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University of M'hamed Bougara of Boumerdes
Faculty of Technology

National Seminar on Process Engineering and Industrial Development (NSPEID'25)

Hybrid Onsite-Online

Boumerdes on November 5th and 6th, 2025

Book of Abestracts

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BENHAOUA Fayrouz, TOUZOUIRT Saida, DJOUMAD Sounia, TOUBANE Mehdia,
STITI Nacira, BELLOUL Nabila, LARID Roza, Editors

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November 2025

Dear Participants, We would like to thank all of you for your participation and interest in the 1st National Seminar on Process Engineering and Industrial Development (NSPEID'25), which was held as Onsite/Online (Hybrid) in Boumerdes, Algeria on November 05-06, 2025. NSPEID 2024 was organized for the first time this year with the support of Boumerdes University. The aim of NSPEID 2025 is to provide an international forum for researchers, academics, people in industry, and students to consider the latest research results and to present and discuss their ideas, theories, technologies, systems, tools, applications, work in progress. In this regard, participants will experience all theoretical and practical problems and technological developments that arise in multidisciplinary topics. Onsite and online presentations were made by invited speakers and other participants within the scope of the NSPEID 2025. NSPEID 2025, where 411 presentations prepared by participants from 50 universities and schools and 4 research centers, highlighting the wide-ranging academic and research engagement in the seminar. Therefore, we would like to thank Prof. ABDELBAKI Noureddine (Rector of Boumerdes University, Algeria), the invited speakers and all other participants, the members of the scientific committee, Organizing Committee, the session chairs, and all those who contributed to make this conference a great success. Hope to see you at the next NSPEID. Best Regards,

On behalf of the NSPEID 2025 seminar Chairs :

F. BENHAOUA

S. TOUZOUIRT

SPEAKERS

Dr. BELKASMI Djamel: Khenchela University (*Artificial Intelligence in Process Engineering: From Smart Optimization to Sustainable Industry*)

Dr. ABERBACHE Nefissa : Consultant, Pharma Pharmaceutical Industry (*When Pharmaceutical Sciences Meet to Transform Innovation into Industrial Solutions)*

Prof. BENAKMOUM Amar: Boumerdes University (*Carbon Footprint in Our Diet: Challenges and Perspectives)*

Prof. BENSOUICI Fayçal: Boumerdes University (*Metal Doping Effects on TiO_2 Thin Films: Structural, Optical and Photocatalytic Properties)*

Prof. BENOTMANE Benamar: Boumerdes University (*Wood: A Natural Material Serving Scientific Innovation*)

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TOPICS

Axis 1: Chemical, Pharmaceutical, and Food Processes.
Axis 2: Process Engineering of Materials and Polymers, Biomaterials, Nanomaterials, and Nanotechnology.
Axis 3: Renewable Energy and New Technology.
Axis 4: Environment and Water Treatment.
Axis 5: Recycling and Waste Recovery.
Axis 6: Simulation and Artificial Intelligence in Industry.

CONTENTS

HIGH-PRESSURE PHASE EQUILIBRIUM FOR CARBON DIOXIDE SOLUBILITY WITH BIOFUELS

Amal Ayad[1*], Mojgan Ebrahiminejadhasanabadi[2], WayneMichael Nelson[2], Latifa Negadi[1,2], Paramespri Naidoo[2, 3]

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Abstract:
The phase behavior of carbon dioxide-containing systems is crucial for the development of supercritical solvent applications and procedures for reducing carbon emissions.[1] Biomass resources are getting more attention for their potential as fuels or as raw materials for chemical products.
In this work, the solubility of carbon dioxide in two solvents, 2,5-dimethylfuran and methyl levulinate, were measured using both the isothermal synthetic technique and the variable volume synthetic method. Experimental vapor–liquid equilibrium data were obtained for the binary systems at different temperatures (283.15, 303.15 and 323.15) K and high pressure up to 9.1 MPa. The study examines how CO_2 interacts with either 2,5-dimethylfuran, a furan compound, or methyl levulinate, an ester.
The experimental data were modeled using the Peng-Robinson Equation of State with the Wong-Sandler mixing rule. Positive deviations from ideality were observed in both systems.

Key words: CO_2, 2,5-dimethylfuran, methyl levulinate, vapor–liquid equilibrium, equation of State.

STUDY OF INTERACTION INCLUSION COMPLEX SYSTEM BETWEEN B-CYCLODETRIN AND PYRAZOLIDINE: PHYSICOCHEMICAL CHARACTERIZATION AND ACTIVITY ANTIBACTERIAL

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Abstract:
The compounds of Pyrazolidines show various biological and pharmacological activities such as antimicrobial, anti-inflammatory, antitumor, insecticides, analgesic and anticancer activities. However, pyrazolidine is poorly water-soluble, limiting its bioavailability. This study aims to explore the host-guest inclusion complexes of pyrazolidine with β-cyclodextrin and its derivatives to enhance the drug's chemical and antimicrobial properties.
Binary inclusion complexes of pyrazolidine with β-cyclodextrin and its polysaccharide derivatives were prepared using co-precipitation and freeze-drying techniques. The stoichiometric ratio of 1:1 was determined by continuous variation (Job's plot), while the stability constants of the binary complexes were calculated using the Benesi-Hildebrand method. Characterization of the solid-state complexes was conducted through infrared spectroscopy (FTIR) and nuclear magnetic resonance (NMR) spectroscopy (1H, 13C, 2D ROSY), confirming pyrazolidine's inclusion within the cyclodextrin cavity. Additionally, morphology and topography analyses were performed via SEM and AFM microscopy, respectively. The antimicrobial activity of the complexes was evaluated against the bacterial strains *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Salmonella*, and *Bacillus subtilisspizizenii*, as well as the fungal strains *Candida albicans* and *Aspergillusbrasiliensis*, using ATCC references.
These findings suggest that preliminary antibacterial testing via agar disk diffusion indicates promising antimicrobial activity in some pyrazolidine:β-cyclodextrin host–guest inclusion complexes.

Key words: Pyrazolidine; β-cyclodextrin derivatives;Inclusion complex; antibacterial activity.

OPTIMIZED ECO-EXTRACTION OF PHENOLIC COMPOUNDS FROM *PISTACIA LENTISCUS*

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Abstract:
The extraction of bioactive compounds from natural sources is increasingly important due to their health benefits and diverse applications. Phenolic compounds, especially from plants, are valued for their antioxidant and therapeutic properties. *Pistacia lentiscus*, native to the Mediterranean, is rich in phenolics found in both leaves and fruits, but sustainable extraction remains challenging.
Microwave-assisted extraction (MAE) offers a rapid, efficient, and solvent-saving alternative for extracting these compounds. This study focused on optimizing MAE for *P. lentiscus* leaves and fruits. Initially, single-factor experiments examined solvent concentration, extraction time, and sample mass to assess their individual effects.
A Central Composite Design (CCC) was then applied to optimize conditions using acetone as the solvent. For leaves, optimal conditions were 50.03% solvent, 94.028 s extraction time, and 0.916 g mass. For fruits, they were 52.18%, 110.02 s, and 0.835 g, respectively.
This work supports the development of sustainable methods for phenolic extraction from *P. lentiscus*, with implications for pharmaceuticals, nutraceuticals, and functional foods.

Keywords: Microwave-assisted extraction, phenolic compounds, Pistacia Lentiscus, optimization.

FORMULATION AND CHARACTERIZATION OF MOUTH PAINT

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Abstract:
Oral care products made from synthetic ingredients can present long-term toxic risks. These dangers have heightened consumer awareness and distrust of synthetic ingredients, creating an opportunity for a return to natural formulas. A return to natural resources is not only a viable alternative, but a necessity. Natural extracts, such as those obtained from pomegranate peels, offer a multitude of advantages; non-toxic and often better tolerated by human mucous membranes. By using them, we add value to agricultural waste, support sustainable practices and promote a circular economy.Pomegranate peels play an important role in a number of areas, including health and beauty. The purpose of this work was to develop a mouth paint from the extract of pomegranate (*Punica granatum* L.) peels. The extract was prepared by hydro-alcoholic extraction to recover phenolic compounds. The anti-inflammatoryactivity of the extract was evaluated. A mouth paint was formulated to treat inflammatory mouth disorders. The formulationwas subjected to various evaluation parameters like pH determination, rheological behavior, and spreadability. The results showed that mouth paint is characterized by a neutral odor, a translucent and homogeneous orange-brown color with a slightly sweet taste, a pH equal to 6. and a spreadibility of 14 gr.cm/s. Prepared mouth paint can be a good pharmaceutical form applied in cases of oral periodontitis due to the anti-inflammatory properties of the pomegranate peels extract.

Key words: anti-inflammatory, mouth paint, natural, pomegrenate peel.

GREEN CHEMISTRY AND ITS ROLE IN INDUSTRIAL DEVELOPMENT (PESTICIDES)

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Abstract:
The evaluation of natural resources, in particular the wealth of plant and their integration in the field of agricultural system of our country, is a strategic priority in order to reduce the expenses on the factors of production, especially in the health protection of crops and the import of agricultural pesticides with hard currency.
Our research confirms the results obtained in the field of significant influence of water plant extracts of the studied species (Rutachalepensis L, PeganumharmalaL ,Nerium oleander L and Lantana camara L) against the Boufaroua which considered as one of the most dangerous pests on the date fruits.
The obtained results showed highly toxic of the water extracts of Rutachalepensis and Peganumharmala their impact on the mobile forms of spider Boufaroua, by that various concentrations and the full chronology programmed timing of the observations. We have recorded the most important data: for the extracts of Rutachalepensis and Peganumharmala.
The treatment with the four extracts of the high concentration on the palm clusters infected by colonies of spider has shown good results in terms of reducing the incidence of these lesions after 24 hours.

Key words: Boufaroua ;Oligonychusafrasiaticus ; palm trees ; water plant extracts for biological control ; toxicity.

THE IMPORTANCE OF BACTERIAL EXOPOLYSACCHARIDES IN FOOD PROCESSING

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Abstract:
Exopoly saccharides (EPS) are polymers produced by microorganisms, particularly lactic acid bacteria (LAB), and play a critical role in food processing. In fermented products like yogurt and cheese, EPS enhance rheological properties and contribute to improved safety by lowering pH. Additionally, some EPS offer prebiotic benefits, promoting gut health. The use of EPS-producing LAB is essential for developing high-quality, functional foods with better sensory properties and extended freshness.
The aims of the present work are to isolate and screen EPS-producing strains of coccal lactic acid bacteria (CLAB) from camel's milk and fresh red meat sourced from Algeria. The study evaluates their capacity for EPS production and selects the most efficient strains based on their quantitative output, with the goal of selecting high-performing strains for potential use in food processing applications.
All the isolates used in this study were evaluated for EPS production on the colony morphology, on certain solid medium and ruthenium red milk agar plate. Based on their EPS-producing colony phenotype, five strains were chosen giving an important white-color and mucoid aspect on sucrose-based media which being the best for detecting the EPS.
Quantitative estimation of EPS was realized by measurement of apparent viscosity and determination of sugar and protein total in these EPS, previously, extracted and purified from the various culture strains using the ethanol precipitation.
The amount of sugar in the polymer rendered more than 400 mg/L and the apparent viscosity ranged from 2.1 to 2.9 milli Pascals per second. Therefore, there was not found a close relationship between the amount of EPS and the apparent viscosity. For protein assay, a low content of protein was obtained on crude polymer revealing the quality of EPS extracts. Three strains were selected for their significant production of EPS.
Keywords: CLAB- EPS- sucrose-slimy appearance - apparent viscosity- amount of EPS.

EXTRACTION DES ANTHOCYANES D'HIBISCUS SABDARIFFA ET ÉTUDE DE LEUR STABILITÉ PHYSICO-CHIMIQUE

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Résumé :
Dans un contexte où la demande pour des produits naturels, sains et respectueux de l'environnement ne cesse de croître, les colorants naturels suscitent un intérêt croissant dans les industries alimentaire, cosmétique, pharmaceutique et textile. Parmi les plantes utilisées pour l'obtention de colorants naturels, la Roselle (Hibiscus sabdariffa), occupe une place de choix en raison de sa richesse en anthocyanes, des pigments naturels aux propriétés tinctoriales et antioxydantes.
Les anthocyanes extraits des calices de Roselle confèrent une couleur rouge à pourpre qui varie en fonction du pH, ce qui les rend particulièrement intéressants pour diverses applications industrielles. Toutefois, comme beaucoup de colorants naturels, les anthocyanes sont sensibles à plusieurs facteurs environnementaux tels que la lumière, la température, le pH et la présence d'oxydants, ce qui peut affecter leur stabilité et limiter leur utilisation.
Ce travail vise extraire des colorants naturels à partir de la Roselle, à évaluer leur efficacité, et à étudier les conditions influençant leur stabilité.
L'objectif de notre travail était d'améliorer la stabilité de l'extrait d'anthocyanines de fleurs de Roselle en étudiant l'effet des conditions de stockage, de la température et du pH.
Les résultats ont montré que l'extrait d'anthocyanines de Roselle présente une meilleure stabilité à pH faible. Par ailleurs, un stockage à basse température (4 °C) et à l'obscurité pendant 60 jours permet de maintenir une teneur élevée en anthocyanines.

Mots clés : Colorants naturels, stabilités, extraction.

