconstructions. Indeed, 3D scanning is expected to facilitate the preservation of historical sites. It also enables the creation of virtual tours and 3D models that are accessible worldwide. In this investigation, the Faro S150 Terrestrial Laser Scanner is used. This performed instrument allows measuring complex objects and structures quickly and easily with height accuracy Table 1. It is able to record up to one million 3D points per second, giving realistic and detailed results with a range of 150 m per scan with or without targets. This study examines the case of the Sidi Boumediene Mosque, located in the El Eubbad district of Telemen, Algeria, originally a tomb built on 1339. The creation of 3D objects from a point cloud is done either semi-automatically or through shape recognition modules. The digital products derived and extracted from this work are of great importance, we can cite as an example, the development of cross and longitudinal sections at any height, creation of 2D plans, verification of the flatness and verticality of the constructive elements of the mosque by the analysis of point clouds. Creation of an educational book that allows to visualize objects in 3D by a simple image track, and the 3D documentation. Also, an augmented reality (AR) application is currently being developed to project virtual elements into a real environment.

**Keywords:** material heritage, 3d scanning, modelling.

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# THE ROLE OF WORKING MEMORY IN ACADEMIC READING: EXAMINING THE RELATIONSHIP BETWEEN WORKING MEMORY AND READING COMPREHENSION IN ENGINEERING EDUCATION

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**Abstract:** This study examined the relationship between the working memory capacity (WMC) and reading comprehension performance among first-year engineering students at Visayas State University Isabel. Specifically, it aimed to (1) determine the demographic profile of the students, (2) determine the classification of students based on their working memory capacity, categorized as high, average, and low, (3) determine the reading performance of the students, (4) find out if there is a significant difference between the demographic profile of the students and the working memory capacity and its reading comprehension performance, and (5) ascertain whether there is a significant relationship between working memory capacity and the reading comprehension performance. Utilizing a descriptive-correlational research design, the study involved 116 students enrolled in Civil, Industrial, and Mechanical Engineering programs. The Automated Operation Span Task (AOSPAN) and standardized reading comprehension tests were used to assess WMC and reading comprehension, respectively. Demographic variables, including age, sex, senior high school (SHS) strand, and degree program, were analyzed concerning these cognitive and academic measures. Findings revealed that most students exhibited average WMC, with a significant variation observed across age groups ($p = 0.022$). Reading comprehension performance differed significantly by degree program ($p = 0.004$), particularly between BSIE and BSME students, indicating that curricular demands may influence literacy outcomes. Importantly, a strong positive correlation ($r = 0.476$, $p = 0.003$) was found between WMC and reading comprehension, suggesting that cognitive capacity plays a critical role in students' academic reading ability. These results align with recent national findings by EDCOM II (2024) on the prevalence of functional illiteracy among Filipino students and underscore the need for cognitive-based instructional interventions. The study recommends integrating memory-enhancing strategies in the classroom, implementing targeted literacy support, and revisiting curriculum design to ensure cognitive readiness and reading competence in higher education.

**Keywords:** aospan task, descriptive-correlational research design, engineering program, functional literacy, working memory

# A NEW 3D ANALYTICAL METHOD FOR CALCULATING THE DISTRIBUTION OF CRITICAL CURRENT DENSITY IN A HIGH TEMPERATURE SUPERCONDUCTING DYNAMO

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**Abstract:** High temperature superconducting dynamos allow contactless direct current injection into superconducting windings, which enables efficient and stable excitation of large scale superconducting systems. This paper presents a new three dimensional analytical model for calculating the distribution of critical current density in a high temperature superconducting dynamo operating under the critical state model. The magnetization of the permanent magnet is described using an equivalent fictitious coil formulation that provides closed form expressions for the generated magnetostatic field. A dynamic penetration depth approach is also introduced to model the motion of current fronts when the superconducting tape is exposed to a time varying magnetic field. The analytical results obtained from the model are compared with finite element simulations, and the comparison shows excellent quantitative agreement over a wide range of operating conditions. At the same time, the analytical approach reduces computation time by more than three orders of magnitude. The proposed method offers physical clarity as well as computational efficiency, and it represents a practical tool for the fast analysis and optimization of high temperature superconducting dynamos and flux pump systems.