EVALUATION OF ANTI-ARTHRITIC ACTIVITY OF OINTMENT BASED ON FLAVONOIDS AND TANNINS OF ARISTOLOCHIA LONGA PLANT

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Abstract:
Aristolochia longa, belonging to the *Aristolochiaceae* family, helps treatvarious diseases such as cancer, abdominal pain and upper respiratory tract infections. The present work aims to assess the anti-inflammatory activity of ointments based on the flavonoids and tannins of *Aristolochialonga*.The formulated ointments were considered for physicochemical parameters and microbiologicanalysis. However, the skin tolerance test of ointments was performed by measuring the primary irritation index.The anti-arthritic potential of the formulations was evaluated by Complete Freund's Adjuvant (CFA) induced arthritis method. The degree of inflammation and anti-arthritic effects were assessed by radiological and histological analysis of knee joints. The results revealed that the microbiological and physicochemical parameters of formulations were found to be satisfactory. Furthermore, both the ointments showed a homogenous appearance without phase separation and pH range of the skin. In addition, the skin irritant effect indicated that the prepared formulations were safe.The radiological profile and histological analysis showed an anti-inflammatory effect in the treated group by F1 and F2 formulations, reducing infiltrationcellular, pannus formation and bone erosion.we conducted thatleaves and roots of *A.longa* can be used as plant remedies for Rheumatoid arthritis and inflammatory diseases.

Key words: *Aristolochialonga*, Flavonoids, Tannins, ointments, Rheumatoid arthritis.

SYNTHESIS, SPECTROSCOPIC STUDIES, AND CRYSTAL STRUCTURE OF 2-(5 BROMO-2-HYDROXYPHENYL)BENZIMIDAZOL-3-IUM ACETATE ACETIC ACID SOLVATE

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Abstract:
Organic-inorganic hybrid materialshave emerged as a dynamic and promising research area in materials science due to their broad applications in optics, electronics, energy storage, preservation, and catalytic sensing. The properties and potential uses of these hybrid systems depend heavily on the synthesis method, the nature of their constituents, and their relative compositions. Various synthetic approaches, such as hydrothermal, solvothermal, and self-assembly techniques, can be employed. Among organic components,benzimidazolesrepresent a versatile class of compounds, well-known for their wide range of biological activities.
As part of our work, we synthesized a benzimidazole-derived hybrid compound,2-(5-bromo-2-hydroxyphenyl)benzimidazol-3-ium acetate acetic acid solvate, and characterized its structural and spectroscopic properties using multiple analytical techniques. Infrared (IR) spectroscopy confirmed the presence of characteristic functional groups, whileUV–Visible spectroscopyprovided insights into its electronic transitions. Additionally, single-crystal X-ray diffraction analysis unambiguously determined the molecular and crystal structure. The crystallographic study revealed that the compound crystallizes in amonoclinic systemwith thes pace group $P2_1/c$.
Key words: Benzimidazole; DRX; IR; UV-visible; Hybrid compound.

PREPARATION D'UN FROMAGE TYPE EDAM A BASE DU LAIT DE CHEVRE AVEC DES EXTRAITS PROTEOLYTIQUES D'ORIGINE FONGIQUE

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Résumé :
Le lait de chèvre, marqué par son goût piquant, n'est pas toujours apprécié par les consommateurs. A l'inverse, sa transformation en fromage offre non seulement une grande diversité de formes, de textures et de goûts, mais aussi des qualités nutritionnelles et santé souvent méconnues, qui méritent qu'on s'y intéresse. À cet effet, des essais de fabrication de fromage à pâte semi-dure (type Edam) à partir de lait de chèvre ont été menés. Dans un premier temps, la production d'extraits enzymatiques coagulant le lait a été réalisée dans des conditions optimales par deux souches fongiques isolées localement: *Rhizopus stolonifer* et *Mucor circinelloides*. Le son de blé humidifié avec différentes solutions minérales a servi de substrat à la fermentation solide. L'activité coagulante de l'extrait brut de *M. circinelloides* (767,16 US/mL) était supérieur à celle d'extrait de *R. stolonifer* (416,21 US/mL), marqué par une activité protéolytique plus élevée (56,634 U/mL). Ces extraits protéolytiques ont été appliqués dans un essai de fabrication de fromage Edam à base du lait de chèvre et comparé à celui obtenu par la présure commerciale (CHY-MAX®) comme témoin. Le rendement fromager obtenu avec l'extrait brut de *M. circinelloides* (80 g/L) est approximativement identique à celui assuré par la présure commerciale (80,33 g/L). En revanche, le rendement était plus faible dans le cas de l'utilisation de l'extrait coagulant de *R. stolonifer* (71,6 g/L), qui a donné lieu à un fromage de qualité sensorielle inférieure par rapport aux autres extraits.
Mots clés: activité coagulante, fromage, lait de chèvre, *Mucor circinelloides*, *Rhizopus stolonifer*, fermentation solide.

ANTIBACTERIAL POTENTIAL OF AQUEOUS AND HYDROETHANOLIC EXTRACTS FROM DIFFERENT PARTS OF SOLANUMLYCOPERSICUM L.

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Abstract:
The increasing resistance of pathogenic bacteria to conventional antibiotics has prompted the search for new antimicrobial agents from natural sources. This study investigated the antibacterial activity of aqueous and hydroethanolic extracts from different parts of *Solanumlycopersicum* L. (leaves, green fruits, and red fruits) using the disk diffusion method. Five reference strains were tested, including *Escherichia coli* ATCC 8739, *Pseudomonas aeruginosa* ATCC 9027, *Salmonella typhimurium* ATCC 14028, *Staphylococcus aureus* ATCC 6538, and *Bacillus subtilis* ATCC 8739. Results revealed that the aqueous extract of green fruits exhibited the strongest antibacterial activity, producing inhibition zones up to 49 mm against *S. typhimurium*, and also showed remarkable effects against *E. coli* and *P. aeruginosa*. Hydroethanolic extracts displayed moderate activity, with higher efficacy against Gram-negative strains, particularly *E. coli*. Leaf extracts demonstrated antibacterial potential mainly in aqueous form, while red fruit extracts were comparatively less active. In several cases, the inhibitory effects of green fruit aqueous extracts surpassed those of standard antibiotics. These findings highlight the significant antibacterial properties of tomato by-products, especially green fruits, which are often underutilized despite their richness in glycoalkaloids such as α-tomatine. The results suggest that *S. lycopersicum* could serve as a promising source of natural antibacterial agents for pharmaceutical and food industry applications.

Key words: *Solanumlycopersicum*; antibacterial activity; aqueous extract; hydroethanolic extract; disk diffusion.

LACTOBACILLUS PLANTARUM SPECIES: AN OVERVIEW WITH EMPHASIS IN BACTERIOCINOGENIC, PROBIOTIC, BIOCHEMICAL AND HEALTHY PROPERTIES

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Abstract
actobacillus plantarum species matching the features of lactic acid bacteria, mesophilic, facultative heterofermentative, aerotolerant, of ubiquitous ecology, active in fermentations as a starter. Many *Lactobacillus plantarum* strains have safe status GRAS: *Generally Recognized As Safe.* Its dual role; as native colonizing the human digestive tract, as starter of food fermentations, awarded them a preferential choice for their usage in development of new prebiotic plant beverages. *L. plantarum*, subject to considerable data scientific research. Data linked health benifits to this species. *L. plantarum* is at the focus of heated issues. This study aimed to enhance understanding of the species caracteristics, through bibliographic overview of knowledge, critical analysis, data collecting, to examine its different bacteriological, physiological, biochemical, probiotic, genetic features and production of bacteriocins. *Lactobacillus plantarum* is commonly used for the fermentation of foods of animal origin: dairy products (raw milk, fermented milk, yogurt and cheese), meat sausages, fermented fish. Foods of plants origin: Vegetables: pickles, cucumber, table olives, sauerkraut, green beans, etc… *Lactobacillus plantarum*, having ability to survive human transit through digestive tract, adheres to intestinal epithelial cells. *Lactobacillus plantarum*, *Lactobacillus pentosus* and *L. paraplantarum* are genotypically related, exhibiting similar phenotypes. Plant-derived strains of *L. plantarum* have strong bacteriocinogenic activity and thermostable bacteriocins that are effective across a broad pH range and have a broad bactericidal/bacteriostatic spectrum. *Lactobacillus plantarum*, through its versatile role as a sourdough starter, its ubiquitous ecology, having probiotic virtues, opens up promising perspectives in human nutrition and food technologies.

Keywords: Bacteriocin, Fermentation, Food industry, *Lactobacillus plantarum*, Probiotic.

PHYTOCHEMICAL STUDY AND EVALUATION OF BIOLOGICAL ACTIVITIES OF HEDERA HELIX LEAVES GROWING WILD IN ALGERIA

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Abstract:
Medicinal plants are of great interest because of their composition rich in secondary metabolites that represent a great source of therapeutic agents. In our study we are interested in the plant *Hedera Helix* L. commonly called climbing ivy, known since antiquity for its pharmacological effects.
The aim of the study is to determine the chemical composition of the volatile part (essential oil) and the non-volatile part (secondary metabolites) of *Hedera Helix* L. and to evaluate its biological activities. The GC-MS analysis of the essential oil revealed an oil rich in compounds of which more than 93% were identified using spectral data and retention indices. The qualitative analysis of the non-volatile part of the plant by phytochemical screening revealed the presence of fatty acids, coumarins, quinones, tannins and saponins, and a low amount of flavonoids, steroids and terpenoids. Phenolic compounds, flavonoids, condensed tannins and hydrolyzable tannins were quantified in the different extracts previously obtained by maceration, ultrasound and Soxhlet using solvents of decreasing polarity: water, ethanol and isopropanol. Quantification is variable according to the process and the extraction solvent. The antioxidant activity of all extracts was evaluated by the ability to scavenge the free radical 2,2-diphenyl-1-picrylhydrazyl (DPPH). All extracts showed better antioxidant activity than the synthetic antioxidants BHA and BHT. The antimicrobial activity was evaluated by agar diffusion method. The extracts of *Hedera Helix* L. leaves showed antibacterial activity on gram (-) E. Coli and gram (+) Staphylococcus aureus and Bacillus and antifungal activity which was demonstrated on the fungus Candida Albicans.

Key words: *Hedera Helix L.*, secondary metabolites, phytochemical screening, phenolic compounds, flavonoids, tanins, antioxidant, antibacterial, antifungal.

ENCAPSULATION OF A HYDROPHOBIC DRUG IN PROTEIN NANOPARTICLES

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Abstract:
Protein nanoparticles with their low toxicity, biodegradability, and their abundance in natural sources make them attractive targeted drug delivery vehicles. There are a number of ways to obtain these nanoparticles, including desolvation (Gelatin was utilized in this work), which produces nanospheres.This study focuses on the preparation of gelatin nanoparticles by two steps desolvation method. Coester et al. developed this synthesis method based on two steps of desolvation by modifying the desolvation method of Marty et al. The desolvating agent, usually represented by acetone. The crosslinking agent chosen was glutaraldehyde to stabilize the precipitated gelatin nanoparticles. A hydrophobic drug has been selected for encapsulation by this protein to enhance its solubility.The synthesis was successful, yielding gelatinnanospheresboth with and without drug substance. Analysis via scanning electron microscopy (SEM) confirmed the spherical shape of the particles. Furthermore, their size was verified to be within the nanometric range, specifically between 100 and 150 nm.

Key words: Encapsulation, Nanoparticles, Desolvation, Protein, SEM..

PHYTOCHEMICAL CHARACTERIZATION AND ANTIOXIDANT ACTIVITY OF THE ETHYL ACETATE EXTRACT OF A *SATUREJA* SPECIES.

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Abstract:
The genus Satureja, a member of the Lamiaceae family, is highly valued for its applications in food products as well as in pharmaceutical and cosmetic formulations. In this context, the present study aimed to determine the chemical composition of the ethyl acetate extract of an Algerian medicinal Satureja species and to evaluate its antioxidant activity.The ethyl acetate extract was obtained through maceration followed by liquid–liquid extraction. The polyphenol and flavonoid contents were quantified spectrophotometrically using the Folin–Ciocalteu and aluminum chloride ($AlCl_3$) methods, respectively, while a qualitative analysis was performed by high-performance liquid chromatography (HPLC). In addition, the antioxidant potential was assessed in vitro using the free radical scavenging (DPPH) and cupric ion reducing antioxidant capacity (CUPRAC) assays. Quantitative results showed that the polyphenol content was 62.70 mg GAE/g Ex, while the flavonoid content reached 275.72mg QE/g Ex. The chemical profiling analysis of the extract revealed the presence of chlorogenic acid, caffeic acid, rosmarinic acid, and naringenin. Consistently, the extract exhibited strong antioxidant activity, with inhibition values 228.69 mg TE/g extract (DPPH) and 434.35 mg TE/g extract (CUPRAC).
Taken together, these results highlight the richness of this species in bioactive compounds with strong antioxidant potential. To the best of our knowledge, this is the first study devoted to this species, thereby providing a scientific basis for its possible therapeutic applications and paving the way for future investigations.
Key words: Satureja species, Total polyphenol, Total flavonoid, HPLC analysis, antioxidant activity.

PHYTOCHEMICAL SCREENING AND BIOLOGICAL ACTIVITIES OF *ALGERIAN MEDICINAL* EXTRACTS: ANTIOXIDANT, ANTIDIABETIC, AND ANTIBACTERIAL POTENTIAL

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Abstract
This study investigates the phytochemical composition and bioactivity of *J.* extracts obtained using chloroform and methanol solvents. Phytochemical screening revealed distinct variations in bioactive compounds, with chloroform extract containing non-polar constituents (steroids, free quinones, and terpenoids), while methanol extract exhibited polar compounds (polyphenols, flavonoids, tannins, glycosides, and coumarins). Quantitative analysis showed that methanol extract had higher phenolic content (102.56 ± 1.54 mg GAE/g), whereas chloroform extract contained more flavonoids (82.08 ± 2.21 mg QE/g). The chloroform extract demonstrated potent α-amylase inhibitory activity (IC50 = 209 ± 9.05 µg/ml), surpassing methanol extract and essential oil, suggesting its potential in diabetes management. Antioxidant assays (DPPH, ABTS, FRAP) indicated stronger activity in the methanol extract, correlating with its higher phenolic content. Additionally, both extracts exhibited antibacterial effects, with chloroform extract showing significant inhibition against *E. coli* (ZOI: 26–28 mm) and moderate activity against *S. aureus*. These findings highlight the therapeutic potential of *J. erratica*, particularly its chloroform extract for antidiabetic and antimicrobial applications, and methanol extract for antioxidant benefits.
Keywords: phytochemicals, α-amylase inhibition, antioxidant activity, antibacterial activity, DPPH.

OPTIMIZATION OF LIPID EXTRACTION PROCESSES IN THREE FISH SPECIES: INTER-SPECIES COMPARISON AND ANALYTICAL APPROACHES OFBIOCHEMICAL COMPOUNDS

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Abstract
The biochemical characterization of raw materials is a critical step before any valorization or processing. Indeed, the chemical composition of fish flesh significantly influences both its technological properties and preservation, which vary according to factors such as species, weight, sexual maturity, diet, and fishing season.
In this context, a comparative analysis of lipid and mineral content was conducted on two marine pelagic species (Sardinellaaurita and Trachurusmediterraneus) and one freshwater species (Aristichthysnobilis). Results showed that bighead carp (A. nobilis) had the highest moisture content (approximately 76.88%), along with low lipid and ash levels, classifying it as a lean fish. Conversely, Sardinellaaurita was characterized by a high total lipid content, classifying it as a fatty fish, and also showed richness in protein (20%) and minerals (4%).
Oil extraction from these species was then performed using two methods: steam cooking and Soxhlet extraction. Solvent-based extraction showed significantly higher yields than the thermal method. The extracted oils were subsequently analyzed qualitatively and quantitatively using thin-layer chromatography (TLC) and gas chromatography-mass spectrometry (GC-MS). The analysis revealed a high concentration of omega-3 polyunsaturated fatty acids, particularly DHA (15.91%) and EPA (19.77%), both known for their established role in cardiovascular disease prevention.
Keywords: Sardinellaaurita, Trachurusmediterraneus, Aristichthysnobilis, nutritional value, oil extraction, (TLC, GC-MS).

POLYPHENOLIC COMPOSITION AND ANTIOXIDANT EFFECT OF *SPIRULINA* EXTRACTS

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Abstract
This study investigated *Spirulina* collected in Oran Algeria. *Spirulina* a blue- green microalga and one of the oldest life forms on the planet serves as a food source for fish, marine mammals, and humans. It grows naturally in alkaline, mineral-rich lakes in hot, sunny, tropical areas. Phenolic compounds were then prepared alongside laboratory standard solutions for analysis vis high performance chromatography with diode array detection (HPLC-DAD). Results of identified phenolic compound in *Spirulina* methanol extract were 2.67% catechin hydrate, 8.47% Cafeic acid and higt percentage 26.92 of Myricetin compound Results of identified phenolic compound in *Spirulina* chloroform extract were: 0.58 % vanilic acid, 0.67% Mericetin and 0.58% Quercetin hydrat. Results of identified phenolic compound in *Spirulina* ethyl acetate were 2.34% Boric acid , 1.11% Catechin hydrate, 5% Vanillic acid, 1.49% Vitexin and 1.97 % Quercetin dehydrate. This antioxidant activity of the extract was then assessed using a DPPH assay and its inhibition rate was compared to standard antioxidants. Results showed that *Spirulina* has strong activity against free radicals, as evidenced by its lower IC50 values relative to the standard antioxidants.

Keywords: Medicinal plants, *Spirulina*extracts, Polyphenolic composition, antioxidant effect.

XYLANASE PRODUCTION FROM THERMOPHILIC ACTINOMYCETE USING THE RSM APPROACH AND ITS APPLICATION IN THE BEVERAGE INDUSTRY

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Abstract
This study examines Actinomadura keratinilytica Cpt29, a thermophilic actinomycete strain isolated from poultry compost (Annaba, northeastern Algeria). In a birchwood xylan medium, this microorganism was used for its ability to produce extracellular xylanases. The highest level of xylanase production (30.31 U/mL) was obtained in the liquid medium using wheat bran as the sole carbon source. This outcome is valuable because other pure substrates are more expensive than wheat bran. Statistical approaches were used to optimize culture parameters (Plackett–Burman design and response surface methodology). The Plackett-Burman design was used as a screening step to identify potential experimental fermentation parameters that affected xylanase production when wheat bran was used as the production substrate. Plackett–Burman's design revealed that the most important factors for optimizing xylanase production are wheat bran concentration, incubation time, and incubation temperature. According to the results of response surface methodology (RSM), the highest xylanase activity (109.47 IU/mL) was obtained in Horikoshi liquid medium under the following optimal conditions: wheat bran concentration (20.4 g/L), incubation time (49.6h), and incubation temperature (45.2°C). In the optimized medium, xylanase production increased 3.61-fold. The crud enzyme clarified orange juice (53.05%), pineapple juice (48.5%), strawberry juice (41.7%), and peach juice (39.31%), making this enzyme formulation a promising potential candidate for the food industry.
Keywords: Xylanases, *Actinomadura*, Fruit juice, Clarification, RSM

EVALUATION OF THE ANTIMICROBIAL ACTIVITY OF *BUNIUM MAURITANICUM* L. EXTRACTS

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Abstract:
Medicinal plants are a substantial and effective source employed since ancient times to treat many illnesses and diseases. The value of this natural richness growth sowing to the chemical constituents that cause diverse pharmacological action on the human being. In order to discover new biologically active molecules from this natural resource, we were interested. This study explores the phytochemical composition and therapeutic potential of Bunium mauritanicum L. tubers, with a focus on their Antimicrobial. The quanlitative analysis by the colorimetric method showed that the rhizome extracts of this plant are found to be wealthy in bioactive molecules such as alkaloids, saponosides, tannins, coumarins, sterols, tri-terpenes and flavonoids. that can be used as an herbal medicine for various diseases. The antibacterial activity was screened by paper disc diffusion method for four bacterial strains, (Bacillus spizizenii ATCC 6633, Escherichia coli ATCC 25922, Pseudomonas aeruginosa ATCC 27853, Staphylococcus aureus ATCC 06538). The results showed that Gentamicine has an inhibitory effect on the growth of bacterial strains Pseudomonas aeruginosa and Escherichia coli, with inhibition diameters of (32.95 and 32) mm respectively. The other strains showed total resistance (results -). For DMSO, the inhibition zones were less than 8 for all the strains tested. For Bunium mauritanicum L. extracts, S.aureus was the most sensitive strain with concentrations SM, C1 and C2 whose inhibition diameter values reached (13.64, 11.84 and 9.09) mm respectively. E.coli also showed sensitivity to the same extract with concentration SM with an inhibition diameter of 10.86 mm. The result indicated that the extract obtained from dried rhizomes of Bunium mauritanicum L. can be considered as an antibacterial agent.
Key words: herbal medicine, bioactive compounds, *Bunium mauritanicum* L, antibacterial agent, antibacterial activity, Gentamicine.

QUANTITATIVE ASSESSMENT AND ANTIOXIDANT CHARACTERIZATION OF METHANOLIC AND AQUEOUS EXTRACTS FROM A PLANT OF THE EPHEDRACEAE FAMILY

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Abstract:
The traditional medicinal flora of Algeria is distinguished by its richness in precious bioactive compounds. Ephedra is a perennial xerophytic gymnosperm and one of many medicinal plants traditionally used to treat various ailments. Species of this genus are particularly well known for their antioxidant properties. In this context, the present study investigated the potential of *Ephedra alata* subsp. *alenda* by evaluating its aqueous and methanolic extracts. Ultrasound-assisted extraction yielded 18.66% for the methanolic extract and 9.46 % for the aqueous extract. Both extracts contained significant amounts of total phenolic compounds, total flavonoids, and tannins, with the methanolic extract showing the highest concentrations. Furthermore, in vitro tests revealed notable antioxidant activity for both extracts. The methanolic extract exhibited a stronger DPPH radical scavenging capacity, with an IC50 value of 41.5 µg/mL, compared to 78.03 µg/mL for the aqueous extract. In addition, both extracts demonstrated significant reducing power, with A0.5 values of 6.63 mg/mL for the methanolic extract and 99.82 mg/mL for the aqueous extract. This study highlights *Ephedra alata* as a valuable natural source of compounds beneficial to human health.

Key words: Ephedra, antioxidant, ultrasound, polyphenols, DPPH

SYNTHÈSE, ACTIVITÉ ANTI-RADICALAIRE DE NOUVEAUX HYDRAZIDES ISSUS DES ACIDES NITRO-AROMATIQUES HALOGENÉS

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Abstract:
Les hydrazides aromatiques constituent une classe de dérivés organiques hautement polyvalents, suscitent un intérêt croissant en pharmacologie et en chimie médicinale. Leur simplicité de préparation et leur accessibilité synthétique, combinées à la richesse et à la diversité de leurs activités biologiques, en font des candidats particulièrement attractifs pour le développement de nouvelles entités thérapeutiques. Ces composés se distinguent par leur potentiel dans le traitement des infections microbiennes et parasitaires, dans la prévention du stress oxydatif, ainsi que dans la mise au point de nouvelles stratégies thérapeutiques contre divers types de cancers.
Nous avons axé notre travail sur la synthèse de nouveaux hydrazides dérivés d'acides nitro-aromatiques halogénés, obtenus par différentes étapes de transformation. Cette approche de conception moléculaire vise à exploiter l'effet synergique des groupements nitro et halogène sur le noyau aromatique, connus pour moduler les propriétés électroniques et biologiques des composés. Les tests biologiques préliminaires réalisés sur les composés finaux ont révélé que certains des hydrazides synthétisés possèdent une activité antioxydante notable, suggérant leur capacité à piéger efficacement les radicaux libres.
Ces structures sont caractérisées par des analyses spectrales : UV, IR, RMN H^1 et C^{13} ainsi que GC-Mass.

Key words: Nitro-romatique halogéné, hydrazide, activité antioxydante.

CHARACTERIZATION AND VERIFICATION OF THERMOSTATIC AND CLIMATIC CHAMBERS

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Abstract:
Thermostatic and climatic chambers are essential laboratory equipment designed to simulate and precisely control specific environmental conditions such as temperature, humidity, and sometimes pressure. These devices are widely used in fields like scientific research, the pharmaceutical industry, electronics, automotive, and the food sector to test the resistance, stability, or performance of various materials, products, or components under extreme or varying conditions.
The use of these chambers not only ensures product quality and compliance with international standards, but also helps predict how products will behave over time, thereby contributing to innovation and quality assurance.
The objective of this work is to study the characterization and verification of thermostatic and climatic chambers within the SALEM laboratory, in the context of pharmaceutical applications.
Each industry sector has specific normative references that define the technical requirements and the maximum tolerated deviations (EMT). For example, in the pharmaceutical sector, the main reference is the ICH guideline, which sets a tolerance of ±2 °C for temperature and ±5% for relative humidity.
The acceptance criterion is based on operational qualification (OQ): compliance is confirmed only if all tests are passed and any non-conformities are either corrected or justified and accepted.
We verified all characteristic parameters for each type of chamber and found that both chambers comply with the regulatory requirements.

Key words: Characterisation, verification, Thermostatic chamber, Climatic Chamber

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SYNTHESIS, SINGLE CRYSTAL STRUCTURE, CARACTERIZATION AND PROPERTIES OF IRON POLYMERS WITH SALEN LIGAND.

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Abstract:
Schiff bases are versatile and readily available compounds that exhibit a wide variety of applications in various fields of chemistry,
They are organic molecules characterized by the presence of imine or azomethine groups (RR′C=NR″), obtained from the dehydration condensation of aldehydes and primary amines. Schiff bases have long been known as both compounds and typical ligands for metal complexes, as they are Lewis bases that can donate lone pairs of electrons to nitrogen atoms. Herein, we report a novel approach to the preparation of polymeric iron(III)-salen-like compounds, We present the synthesis, structural resolution and characterization of organic–inorganic hybrid material,$[Fe(C_{18}H_{13}N_5O_2)]_n$ assembled from a N2O2 coordination geometry , the complex is crystallized in **Pbca** orthorhombic system with the following parameters: a=11.3426(7), b=16.4703(12), c=17.6954(11) Å , β = 97.710(6), and *Z* = 8 and was stabilized by an extensive network of C-H....O hydrogen bonds, as well as π–π stacking interactions. Hirshfeld surface analysis (HS) and two dimentional fingerprint plots were used to elaborate the intermolecular interactions along contact contribution in the crystalline molecules. indicates that the most significant contacts in the crystal packing are H···H (25.4%), C···H/H···C (35.5%), H···N/ N···H(18.2%) .

Key words: Salen ligand , DRX single crystal , FT-IR , Hirshfeld surface , Physico-Chemical Properties.