**Keywords:** high temperature superconducting, permanent magnet, critical current density, magnetic field, critical state model

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# PATTERNS OF LLM WEAPONIZATION: A COMPARATIVE ANALYSIS OF EXPLOITATION INCIDENTS ACROSS COMMERCIAL AI SYSTEMS

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**Abstract:** This comparative study examines patterns of Large Language Model (LLM) weaponization through systematic analysis of four major exploitation incidents spanning 2023-2025. While existing research focuses on isolated incidents or theoretical vulnerabilities, this study provides the first comprehensive comparative framework analyzing exploitation patterns across state-sponsored cyber-espionage (Anthropic Claude incident), academic security research (GPT-4 autonomous privilege escalation), social engineering platforms (SpearBot phishing framework), and underground criminal commoditization (WormGPT/FraudGPT ecosystem). Through comparative analysis across eight dimensions—adversary sophistication, target selection, exploitation techniques, autonomy levels, detection evasion, attribution challenges, defensive gaps, and capability democratization—this research identifies critical cross-case patterns informing defensive prioritization. Findings reveal three universal exploitation mechanisms transcending adversary types: autonomous goal decomposition via chain-of-thought reasoning (present in all four cases), dynamic tool invocation and code generation (3/4 cases), and adaptive social engineering (4/4 cases). Analysis demonstrates progressive capability democratization: state-level sophistication (Claude: 80-90% autonomy) transitioning to academic accessibility (GPT-4: 33-83% success rates), specialized criminal tooling (SpearBot: generative-critique architecture), and mass commoditization (WormGPT: $200-1700/year subscriptions). Comparative findings identify four cross-cutting defensive imperatives applicable regardless of adversary type: multi-turn conversational context monitoring, behavioral fingerprinting distinguishing legitimate from malicious complex workflows, federated threat intelligence enabling rapid cross-organizational learning, and capability-based access controls proportional to LLM reasoning sophistication.

**Keywords:** large language models, comparative analysis, cyber exploitation patterns, llm weaponization, autonomous agents, capability democratization, underground ai, defensive frameworks

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# INVESTIGATING THE MECHANICAL BEHAVIOR OF FRICTION STIR SPOT WELDED AA7075 JOINTS WITH CU INTERLAYERS USING DIGITAL IMAGE CORRELATION

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**Abstract:** Friction Stir Spot Welding (FSSW) has gained significant attention in aerospace and lightweight structural applications due to its ability to produce high-strength, defect-free joints. This study investigates the influence of a copper (Cu) interlayer on the mechanical properties of FSSW joints in Al7075 alloy. Three joint configurations were examined: (1) a direct Al7075-to-Al7075 joint without an interlayer, (2) a joint with a continuous (solid) Cu interlayer, and (3) a joint with a pre-pierced Cu interlayer. The effect of these configurations on tensile strength, displacement, and fracture behavior was analyzed. Tensile test results revealed that the joint with a solid Cu interlayer exhibited the highest strength and energy absorption, indicating improved mechanical integrity. The Cu layer facilitated heat distribution and softened metal flow, leading to a larger welded area, better stress distribution. The pre-pierced Cu interlayer, however, introduced stress concentrations around the hole leading to premature fracture. The joint without a Cu interlayer was the weakest, with lower strength, limited plastic deformation, and reduced fracture energy, making it less suitable for high-performance applications. Microstructural analysis confirmed the formation of an intermetallic compound (IMC) in the Al-Cu transition zone due to diffusion bonding under high temperature and pressure. Digital Image Correlation (DIC) analysis further supported these findings by revealing localized strain distribution and stress evolution, showing that the solid Cu interlayer resulted in more uniform stress dissipation. These results demonstrate the critical role of interlayer design in optimizing the performance of FSSW joints. The solid Cu interlayer is recommended for applications requiring superior strength, higher fracture energy, and enhanced safety under tension-shear loading. This study provides valuable insights for designing FSSW joints in aerospace and automotive applications, where lightweight materials with high structural integrity are essential.

**Keywords:** aa 7075-t6, digital image correlation, friction stir spot welding, mechanical properties.