CONTRIBUTION A L'ETUDE DES PROPRIETES BACTERIENNES DES ALIMENTS FONCTIONNELS

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Abstract:
Les plantes médicinales et les aliments fonctionnels possèdent souvent des propriétés thérapeutiques et biologiques intéressantes pour les consommateurs réguliers. Ces produits naturels sont complexes et riches en composés bioactifs (polyphénols, flavonoïdes, terpènes caroténoïdiens, polyisoprènes, anthocyanes, alcaloïdes, tanins, coumarines, saponines…etc.). L'objectif de notre présent travail est de comparer l'activité antibactérienne d'une plante médicinale avec certains aliments fonctionnels. Les produits testés sont: le miel naturel de montagne ; deux plantes locales : *Arisarumvulgare et Alliumsativum* (variété blanche et rouge). Les tests des activités antibactériennes ont été réalisés par la méthode de diffusion en milieu gélosé sur trois souches bactériennes : *Staphylococcus aureus, Bacillus cereus* et *Escherichia coli*. Les résultats obtenus sont respectivement les suivants:*S. aureus* (19.66 ± 0.57 mm ; 11.66 ± 0.57 mm; 53±3 mm; 50±1mm), *B. cereus (*13.33 ± 8.73; ≤ 6 mm; 10, 33±0, 577mm; 37±1,732mm), *E.coli*(24±6.08 mm ; 12.33±4.61 mm ; 42,666±3, 214 mm; 34± 1,732mm). En conclusion, le miel et l'ail ont présenté des actions inhibitrices plus fortes par rapport à la plante médicinale *A. vulgare* sur la croissance des bactéries pathogènes testées. Nous pouvons conclure que les deux aliments possèdent en plus des propriétés nutritionnelles de base de bonnes propriétés antibactériennes.

Key words:*Allium sativum, Arisarumvulgare, Staphylococcus aureus, E. coli*, miel naturel local, activité antibactérienne.

GREEN EXTRACTION, BIOACTIVITY, AND TOXICITY ASSESSMENT FOR FOOD SAFETY APPLICATIONS OF NATURAL PRESERVATIVES FROM OLIVE LEAVES

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Abstract:
The search for natural preservatives is intensifying due to the increasing demand for sustainable and safe food additives. This study explores the green extraction of bioactive compounds from olive leaves (*Oleaeuropaea*), with a focus on their antioxidant, antibacterial, and toxicological safety for use as natural preservatives in food systems. Ultrasound-assisted extraction, optimized using a Box-Behnken response surface methodology, was used to recover phenolic compounds. The optimal conditions (20 min, 50% ethanol, 40 °C) yielded 145 mg GAE/g DW. The extracts exhibited strong antioxidant activity (IC50: 24 µg/mL for DPPH and 28 µg/mL for ABTS) and antibacterial efficacy against Staphylococcus aureus and Escherichia coli.
To assess food safety, an in vivo toxicity study was performed using three different concentrations of olive leaf extract: low (25 mg/kg), medium (50 mg/kg), and high (100 mg/kg), with a control group receiving saline solution. The results demonstrated no significant toxicity at low and medium doses, whereas the high dose caused minor liver function alterations, indicating a need for further refinement to ensure safe application in food products. This toxicity assessment is a critical step towards integrating olive leaf extracts into the food industry as natural preservatives.
This research highlights the role of green extraction technologies in enhancing the value of agricultural by-products while supporting the principles of a circular economy. Olive leaf extracts not only provide antioxidant and antibacterial properties but also offer a safe, sustainable, and natural alternative to synthetic food preservatives.

Key words: Olive leaves, natural preservatives, green extraction, antioxidant, antibacterial, toxicity, in vivo, food safety, circular economy.

α-AMINOPHOSPHONATE/ PHOSPHATE *α*-AMINOPHOSPHONATE: SYNTHESIS, DFT CALCULATIONS AND MOLECULAR DOCKING AS ANTI-INFLAMMATORY AGENTS

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Abstract:
The *α*-aminophosphonates are an important class of organophosphorus compounds that have attracted attention due to their structural analogy with amino acids and their broad spectrum of pharmacological applications. The presence of both phosphonate and amine functionalities confers significant biochemical versatility, making these molecules promising scaffolds for drug discovery. Among their diverse biological activities, recent studies suggest potential anti-inflammatory properties, driven by their ability to modulate enzymatic and receptor-mediated processes. In this study, we synthesized and investigated *α*-aminophosphonates and their phosphate analogues to evaluate their stability, reactivity, and potential as anti-inflammatory agents. Density Functional Theory (DFT) calculations were performed at the CAM-B3LYP/6-31G(d,p) level to optimize molecular geometries and predict electronic properties. Global reactivity descriptors and frontier molecular orbital (HOMO/LUMO) analyses provided insights into charge transfer mechanisms and structure–activity relationships. The results indicated that phosphate-substituted *α*-aminophosphonates exhibit improved electronic stability and enhanced reactivity compared to their non-substituted counterparts. To further assess their biological potential, molecular docking simulations were carried out against key inflammation-related target as cyclooxygenase-2 (COX-2). The docking results revealed strong binding affinities, with phosphate α-aminophosphonates forming stable hydrogen bonding and hydrophobic interactions within the active sites. The diethylphosphate group was found to play a crucial role in enhancing these interactions, leading to greater predicted inhibitory activity. Overall, these findings highlight the potential of phosphate α-aminophosphonates as promising anti-inflammatory drug candidates and provide a theoretical foundation for further biological evaluation.
Key words: *α*-Aminophosphonates, phosphates, DFT, molecular docking, anti-inflammatory activity

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EFFECT OF SOLVENTS AND EXTRACTION METHODS ON TOTAL ANTHOCYANINS AND ANTIOXIDANT CAPACITY OF HIBISCUS SABDARIFFA.L

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Abstract:
Medicinal plants are recognized as valuable sources of bioactive compounds and play a key role in traditional and natural medicine. Among them, Hibiscus sabdariffa is distinguished by its high content of anthocyanins, natural pigments belonging to the flavonoid family, known for their antioxidant, anti-inflammatory, and cardioprotective properties, as well as their contribution to immune support. This study investigates the extraction of anthocyanins from hibiscus flowers using two techniques: Conventional Solvent Extraction (CSE) and Microwave-Assisted Extraction (MAE). Both methods employed a water–ethanol solvent system with ethanol concentrations varying from 0% to 100%. The highest anthocyanin yield was obtained at 60% ethanol for both techniques. Results revealed that the traditional CSE method produced 14.46 ± 0.47 mg/g of dry matter, while the modern MAE method achieved a higher yield of 16.34 ± 0.48 mg/g, demonstrating the superior efficiency of microwave-assisted extraction. The antioxidant activity of the extracts was measured by DPPH and FRAP assays. DPPH radical scavenging was slightly higher in the conventional method (195.33 ± 1.66 µM Trolox eq/g), whereas FRAP values were comparable, indicating similar ferric reducing capacity. These findings underline the importance of optimizing extraction parameters to enhance the recovery of bioactive molecules. The results support the potential application of hibiscus anthocyanins in the food, pharmaceutical, and cosmetic industries as natural colorants and functional ingredients.
Keywords: Hibiscus sabdariffa, anthocyanins, antioxidant activity, conventional extraction, microwave-assisted extraction, natural colorant.

PROCESS ENGINEERING APPROACH TO THE BIOTECHNOLOGICAL VALORIZATION OF POMEGRANATE JUICE THROUGH LACTIC FERMENTATION

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Abstract:
Pomegranate (Punica granatum L.) juice is naturally rich in bioactive compounds such as phenolics, flavonoids, and anthocyanins, which are associated with strong antioxidant activity. However, its industrial application is limited due to high acidity, instability of bioactive molecules, and sensitivity to microbial spoilage. The objective of this work was to apply a lactic fermentation process to improve the nutritional and microbiological quality of pomegranate juice.The juice was fermented using a selected lactic acid bacterium, and changes in phytochemical composition, antioxidant activity, and microbial safety were monitored during fermentation and refrigerated storage. Spectrophotometric analyses showed enhanced retention and bioavailability of phenolics and anthocyanins, with a notable increase in antioxidant activity compared to the non-fermented juice. Probiotic viability was maintained throughout storage and under simulated gastrointestinal digestion, confirming the potential of the juice as a carrier for probiotics. In parallel, microbiological analysis revealed the complete absence of pathogens, including coliforms, yeasts, and molds, ensuring the product's safety.This study demonstrates the originality of integrating process engineering and biotechnology to valorize pomegranate juice into a safe, probiotic-rich, and antioxidant-enhanced beverage. Such an approach highlights the role of food process engineering in developing clean-label, functional products that align with consumer expectations and industrial sustainability.
Key words: Pomegranate juice, lactic fermentation, probiotics, process engineering, antioxidant activity, food safety.

CIPROFLOXACIN COOPER (II) COMPLEX: ANTIMICROBIAL EVALUATION, MOLECULAR DOCKING AND ADME PREDICTION STUDIES

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Abstract:
Ciprofloxacin is a fluoroquinolone that was created in 1987. It is sometimes referred to as 1-cyclopro-pyl-6-fluoro-1,4-dihydro-4-oxo-7-(1-piperazinil)-3-quinolone carboxylic acid. It is well-known as one of the greatest fluoroquinolone antibiotics, which is frequently used to treat a variety of diseases brought on by both Gram-positive and Gram-negative bacteria. Its ability to fight bacteria is due to the inhibition of type II topoisomerase (DNA-gyrase) and topoisomerase IV, which are essential for the replication, transcription, repair and recombination of bacterial DNA (deoxyribonucleic acid). The metal complexes of ciprofloxacin and their interactions with DNA are not well-studied, despite the fact that the pressing issue of antibiotic resistance drove a great deal of study in the development of new antibacterial medicines. Herein, we present the an in vitro antimicrobial assay against Escherichia coli, showing that the metal complex demonstrated improved inhibitory activity relative to the free drug. Farthermore, molecular docking study, in order to predict the interactions and binding affinity of the free ligand and the metal complex against the DNA-gyrase enzyme (PDB code 1KZN). Where the metal complex [$Cu(Cipro)_2Cl_2$] showed a better affinity compared to the free ligand. In addition, a pharmacological ADME properties study with Drug likeness was performed for the synthesized complex.
Key words: Cooper(II) complex, Ciprofloxacin, Molecular Docking, DNA-gyrase enzyme, ADME, Antibacterial Agent.

THE ANTIOXIDANT ACTIVITY OF OLIVE LEAVES USING SPECTROPHOTOMETRIC AND DIFFERENTIAL PULSE VOLTAMMETRY METHODS

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Abstract:
The evaluation of the antioxidant activity of olive leaves extract involves studying its ability to neutralize free radicals, which are responsible for oxidative stress in the body. This activity is mainly attributed to the presence of phenolic compounds and flavonoids in olive leaves. Studying antioxidant activity using both chemical and electrochemical methods offers a complementary approach to evaluating a substance's capacity. In the first part of this study, we extracted and quantified the phenolic compounds from olive leaves. The second part then compared the antioxidant capacities determined by cyclic voltammetry with those obtained via spectrophotometry. The results demonstrate that the content of total phenolics was 49.03±0.28 mg of Gallic acid equivalence per 1g of extract, and the content of total flavonoids was 1.28 ± 3.5 ± 0.46 mg of Quercetin equivalence per 1 g of extract. The antioxidant activity, measured via spectrophotometric methods, was expressed as an EC50 value. It showed an EC50 of 9.32 ± 0.56 µg/ml by the DPPH test and 21.08 ± 1.07 µg/ml by the reducing power test (FRAP). The voltammogram obtained from cyclic voltammetry, an electrochemical method, indicates two oxidation peaks with potentials of 174.2 mV and 277.4 mV versus Ag/AgCl, corresponding to peak currents of 81 µA and 83 µA, respectively.

Key words: Phenolic content, Antioxidant capacity, DPV, DPPH, FRAP

LEARNING FOOD REPRESENTATIONS VIA NMF/PCA + NEURAL NETWORKS (HYBRID APPROACH) FOR NEURODEGENERATIVE DISEASE PROGRESSION PREDICTION

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Abstract:
Neurodegenerative diseases (NDs) represent a growing global health challenge, with nutrition increasingly recognized as a modifiable factor influencing disease onset and progression. Traditional approaches for analyzing nutritional data often face limitations due to high dimensionality and the complex interdependence of dietary components. In this study, we propose a hybrid machine learning framework that integrates Non-negative Matrix Factorization (NMF) and Principal Component Analysis (PCA) with neural networks to predict disease progression based on food and nutrient intake patterns. The method was evaluated on synthetic longitudinal data from 1,000 individuals across 48 time points, with the first 47 observations comprising demographic and nutritional variables as well as clinical progression indicators. The hybrid NMF/PCA + Neural Network model achieved an accuracy of 95.5% and an AUC of 0.535, while successfully reducing 50 nutritional features into 20 latent components (60% reduction) with improved interpretability. Key protective nutritional patterns included antioxidants, flavonoids, and polyphenols, whereas demographic factors such as age and education remained strong predictors. These findings highlight the potential of hybrid dimensionality reduction and neural approaches in nutritional epidemiology and their relevance for understanding neurodegenerative disease trajectories.

Key words: Machine learning, dimensionality reduction, NMF, PCA, neural networks, nutritional epidemiology

Essential oils: physicochemical study and prospects for use in plant protection

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Abstract
This study aimed to characterize the physicochemical properties of essential oil extracted from *Citrus sinensis* peels by hydrodistillation and to evaluate its antifungal potential against the phytopathogenic fungus *Fusarium* sp. using the direct contact method. The extraction yield was 0.66%. Organoleptic and physicochemical analyses revealed that the oil exhibited a pale yellow color, a fresh odor, an acidic pH, an acid value of 2.80, and a refractive index of 1.474. Spectroscopic and chromatographic analyses confirmed the presence of two major constituents, limonene and linalool. In vitro antifungal assays showed that the essential oil exerted a significant inhibitory effect on *Fusarium roseum*. Clear inhibition zones were observed even at the lowest tested volume (5 µL), and the inhibitory activity increased proportionally with concentration, reaching an average inhibition diameter of 3.85 cm at 40 µL. These findings demonstrate that the essential oil possesses strong fungitoxic activity, in agreement with previous studies reporting the effectiveness of citrus essential oils against different *Fusarium* species. Overall, the results highlight the potential of citrus essential oils as eco-friendly antifungal agents, offering both chemical and biological value. Their use could contribute to sustainable plant protection strategies while reducing reliance on synthetic fungicides.

Keywords: essential oil, *Citrus sinensis*, physicochemical properties, antifungal activity, *Fusarium* sp.

PROCESS INTENSIFICATION AND GREEN SYNTHESIS OF A NOVEL A-AMINOPHOSPHONATE SCAFFOLD WITH POTENTIAL ANTITUBULIN ACTIVITY FOR PHARMACEUTICAL APPLICATIONS

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Abstract:
α-Aminophosphonates represent an important class of bioisosteres of amino acids, well recognized for their wide spectrum of biological activities, including antimicrobial and anticancer effects. However, their conventional synthesis often suffers from limitations such as reliance on hazardous solvents, expensive catalysts, and inefficient energy consumption, which restricts their scalability and environmental sustainability. In the present work, novel *α*-aminophosphonate derivatives were rationally designed and synthesized through the *Kabachnik–Fields* three-component reaction, selected as a versatile and green synthetic strategy. To intensify the process, critical parameters such as catalyst type, solvent system, and energy input were optimized, giving the desired products in excellent chemical yields. The compounds were confirmed by comprehensive spectroscopic characterization, including NMR, IR, and MS analyses. In addition, the synthesized compounds were computationally evaluated for their pharmaceutical potential. Molecular docking studies demonstrated strong binding affinities toward the tubulin active site, suggesting that these *α*-aminophosphonates could act as inhibitors of tubulin polymerization, a crucial mechanism targeted in anticancer drug development. The significance of this study therefore lies in its dual contribution: the establishment of an environmentally benign, scalable synthetic methodology, and the identification of promising new aminophosphonate scaffolds with potential anticancer activity, providing a solid basis for further biological investigations.

Key words:α-Aminophosphonates, pharmaceutical agent, molecular docking, anticancer drug, *Kabachnik–Fields, NMR, IR.*

PHYTOCHEMICAL INVESTIGATION AND ANTIOXIDANT ACTIVITY OF HELIANTHEMUM RUBELLUM

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Abstract:
Natural products have been major sources of chemical diversity and starting materials for drug discovery over the past century. The genus *Helianthemum* is the largest genus in this family, with more than 140 spread species. In Algerian flora, this genus is presented by more than 40 species. Some of them are important medicinal plants used in several countries for various purposes. However, studies addressing the phytochemistry or biological activities of many of these species are currently lacking; only about 22 species have been investigated for their phytochemical composition. *Helianthemum rubellum* is one such species with only a few published phytochemical studies, and this plant was the subject of the present investigation. Chromatographic separation of a semi-polar extract obtained from aerial parts of the H. rubellum yielded ten compounds: kaempferol, luteolin, luteolin 4′-O-β-xylose, luteolin 4′-O-β-glucoside, quercetin 4′-O-β xyloside, trans-tiliroside, protocatechuic acid, gallic acid, methyl gallate and ethyl gallate. The structures of these compounds were elucidated using extensive spectroscopic methods, primarily UV-Visible spectroscopy, nuclear magnetic resonance (1D: ^{1}H and ^{13}C NMR; 2D: HSQC and HMBC), and mass spectrometry (ESI-MS), as well as by comparison with previously reported spectroscopic data. The organic extract was evaluated for their potent phenolic and flavonoid contents using Folin-Ciocalteu and aluminum chloride colorimetric methods. Furthermore, the antioxidant activity of this extract was determined using the DPPH, FRAP, and ABTS methods. This study revealed that *H. rubellum* extracts exhibit strong antioxidant potential, with the ethyl acetate extract showing the highest activity, followed by the butanolic extract.

Keywords: *Helianthemum rubellum*, Cistaceae, luteolin, gallate, 1D and 2D NMR, ESI, DPPH, FRAP

STUDY OF CONTINUOUS CATALYST REGENERATION REFORMING OF CR 401 CATALYST

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Abstract:
Catalytic reforming represents a crucial upgrading process in petroleum refining for enhancing gasoline octane ratings through the conversion of low-octane naphtha fractions into high-octane aromatic compounds. This study investigates the performance optimization of catalytic reforming processes using highly stable, selective, and reactive monometallic and bimetallic catalysts to valorize atmospheric distillation naphtha while maximizing octane number enhancement. The research focuses on evaluating catalyst performance through dehydrogenation of naphthenes and dehydrocyclization of paraffins reactions. Various monometallic and bimetallic catalyst formulations were tested under controlled reforming conditions to assess their stability, selectivity, and reactivity parameters. Process optimization was conducted by analyzing conversion rates, product distribution, and octane improvement metrics. The catalytic reforming process successfully enhanced naphtha octane rating from 101.6 to a minimum of 102 RON. The developed catalysts demonstrated superior performance in promoting aromatic formation while maintaining structural integrity and catalytic activity over extended operation periods. This work contributes novel insights into catalyst design for naphtha reforming applications, providing enhanced understanding of structure-activity relationships in mono- and bimetallic systems for octane enhancement processes.

Key words: catalytic reforming, naphtha upgrading, octane enhancement, bimetallic catalysts, dehydrogenation, aromatics production.

ADIPIC ACID REINVENTED: GREEN CATALYSIS AND EMERGING PHARMACEUTICAL POTENTIAL

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Abstract:
This work focuses on the valorization of adipic acid, a dicarboxylic acid widely used in the polymer industry, for pharmaceutical applications. A green synthesis method was employed to produce pharmaceutical-grade adipic acid using a Keggin-type polyoxometalates (POMs) catalyst. The compound $HVOPMo_{12}O_{40}$ was selected from a series of vanadyl- and iron-substituted POMs ($HVO_xFe_\gamma PMo_{12}O_{40}$), following structural, thermal, and electrochemical characterization (IR, UV-Vis, XRD, TGA/DSC, cyclic voltammetry).This catalyst achieved a 48.0% yield in the oxidation of cyclohexanone with hydrogen peroxide (H_2O_2) under solvent-free conditions. The resulting product was then characterized physicochemically, with a melting point of 154 °C, a purity of 95.52% (by HPLC), as well as solubility and pH measurements. Biological evaluation of the synthesized adipic acid revealed mild antioxidant activity (11.43% inhibition at 1 mg/mL using the DPPH method) and moderate antimicrobial activity against *Bacillus subtilis* (inhibition zone of 7.75 mm), but no activity against *Pseudomonas aeruginosa*. These results highlight the relevance of adipic acid not only as an excipient but also as a molecule with exploitable biological potential, thereby reinforcing its value in sustainable pharmaceutical applications.

Key words: Adipic Acid ; Pharmaceutical applications ; Polyoxometalates ; Antioxidant activity ; Antimicrobial activity

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EVALUATION OF THE ANTI-INFLAMMATORY ACTIVITY OF AN INCLUSION COMPLEX PIROXICAM – HYDROXYPROPYL- β -CYCLODEXTRINE

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Abstract:
The aim of this study was to assess the anti-inflammatory activity of an inclusion complex formed between hydroxypropyl-β-cyclodextrin (HPβCD) and Piroxicam (PXM), while also investigating its stoichiometry and aqueous solubility. The inclusion complex was prepared, and its stoichiometry was determined using Job's plot, which confirmed a 1:1 molar ratio. Solubility phase study was evaluated using the Higuchi and Connors method, revealed a notable improvement in the solubility of PXM, increasing it from 2.2 µM to 9.2 µM, potentially leading to enhanced bioavailability and a faster onset of action. The heat-induced bovine serum albumin (BSA) denaturation method in vitro was employed to evaluate anti-inflammatory activity. The results demonstrated that the inclusion complex exhibited superior efficacy compared to the free drug. These findings highlight the potential of the inclusion complex to not only enhance the solubility of PXM but also improve its therapeutic performance. This approach could be further explored for other poorly soluble drugs, offering a promising strategy for developing more effective pharmaceutical formulations.

Key words: Inclusion complex, hydroxypropyl-β-cyclodextrin, Piroxicam, anti-inflammatory.

BIOPRODUCTION OF LIPASE FROM *CANDIDA* SP. USING AGRO INDUSTRIAL WASTES: A SUSTAINABLE APPROACH FOR INDUSTRIAL APPLICATIONS

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Abstract:
In Algeria, lipases used in various industrial sectors including food, detergent, and pharmaceutical industries are fully imported, creating a significant economic burden. This study aims to produce an industrially relevant yeast lipase from a *Candida sp.* strain, selected based on its dual enzymatic activity on Tween 80 and olive oil. Lipase production was evaluated under both solid-state fermentation (SSF) and submerged fermentation (SmF) using agro-industrial residues such as mastic waste and olive pomace as substrates and support materials to replace the high cost media. The influence of additional nitrogen and carbon sources, as well as the interaction of various process factors, was studied to optimize enzyme production. Results showed that the best lipase yield was achieved under SSF using mastic waste. Among nitrogen sources, yeast extract significantly enhanced lipase production, while peptone, corn steep liquor, NH_4Cl_2, and $(NH_4)_2SO_4$ had no distinct effect. The addition of sugars did not significantly improve production. However, Tween 80 led to the highest activity of 1378.08 U/g, doubling the baseline level. The best conditions Tween 80, yeast extract, and pH 5 resulted in an activity of 1243.34 U/g. These findings highlight the potential of agro-industrial by-products as cost-effective substrates for enzyme production, contributing to sustainable bioprocess development and industrial independence in enzyme supply.

Key words: Lipase, *Candida* sp, Mastic waste, SSF, Bioprocess development.

PREPARATION, CHARACTERIZATION AND CATALYTIC PERFORMANCE OF CoO/SiO_2 CATALYSTS : EFFECT OF THE PREPARATION SOLVANT

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Abstract:
The hydrogenation of carbonyl compounds into their corresponding alcohols is a reaction of significant importance in the fine chemistry. The resulting alcohols, such as benzyl alcohol, are key intermediates used in phamaraceutical, cosmetic and agri-food applications. Industrially, their synthesis typically involved multiple steps and requires highly selective catalytic processes. The aim of this work is to prepare, characterize and evaluate cobalt based catalyst in the hydrogenation of benzaldehyde. The catalysts were prepared by wet impregnation method using different solvants: water, sodium hydroxide and ammonia. The resulting materials were characterized using X-Ray deffration (XRD) , thermogravimetric analysis (TGA) , and scanning electron microscopy (SEM) Prior of catalytic testing 0.2 g of each catayst was pretreated under a hydrogen flow at 250°C for 02 hours.Hydrogenation reactions were conducted at 160°C and 200°C. Reaction products were analyzed online using gas chromatochraphy (CG) equipped with a flame ionization detector (FID) The results showed that al catalysts exhibited good thermal stability and catalytic activity , with conversion rates ranging from 2% to 87 %. However, selectivity toward benzyl alcohol was low. Higher temepratures favored increased conversion but decreased selectivity promising side reactions and the formation of benzene and toluene.
Key words: Benzaldehyde hydrogenation, Cobalt-catalyst, Benzyl alcohol, Solvant effect.

OPTIMIZATION OF ULTRASONIC-ASSISTED EXTRACTION OF BIOACTIVE COMPOUNDS AND BIOACTIVITIES OF SECONDARY DATE FRUIT CULTIVARS: IMPLICATIONS FOR PROCESS ENGINEERING AND INDUSTRIAL DEVELOPMENT

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Abstract:
This research focused on enhancing the extraction efficiency of total phenolic content (TPC) and antioxidant capacity of date fruits through an ultrasonic-assisted process optimized by response surface methodology (RSM). Primary factors included solvent concentration (20–80% ethanol), sonication amplitude (30–100%), and extraction duration (5–45 min). By applying the Box–Behnken design in JMP software, the optimal parameters were determined as 63% ethanol, 81.50% ultrasound amplitude, and 18.30 min extraction time. These conditions yielded 533.72 mg GAE/100 g of TPC, 766.97 mg GAE/100 g DW of reducing power, 76.697± 1.97 % of DPPH scavenging potentiel and 71.20 ± 0.03 % of chelating capacity. Extracts exhibited strong anti-inflammatory, enzymatic and antimicrobial potential, with mean BSA denaturation averaging 79.15 ± 3.44 %, acetylcholinesterase α amylase inhibition showing an IC_{50} of 411.12±2.15 µg/mL, and inhibition zones diameters ranging from 1.5 to 2.8 cm, particularly against Gram-positive bacteria Staphylococcs aureus. The developed predictive models exhibited strong statistical significance ($P < 0.01$) and high determination coefficients ($R^2 \geq 0.99$), while the lack-of-fit test showed no significant deviation. Overall, RSM proved to be a reliable tool for modeling and optimizing the recovery of phenolic constituents and antioxidant potential in date palm fruits. Such optimized extraction strategies not only advance process engineering by improving efficiency and reducing energy inputs but also open new avenues for scaling up to industrial production. Implementing this approach could support the development of high-value functional ingredients from underutilized date varieties, contributing to the growth of food, nutraceutical, and cosmetic industries.
Key words: Date cultivars, Ultrasonic-assisted extraction, Bioactive compounds, Bioactvities, Process optimization, Industrial valorization.

PHYTOCHEMICAL SCREENING AND REDUCING CAPACITY OF TREE EXTRACTS OF PLANT BELONG TO THE ROSACEAE FAMILY

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Abstract:
The aim of this research work was designed to evaluate the phytochemical composition and investigated the reducing capacity of tree extracts of a plant belong to the *Rosaceae* family. Extracts were prepared by sequential maceration of the powder aerial parts of the studied plant. Subsequently, liquid-liquid extraction using solvents with increasing polarity, namely $CHCl_3$, EtOAc and *n*-BuOH, then, several procedures were carried out on RCh, RAc and RBu extracts. Following, screening tests were done along with thin layer chromatography (TLC) for the detecting and characterization of polyphenols and the flavonoids. Furthermore, the reducing power was estimated by FRAP assay to explore the antioxidant activity. The preliminary phytochemical screening of the three selected extracts reflected the presence of polyphenols, tannins, flavonoids and terpenoids. Mainly, TLC profiling of RAc and RBu extracts showed the presence of flavonoids and in RCh extract the presence of terpenoids. The RAc extract revealed a remarkable reducing power with $A_{0.5}$ value of (04.06 ± 0.46 µg/mL) comparing with two standards ascorbic acid of (03.62 ± 0.29 µg/mL) and Trolox with (05.25 ± 0.20 µg/mL). Hence, the reducing capacity of the mention extract may serve as a significant indicator of a source of bioactive molecules. Therefore, it can be concluded that the polyphenols and particularly flavonoids detected in acetate extract may constitute an excellent antioxidant agent.
Key words: Rosaceae family, phytochemical screening, TLC, FRAP assay.

SYNTHESIS OF A NEW MANNICH TYPE β AMINO KETONE: ANTIOXIDANT EVALUATION AND DOCKING SIMULATION

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Abstract:
Given the biological significance of β-amino ketone compounds and the synthetic challenges in obtaining enantiomerically pure forms, a new series of Mannich-type β-amino ketone derivatives was successfully synthesized, with exclusive formation of the anti-enantiomer. These compounds were fully characterized and extensively evaluated for their biological activities. Antioxidant properties were assessed using the DPPH radical scavenging assay, and the results demonstrated excellent antioxidant activity for the synthesized molecules. In addition, molecular docking simulations were conducted to investigate the interaction of the compounds with key biological targets, particularly acetylcholinesterase and tubulin. The anti-enantiomers exhibited strong binding affinities, suggesting potential anti-Alzheimer's and anticancer activities. The docking analysis revealed multiple hydrogen bonding and hydrophobic interactions with critical amino acid residues in the active sites, supporting their strong inhibitory potential.
Furthermore, ADMET (absorption, distribution, metabolism, excretion, and toxicity) profiling showed that the compounds possess favorable drug-likeness properties. Specifically, they were predicted to cross the blood–brain barrier and to comply with Lipinski's Rule of Five, indicating potential oral bioavailability and activity within the central nervous system. In conclusion, these newly synthesized Mannich-type β-amino ketone derivatives exhibit promising pharmacological profiles and represent valuable candidates for further development as therapeutic agents targeting oxidative stress, neurodegenerative diseases, and cancer. The synthesized anti-β-amino ketone derivatives show great potential as lead compounds for future drug development.

Key words: Mannich, β-amino ketone, Anti-Syn isomers, antioxidant activity, docking, antialzheimer, anticancer, ADMET study

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ENCAPSULATION OF A HYDROPHOBIC DRUG IN PROTEIN NANOPARTICLES

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Abstract:
Protein nanoparticles with their low toxicity, biodegradability, and their abundance in natural sources make them attractive targeted drug delivery vehicles. There are a number of ways to obtain these nanoparticles, including desolvation (Gelatin was utilized in this work), which produces nanospheres. This study focuses on the preparation of gelatin nanoparticles by two steps desolvation method. Coester et al. developed this synthesis method based on two steps of desolvation by modifying the desolvation method of Marty et al. The desolvating agent, usually represented by acetone. The crosslinking agent chosen was glutaraldehyde to stabilize the precipitated gelatin nanoparticles. A hydrophobic drug has been selected for encapsulation by this protein to enhance its solubility. The synthesis was successful, yielding gelatin nanospheres both with and without drug substance. Analysis via scanning electron microscopy (SEM) confirmed the spherical shape of the particles. Furthermore, their size was verified to be within the nanometric range, specifically between 100 and 150 nm.

Key words: *Encapsulation, Nanoparticles, Desolvation, Protein, SEM.*

ENHANCING AMMONIUM NITRATE QUALITY VIA TARGETED ADJUSTMENTS IN INDUSTRIAL FERTILIZER PRODUCTION

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Abstract:
Ammonium nitrate is a key component in the production of nitrogen-based fertilizers and represents a critical product within the Fertial complex, which integrates the manufacture of phosphate, nitrogen fertilizers, and ammonia. Ensuring the stability and quality of ammonium nitrate is essential both for agronomic efficiency and industrial safety. This study aimed to enhance the quality and reliability of ammonium nitrate production through targeted modifications in the industrial process. Several technical adjustments were introduced directly at the production unit. First, a pH meter was installed at the concentrator, allowing continuous monitoring and more precise control of solution acidity, a key parameter for product stability and crystallization. Second, a newly designed concave plate (1 mm thickness) was implemented within the unit, improving flow dynamics and contributing to better process control. Finally, the addition of dolomite to calcium ammonium nitrate (CAN 27) was incorporated into the formulation, providing stabilization while enhancing the final product's agronomic performance. The modified process was systematically evaluated through an in-depth analytical program conducted in the on-site Fertial laboratory, where parameters such as chemical purity, granule strength, and moisture content were assessed. The results demonstrated marked improvements in product homogeneity, mechanical resistance, and storage stability compared to baseline production. These findings confirm that relatively straightforward yet targeted engineering interventions can significantly enhance both the quality and robustness of ammonium nitrate production, supporting Fertial's strategy of continuous innovation and industrial optimization.
Key words: Fertial Arzew; Nitrogen fertilizers; Ammonium nitrate; Process optimization; Product homogeneity; Quality enhancement.

EVALUATION OF THE ANTI-INFLAMMATORY ACTIVITY *IN VIVO* AND *IN VITRO* OF FENUGREEK EXTRACTS

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Abstract:

Fenugreek (*Trigonella foenum-graecum* L.) is a medicinal plant belonging to the Fabaceae family, a well-known medicinal plant in traditional medicine. This study focuses on the evaluation of the anti-inflammatory activity of fenugreek (*Trigonella foenum-graecum* L.) seeds. Two types of extracts were prepared by maceration: an aqueous extract and an ethanolic extract. The *in vitro* analysis made it possible to measure the ability of these extracts to inhibit albumin denaturation. The results showed significant activity, with CI50 values of 86.48 µg/ml for aqueous extract and 83.93 µg/ml for ethanolic, compared to 129.35 µg/ml for aspirin, used as reference substance. The *in vivo* evaluation was performed using the carrageenan-induced edema model. The ethanolic extract showed the best efficiency, with a reduction in inflammation of 62.76%, higher than that of diclofenac (58.21%). The aqueous extract achieved a more moderate effect, with a reduction of 52.06%. In conclusion, these results suggest that fenugreek seeds possess an interesting anti-inflammatory potential, justifying their valorization in the pharmaceutical and preventive fields.

Key words: Anti-inflammatory activity, *In vitro*, *In vivo*, *Trigonella foenum-graecum* L.,

HEMOLYTIC ACTIVITIES AND A-AMYLASE INHIBITORY OF *ARISARUM VULGARE* EXTRACTS: INSIGHTS INTO SAFETY PROFILE AND ANTIDIABETIC POTENTIAL

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Abstract
Arisarum vulgare is a medicinal plant traditionally used in North African folk medicine, yet its bioactive potential remains insufficiently characterized. This study aims to evaluate the hemolytic activity of the extracts to assess their potential interaction with cell membranes and ensure safety. Subsequently, the α-amylase inhibitory activity is investigated to explore the potential antidiabetic properties of the extracts. The plant material collected in November 2024 from Tlemcen was dried, then subjected to aqueous reflux extraction. The hemolytic activity was tested on human erythrocytes, and the α-amylase inhibitory activity was determined by the DNSA (3,5-dinitrosalicylic acid) method. The results revealed that the aqueous extract from dried tubers (AQT) exhibited an IC_{50} of 3.709 mg/mL, while the aqueous extract from aerial parts (AQA) showed an IC_{50} of 6.441 mg/mL. Indicating low membrane-disruptive effects and suggesting a favorable safety profile. In the α-amylase inhibition assay, (AQT) exhibited an IC_{50} of 1.082 mg/mL, (AQA) showed a markedly lower IC_{50} of 0.268 mg/mL, indicating stronger inhibitory potential. Acarbose, the reference inhibitor, displayed an IC_{50} of 0.111 mg/mL.These findings suggest that AQA possesses notable α-amylase inhibitory activity, approaching that of the standard drug. The aqueous extract of *Arisarum vulgare* aerial parts demonstrated potent α-amylase inhibitory activity with minimal hemolytic effects, suggesting promising antidiabetic potential and a favorable safety profile.These results support further phytochemical and pharmacological investigations to identify and characterize the active constituents that may contribute to the development of plant-derived agents in pharmaceutical applications.

Keywords: *Arisarum vulgare*, medicinal plants, hemolytic activity, α-amylase inhibition, antidiabetic potential

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CALIBRATION OF NON-AUTOMATIC WEIGHING INSTRUMENTS

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Abstract:

Metrology plays a fundamental role in many fields, and weighing scales are a prime example. These measuring instruments are essential in sectors such as industry, pharmaceuticals, and scientific research and must meet strict standards of precision, accuracy, and reliability.
Calibration of non-automatic weighing instruments is a key step in securing mass measurements, essential in sectors such as industry, commerce, and laboratories. This operation checks that the instrument's indications conform to reference values, particularly those provided by certified mass standards. In doing so, it ensures the accuracy of results and detects any potential metrological drift. The objective of our work is to calibrate two types of non-automatic weighing instruments a laboratory balance and a commercial balance and then prepare the corresponding calibration certificates.The results obtained highlighted the importance of following a rigorous approach during calibration, in order to guarantee the reliability of the measurements and ensure compliance with regulatory requirements.

Key words: Calibration, non-automatic weighing instruments, calibration certificates, accuracy, reliability.

CONVERSION OF ISOPROPANOL OVER MODIFIED COPPER CATALYSTS

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Abstract:

The catalytic conversion of isopropanol via dehydrogenation and dehydration has emerged as a topic of considerable interest due to its ability to produce high-value chemical compounds efficiently. In the dehydrogenation reaction, isopropanol is transformed into H_2 and acetone, a crucial solvent and versatile intermediate in the synthesis of pharmaceuticals, polymers, and fine chemicals. Meanwhile, dehydration of isopropanol generates propene, a fundamental building block for polypropylene and a variety of other petrochemical products. The present work deals with the effect of iron or cobalt on the properties of copper supported silica catalyst in the selective conversion of isopropanol. The solids were prepared by impregnating an aqueous suspension of the support with metal nitrate. They were characterized by their BET surface area, atomic absorption spectroscopy, X-ray diffraction and infrared spectroscopy. Isopropanol conversion was investigated at atmospheric pressure in a dry inert atmosphere. The results show that dehydrogenation and dehydration reactions occur via parallel elimination pathways, leading respectively, to acetone (via α-hydrogen elimination) and propene (via β-hydrogen elimination). Acetone is the main reaction product, likely formed via catalytic pathway involving basic sites and/or redox properties. The highest dehydrogenation efficiency was observed in the presence of cobalt.

Key words: Isopropanol; Dehydrogenation; Dehydration; Catalyst.

OPTIMIZATION OF THE EXTRACTION YIELD AND PURIFICATION OF CAPSAICIN EXTRACTED FROM ALGERIAN RED CHILI PEPPERS

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Abstract:
Algeria ranks 6th worldwide in red chili pepper production. Capsaicin extracted from red chili peppers offers health benefits, making it a valuable raw material for pharmaceutical preparations. This study aims to optimize the yield of extraction and purification of capsaicin from red chili peppers (*Capsicum annuum* L). Additionally, the extract is valorized through physicochemical characterization and microbiological analysis. The chili pepper extract was obtained using a solid-liquid extraction process via the Soxhlet method. Optimization of the extraction yield was carried out using experimental design methodology. The optimal resolution indicates that the best extraction yield of capsaicin using the Soxhlet method (32.3%) is achieved with a mass/solvent ratio of 1/8 and 4 extraction cycles. The purification of capsaicin was performed by decantation with pure castor oil, and the qualitative characterization of the extracts was carried out using spectroscopy (UV-Vis, IR) and HPLC chromatography. The UV-visible analysis of the capsaicin extract after purification showed a single absorption band at approximately 279 nm, which characterizes the maximum wavelength of capsaicin. These results were confirmed by IR spectroscopy.
HPLC analysis revealed two retention times at 6.09 min and 6.79 min, corresponding to capsaicin and dihydrocapsaicin, respectively.

Key words: *Capsicum annuum* L; Capsaicin; Optimization; Purification; Microbiology

LACTOBACILLI PRODUCING ANTIMICROBIAL SUBSTANCES INHIBITING PATHOGENS: CASE OF ORGANIC ACIDS

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Abstract:
Lactic acid bacteria play a leading role in the production of fermented food products due to their preservative role.In this study we aim to isolate and select Lactic acid bacteria (LAB)from traditional fermented dairy products characterized with antagonist effect against certain pathogenic bacteria associated with foodborne illnesses. LAB were isolated using MRS agar and a pre-identification was carried out based on phenotypic and biochemical study including Gram staining, catalase test, endospore formation, production of CO_2 from glucose and sugar fermentation. The inhibitory capacity of Cell free supernatant (CFS) of the LAB was evaluated against Gram positive and Gram-negative pathogenic bacteriausing well diffusion assay. To investigate the natural of the substance responsible for the inhibition; the effect of organic acids was eliminated by adjusting the pH of the CFS to 6.5 using NaOH 1N. The results show a significant capacity of the isolates to inhibit growth of pathogenic bacteria with diameters attend 14 mm, 13.5 mm and 16 mm against*Pseudomonas aeruginosa* ATCC 27853, *Staphylococcus aureus* ATCC 25923 and *Bacillus cereus* ATCC 11778 respectively. The biochemical tests allowed to determine the isolates as belonging to *Lactobacilli* group. Neutralizationof organic acid effect of the CFS leaded to absence of inhibition zones confirming their role in the antagonist activity.
Interestingly, this research highlights the importance of organic acids as biomolecules of interest as an effective preservationmolecules.Further study is recommended to characterize the organic acids involved in pathogens inhibition particularly through the use of High-Performance Liquid Chromatography (HPLC).

Key words: Lactic Acid Bacteria, antimicrobial activity, organic acid, phathogenic bacteria.

SYNTHESIS AND ANTIMICROBIAL ACTIVTY OF SYMMETRICAL DIQUATERNARY *AMMONIUM* SALT BEARING BIS 1,3,4-OXADIAZOLE *HETEROCYCLIC* RINGS

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Abstract:
In the past years, the literature is enriched with progressive findings about the synthesis and pharmacological action of fused heterocycles. 1,3,4-oxadiazole constitute an important class of heterocyclic compounds possessing a wide spectrum of biological activities. Several compounds of this class have been screened for biological activities such as antimicrobial, antimalarial, anti-inflammatory, cytotoxicity, Also compounds containing a 1,3,4-oxadiazole ring display a broad spectrum of biological activities for new drug development. The present study reports the successful synthesis and antimicrobial activity of novel bis-1,3,4-oxadiazole compound containing quaternary ammoniums salts moiety, the heterocyclic compounds were synthesized by ring-closing reactions, and quaternary ammonium salt was obtained by *N*-alkylation with 2-(dimethylamino)ethyl methacrylate (DMAEMA) and 2-(diethylamino) ethyl methacrylate *(DEAEMA)*. The compounds were characterized using spectroscopic techniques and evaluated for their antibacterial and antifungal activity. All the newly synthesized compounds showed satisfactory analytic data for the proposed structures, which were confirmed by IR and NMR (^{1}H and ^{13}C) spectroscopy. The results of biological tests indicated that most of the synthesized compounds exhibited promising results and make 1,3,4-oxadiazole with quaternary ammoniums salts moieties interesting lead molecules for further synthetic and biological evaluation.

Key words: Quaternary ammonium salts, 1,3,4-oxadiazole, antimicrobial activities.

ANTIMICROBIAL ACTIVITY OF AQUEOUS EXTRACT OF *MORUS ALBA* AND *MORUS NIGRA*

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Abstract:

This study investigates the antibacterial activity of aqueous extracts from two Moraceae species—*Morus alba* and *Morus nigra*—collected from the Djelfa and El Hamel (M'Sila) regions. The extracts were obtained by infusion and tested in vitro on five bacterial strains using both qualitative (aromatogram) and quantitative (solid medium dilution) methods. To our knowledge, this is the first study to assess the antibacterial activity of *Morus alba* and *Morus nigra* aqueous extracts collected from these specific Algerian regions.Extraction yields were 9% for *Morus nigra* and 3% for *Morus alba*. Both extracts demonstrated significant inhibitory effects against *Escherichia coli*, *Staphylococcus aureus*, and *Klebsiella pneumoniae*, with inhibition zones ranging from 25 to 35 mm. *Pseudomonas aeruginosa* was resistant to both extracts. Minimum inhibitory concentrations (MICs) ranged from 0.2 to 0.5 g/ml, depending on the strain and extract. *Morus nigra* extract showed the highest activity, particularly against *E. coli* (MIC = 0.2 g/ml). Minimum bactericidal concentration (MBC) results indicated no bactericidal effect, with MBC/MIC ratios confirming a bacteriostatic mode of action. These findings highlight the potential of *Morus alba* and *Morus nigra* aqueous extracts as sources of natural antibacterial agents.

Key words: *Morus alba, Morus nigra,* aqueous extract, antimicrobial activity, MIC, MBC

ENHANCING THE EXTRACTION OF ROSEMARY ESSENTIAL OIL THROUGH LOW-DOSE GAMMA IRRADIATION

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Abstract:

Gamma rays are known for their influences on plant growth and development by inducing changes in cells and tissues. This study aims to determine the influence of gamma-irradiation process on the yield and extracted essential oils content from either non irradiated and irradiated rosemary leaves. The samples were treated at different gamma rays doses (5, 10, 15, 20, 30, 40 and 50 KGy) using cobalt 60 as the irradiation source. Essential oils (EO) were extracted from dried rosemary leaves, which irradiated or non- irradiated by hydrodistillation using Clevenger-type apparatus. To identify the components of rosemry essential oils, GC-MS analyses were carried out for those irradiated or non- irradiated. The experimental results show that the extraction yield is affected by the variation of the doses used during the pretreatments. The yield of essential oil increases with the increase in the dose and then decreases , the higher yield was obtained at a dose of 20KGy, i.e. 1.68%. 1,8cineole, camphor, endo-borneol andD-limonene were found to be as the main compounds of the essential oil of non-irradiated rosemary leaves. The essential oils of different irradiated rosemarysamples showed the same chemical compounds. However, the gamma-irradiated rosemary by 30kGy caused a decreasing in content of some essential oils components.

Key words: Rosmarinus officinalis L., Extraction yield, Essential Oil Composition, Gamma Irradiation.

NUTRITIONAL PROFILING AND SENSORY EVALUATION OF COUSCOUS TYPES PRODUCED IN BLIDA

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Abstract

Couscous, inscribed in UNESCO's intangible cultural heritage in 2020, holds significant sociocultural importance in Algeria and North Africa. This study aims to determine the nutritional value, culinary qualities, and sensory characteristics of seven types of artisanal couscous known in the Blida region: whole wheat couscous, barley couscous, corn couscous, acorn couscous, carob couscous, oregano couscous, and el hamama. These are compared to a control sample made from durum wheat. To achieve this objective, a nutritional analysis (moisture content, ash content, proteins, lipids, fibers, total carbohydrates) was conducted according to AFNOR standards 1991. Total phenols, antioxidant activity, color indices, culinary quality (swelling index, degrees of deliquescence), and organoleptic quality were also evaluated. The results show that nutritionally, carob couscous is the richest. All samples exhibit good cooking aptitude, with homogeneous and non-sticky granules for carob and corn. The tasting test reveals that oregano and acorn couscous are the most appreciated, featuring well-separated and non-clumped grains.

Keywords: couscous, physicochemical characteristics, culinary quality.

BRIDGING SYNTHESIS AND APPLICATION: AN INTEGRATED PROCESS-ORIENTED STUDY OF NOVEL AZO-PHOSPHONATES AS POTENTIAL ANTIBACTERIAL AGEN

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Abstract:

Compounds containing a nitrogen with a double bond, such as (-C=N-) or (-N=N-) moieties, exhibit various biological applications. Specifically, the (-N=N-) moiety, when conjugated with aromatic rings, is referred to as azo dyes, which are an important pharmacophore. These compounds find widespread applications in diverse sectors, including textiles and cosmetics, liquid crystal displays, selective colorimetric sensing of ions, the photovoltaic industry, and in the biological field. In this context, we have designed α-aminophosphonate derivatives containing azo dye groups, through an eco-friendly reaction conditions using diphenylphosphate as organocatalyst. The reaction, conducted at room temperature in ethanol as green solvent, within 20 minutes and yielded up to 90%. The compounds underwent characterization through IR, UV-vis, NMR (^{1}H, ^{13}C, ^{31}P), and HRMS. DFT calculations using the B3LYP 6-311G (2d, p) basis set were performed for geometry optimization, stability, and reactivity studies, including HOMO/LUMO, ΔEgap and different descriptors. Molecular docking studies showed strong interactions between the synthesized compounds and proteins with various binding affinities. Notably, diethyl (4-biphenyl (4-phenyldiazenyl) phenylamino) methylphosphonate exhibited the highest antibacterial potential, making it a promising candidate for further study.

Key words: 4-phenyldiazenyl phenyl aminophosphonates, DFT, antibacterial, molecular docking

LIQUID-LIQUID EXTRACTION OF MOLYBDENUM (VI) FROM AQUEOUS SOLUTION USING 1-HYDROXYHEXADECYLENE-1,1-DIPHOSPHONIC ACID

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Abstract:
The objective of this study is to synthesize a new organophosphorus diphosphonic acid-type extractant molecule with high extractability and improved selectivity in the separation, purification and recovery of various metals. The synthesized diphosphonic acid HPHPA has been the subject of application tests, particularly in the liquid-liquid extraction of molybdenum (VI) from a synthetic molybdenum solution.
A parametric study of the extraction of molybdenum (VI) was carried out on different factors, namely: the contact time, the initial concentration of the metal, the acidity of the aqueous phase, the ratio of the volumes of the two phases V_{aq}/V_{org}, the concentration of the diphosphonic acid, and the temperature.
The optimum conditions obtained were: contact time = 25 min, [Mo(VI)] = 0.0005M, [HNO_3] = 0.001M, (Vaq/Vorg) = 1, [HPHPA] = 0.3M, and temperature = 20°C. The values of the thermodynamic properties ΔH°, ΔS°, and ΔG° of the molybdenum(VI) extraction show respectively the exothermic nature of the extraction process, the low affinity of the extractant towards molybdenum(VI), and its slightly favorable feasibility at low temperature.

Key words: Diphosphonic acid, HPHPA, Synthesis, Molybdenum (VI), Liquid–liquid extraction, FTIR.

CARACTERISATION PHYSICO-CHIMIQUE DES SILICES PHARMACEUTIQUE

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Abstract:

La silice est un élément très abondant dans la nature, ce qui lui permet d'être présente dans presque tous les domaines industriels, y compris le domaine de construction et le domaine pharmaceutique. La présente étude tend à une caractérisation physico-chimique des silices amorphes (la silice colloïdale anhydre et le gel de silice amorphe) et leur pertinence pour les applications pharmaceutiques. L'étude combine une revue des propriétés intrinsèques de la silice avec une analyse expérimentale approfondie (notamment essais de pH, chloreur, rhéologie, FTIR et MEB-EDX). Les résultats des caractérisations de DRX et de MEB-EDX confirment la haute pureté des matériaux et révèlent une morphologie de particules sphériques et sub-sphériques de taille très fine inférieure à 10 µm, agglomérées sous forme de structures poreuses, essentielles pour leur fonctionnalité. L'étude rhéologique démontre que la silice colloïdale a un impact majeur et très significatif sur l'épaississement de la formulation de base. En définitive, cela nous confirme que le gel de silice anhydre est un agent anti-agglomérant ainsi qu'un désintégrateur efficace. Les autres tests effectués prouvent la pleine conformité des silices aux exigences rigoureuses des pharmacopées, validant ainsi leur rôle indispensable comme excipients polyvalents et sûrs dans la formulation des produits de santé.

Key words: Excipient Pharmaceutique, Gel de silice Amorphe, Silice colloïdale anhydre.

PHENOLIC COMPOSITION AND TYROSINASE INHIBITORY POTENTIAL OF ARTEMISIA HERBA-ALBA EXTRACT: IN VITRO AND IN SILICO INSIGHTS

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Abstract:
Artemisia herba-alba Asso, a medicinal plant widely used in North African traditional medicine, is recognized for its abundance of bioactive secondary metabolites. This work investigated the phenolic fraction of *A. herba-alba* with emphasis on its potential as a natural tyrosinase inhibitor, given the enzyme's central role in melanin biosynthesis.
The phenolic profile of the hydroalcoholic extract was characterized using LC–MS, revealing a diversity of compounds including phenolic acids (gallic, caffeic, ferulic, salicylic, cinnamic), flavonoids (quercetin, kaempferol, luteolin, naringenin), and vanillin. Quantitative analysis showed that flavanones, particularly naringenin (127.67 $\mu g \cdot g^{-1}$), dominated the composition, followed by vanillin (51.78 $\mu g \cdot g^{-1}$), luteolin (14.03 $\mu g \cdot g^{-1}$), and quercetin (8.21 $\mu g \cdot g^{-1}$). The extract exhibited strong tyrosinase inhibitory activity with an IC_{50} value of 4.20 $\mu g \cdot mL^{-1}$, confirming its biological relevance, docking simulations further showed that major phenolics, notably naringenin, luteolin, and quercetin, interact favorably with the tyrosinase active site through hydrogen bonding and hydrophobic contacts, supporting the in vitro inhibition observed.
Overall, the study provides new evidence that *A. herba-alba* phenolic compounds possess potent antityrosinase activity, supporting their potential application in the development of safe and effective natural agents for cosmetic and pharmaceutical use against hyperpigmentation disorders.

Key words: Artemisia herba-alba, phenolic compounds, tyrosinase inhibition, molecular docking.

BROMELAIN FROM PINEAPPLE: EXTRACTION, APPLICATIONS, AND BY-PRODUCT VALORIZATION

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Abstract:
Pineapple (*Ananas comosus*) is a tropical fruit rich in bromelain, a proteolytic enzyme complex with significant applications in food technology and health care. However, efficient recovery of bromelain and valorization of pineapple by-products remain challenging in the context of sustainable agro-industrial development. The objective of this work was to optimize bromelain extraction while exploring innovative valorization pathways for pineapple residues. Extraction was carried out using ammonium sulfate precipitation followed by centrifugation, applying a full factorial design to identify optimal parameters. The best recovery (990 mg) was obtained at 60% ammonium sulfate saturation and 5000 rpm centrifugation. The crude enzyme extract demonstrated multiple applications in the food sector, including meat tenderization, milk coagulation, improvement of bread quality, and prevention of enzymatic browning in potatoes. Moreover, bromelain exhibited therapeutic potential with anti-inflammatory, wound healing, cardiovascular protective, digestive, and anticancer effects, in addition to emerging evidence of a supportive role in COVID-19 management. In parallel, pineapple peels—often discarded as waste—were successfully processed into value-added products such as syrup, jam, paste, and fermented beverages. This integrated approach highlights bromelain's multifunctionality while reducing agro-industrial residues, thus contributing to sustainability and circular economy practices. These findings underline the originality of combining enzyme recovery with waste valorization and position pineapple as a strategic resource for both food biotechnology and pharmaceutical industries.

Key words: Bromelain, Pineapple, Extraction, Food applications, Therapeutic, Valorization

MISE AU POINT D'UN BIOPROCÉDÉ VERT POUR LA PRÉPARATION D'UN AMIDOPROFÈNE, COMME PRO-MÉDICAMENT, IMPACT DE L'INTRODUCTION DES DESSÉCHANTS

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Abstract
Les lipases, en particulier, la lipase de *Candida antarctica*, fraction B, immobilisée sur un support hydrophobe (*Novozym®435*), est la plus exploitée en biotechnologies industriels. Les réactions d'acylation catalysées par des lipases sont les plus utilisées pour la création des liaisons esters et amides. La réaction d'amidation par condensation directe acide carboxylique-amine catalysée par la *Novozym®435* s'est avérée comme une alternative eco-compatile, par le fait que le seul déchet est l'eau . Afin d'éliminer l'eau produite, plusieurs méthodes peuvent être appliquées telles que : forte pression distillation azéotropique, en utilisant des solvants hydrophobes ou en introduisant des desséchants Dans la continuité de nos travaux orientés vers l'utilisation des biocatalyseurs pour la préparation des briques moléculaires chirales d'intérêt pharmacologique, nous avons envisagé d'étudier quelques paramètres ayant un impact crucial sur la réactivité enzymatique lors de l'amidation biocatalysée du *(S)*-ibuprofène. Cette approche obéit à certains critères de la chimie verte et permet l'obtention de quantités substantielles d'amidoprofènes, qui vont être valorisés ultérieurement par l'évaluation de leur bioactivité. Amidation directe du (S)-ibuprofène catalysée par la *Novozym®435* dans un 1 mL d'heptane, à 80°C pendant 72 heures. Trois dessiccants sont examinés : (TM4Å, $MgSO_4$, K10). Une évaluation *in silico* du profil toxicologique et de drug-likeness a permis le choix du meilleur candidat pour l'évaluation *in vivo*.Une nette optimisation de la réactivité lipasique au cours de la réaction d'amidation en présence du $MgSO_4$ et de K10. Des rendements isolés de l'ordre 90 % sont atteints. Le dérivé (S)-N-benzyl-ibuprofène a été retenu comme candidat prioritaire avec un profil *in silico* favorable.
Key words: *Novozym®435*, amidation enzymatique, Montmorillonite K10, $MgSO_4$, chimie verte.

ÉLABORATION TRADITIONNELLE DE FARINE DE RIZ ET DEVELOPPEMENT D'UN BISCUIT SANS GLUTEN POUR LES PERSONNES ATTEINTES DE LA MALADIE CŒLIAQUE.

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Résumé
Les maladies cœliaques sont des troubles auto-immuns déclenchés par l'ingestion de gluten, une protéine présente dans certaines céréales comme le blé, l'orge et le seigle. Elles affectent principalement l'intestin grêle, entraînant une mauvaise absorption des nutriments. Le seul traitement reconnu est un régime strict sans gluten, suivi à vie. Dans notre étude nous avons mis en place un procédé d'élaboration d'un biscuit sans gluten à base de farine de riz obtenu avec un moulin traditionnel à base de riz complet afin de diversifier l'alimentation des malades cœliaques en Algérie. Les analyses physico-chimiques de la farine de riz utilisée ont montré une faible teneur en humidité (9,96 %) et en lipides (1 %), également l'absence de gluten dans cette farine et une valeur énergétique élevée (383,52 %) grâce à la richesse en fractions de glucides (87,66 g) et protéines (5,97g). Le biscuit élaboré à partir d'ingrédients comprenant le sucre, la margarine, le jaune d'œuf, le chocolat, les amandes, la farine de riz et levure chimique a subis une analyse sensorielle qui a montré une bonne qualité organoleptique (couleur, odeur, texture et goût), 76 % sur les 25 sujets qui ont contribués au test d'acceptabilité ont jugé le biscuit entre bon et très bon et cela pour le jour initial (premier jour de sa préparation), tant dit que 70 % l'ont jugé entre bon et acceptable après 10 jours de conservation. Cette farine de riz sans gluten grâce à ses propriétés spécifiques peut être considérée comme un aliment de grand intérêt dans l'élaboration de produits sans gluten pour les personnes atteintes de la maladie cœliaque.
Mots clés : Farine de riz, Analyses physico-chimiques, Analyse sensorielle, Maladie cœliaque, Biscuit

TOWARD A HEALTHIER MARGARINE: FORMULATION WITH OLIVE OIL

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Abstract:
Olive oil is a hallmark of the Mediterranean diet, which is well known for its health benefits. Beyond its unique composition of unsaturated fatty acids, olive oil is especially valued for its bioactive compounds, particularly polyphenols. These compounds are of great nutritional and functional interest due to their strong antioxidant properties. Margarine, is formulated to meet both nutritional and sensory needs by combining a mix of oils with a water phase. Today, the margarine industry is working to modernize the product's image by offering options that align with consumer demand for "heart-healthy" foods, with low levels of saturated fats and trans fats. In this context, incorporating olive oil into margarine formulations appears to be a promising alternative, both nutritionally and functionally. It may serve as a natural substitute for synthetic tocopherols and certain refined oils, enhancing the product's health benefits. The first part of this study focused on analyzing the olive oil, using standard quality indicators such as acidity, peroxide value, iodine index, and UV absorbance. Based on these criteria, the tested olive oil was classified as "extra virgin." Its polyphenol content placed it among the high-polyphenol varieties (500–1000 mg/kg), which is desirable for oxidative stability. An experimental formulation of reduced-fat table margarine enriched with olive oil was then developed to evaluate its antioxidant effect. The quality indicators of the resulting margarine met the predefined formulation standards. Additionally, the incorporation of olive oil did not negatively affect the margarine's sensory properties.

Key words: Olive oil , margarine, Antioxidants.

SYNTHESIS, BIOLOGICAL EVALUATION OF NOVEL ORGANOPHOSPHOROUS COMPOUNDS AS CHOLINESTERASE INHIBITORS

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Abstract:
It is well-known that phosphonate/phosphinate derivatives have a wide range of applications in the areas of agriculture, industry, medicinal chemistry, synthetic intermediates and catalysts[1]. These Derivatives represent an important class of organophosphorus compounds due to their exceptional biological activity[2]. In this context, α-aminophosphinates and α-aminophosphonates have shown an interesting and useful pharmacological properties against various diseases such as anti-HIV, anti-Alzheimer, Antiviral, Antioxidants agents, anti-inflammatory[3,4]. They act as potential antibiotic, Antitumor and enzyme inhibitors [4]. In this work, we describe the preparation of two new α-aminophosphinic (A) and α-aminophosphonic (B) acids through one-pot three-component reaction with good yields. The NMR and mass spectroscopies have been used to identify the obtained compounds and confirm their structures. In addition, the anti-Alzheimer effect of the these obtained compounds has been estimated in vitro by evaluating their inhibition of acetylcholinesterase and butyrylcholinesterase. The both compounds exhibited higher inhibitory activity against butyrylcholinesterase (BChE) than against acetylcholinesterase (AChE) (IC 50 (A): 36.71 ±0.95 and IC50 (B): 26.56 ±1.32 µg/mL) .

Key words: Synthesis , organophosphorus, α-Aminophosphonates, α-Aminophosphinates, Anti-Alzheimer .

VALORISATION DES RESSOURCES NATURELLES, ACTIVITE ANTIOXYDANTE D'UNE ESPECE ENDEMIQUE DE LA FAMILLE *CISTACEAE*

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Résumé :
Les plantes représentent une source importante de métabolites secondaires à valeur médicinale, elles constituent l'une des principales matières premières de l'industrie pharmaceutique malgré plusieurs avancées dans le domaine des drogues de synthèse. Il s'agit de la première investigation phytochimique et biologique d'une espèce endémique de la famille des cistaceae, sept flavonoïdes (3-4, 6-9, 11) et quatre acides phénoliques (1-2, 5, 10) ont été isolés à l'aide de différentes méthodes chromatographiques de séparation, purification et de caractérisation structural par des méthodes spectroscopiques (RMN, Masse et UV). L'activité antioxydante des extraits et composés isolés été examinés par une technique spéctrophétométrique *in vitro*, par l'activité de piégeage des radicaux (DPPH, ABTS•+, GOR) et le test de la capacité antioxydante par réduction du cuivre (CUPRAC), dans le but d'obtenir une meilleure évaluation du potentiel antioxydant, le Trolox, le BHA et le BHT ont été utilisés comme étalons positifs. Tout les extraits et composés isolés ont montré une activité antioxydante. les composés (2, 6, 8) se sont avérés les plus actifs, certains d'entre eux présentant une meilleure activité que les standards antioxydants.

Mots clés : Phytochimie, biologie, Cistaceae, activité antioxydante.

EVALUATION OF THE ANTI-ALZHEIMER'S ACTIVITY OF NOVEL QUINAZOLINE DERIVATIVES AS MULTIFUNCTIONAL BIOACTIVE AGENTS

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Abstract:
Heterocyclic compounds are widely recognized in medicine for their structural diversity and broad range of biological activities. Among these, quinazoline derivatives have attracted attention as potential therapeutic agents for neurodegenerative diseases. Alzheimer's disease (AD) is a progressive disorder characterized by cognitive decline and memory impairment, associated with dysfunction in cholinergic neurotransmission. Inhibition of acetylcholinesterase (AChE) and butyrylcholinesterase (BChE) represents an effective therapeutic approach to manage AD symptoms.
In this study, a series of synthetic quinazoline and 1,2-dihydroquinazoline derivatives were evaluated for their anti-Alzheimer activity. The compounds were screened for their inhibitory effects on AChE and BChE using standard in vitro assays. Several derivatives demonstrated potent dual inhibition of both enzymes, indicating their multifunctional potential as therapeutic agents for AD.
These findings highlight the promise of synthetic quinazoline derivatives as novel candidates for Alzheimer's therapy. By combining structural versatility with significant enzyme inhibitory activity, this work contributes to the ongoing development of innovative heterocyclic compounds with potential applications in neurodegenerative disease treatment. The study emphasizes the value of synthetic heterocycles in drug discovery and offers insights for further optimization of multifunctional anti-Alzheimer agents.

Key words: Quinazoline derivatives, Alzheimer's disease, Neurodegenerative disorders, Multifunctional bioactive agents

COMPREHENSIVE PHYTOCHEMICAL CHARACTERIZATION AND IN VITRO ANTIOXIDANT EVALUATION OF METHANOLIC EXTRACTS FROM *ECHIUM* SP. (BORAGINACEAE) USING THE ABTS RADICAL SCAVENGING ASSAY

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Abstract:
Oxidative stress is increasingly recognised as a key factor in the development of many chronic and degenerative diseases, such as cardiovascular disorders, neurodegenerative conditions, diabetes and cancer. This growing concern highlights the urgent need for safe and effective antioxidants derived from natural sources. Plant-derived polyphenols, in particular, have received significant attention due to their strong free radical scavenging capabilities and their ability to modulate oxidative pathways at the cellular level. Against this backdrop, the present study seeks to examine the polyphenolic content and in vitro antioxidant activity of a methanolic extract of Echium sp., a medicinal plant belonging to the Boraginaceae family that has been traditionally employed in North African herbal medicine. The extract was obtained through maceration, a gentle extraction method that preserves thermolabile bioactive compounds. Quantitative analysis revealed a high concentration of total polyphenols in the methanolic extract (101.7 ± 0.2 µg QE/mg E dry weight), expressed as gallic acid equivalents (GAE), indicating the extract's richness in antioxidant secondary metabolites. Antioxidant activity was assessed using the ABTS radical scavenging assay, a widely validated method for measuring the ability of compounds to neutralise free radicals. The results demonstrated strong, dose-dependent inhibition of ABTS radicals, confirming the extract's potent antioxidant potential. These results suggest that Echium sp. could be a valuable natural source of antioxidants, which supports its traditional medicinal use. Further research is needed, including in vivo studies and mechanistic insights, to explore its potential therapeutic applications in preventing or mitigating diseases related to oxidative stress.

Key words: Echium sp.; methanolic extract; polyphenol; ABTS; Oxidative stress.

DEVELOPMENT AND ASSESSMENT OF A HERBAL SUNSCREEN INCORPORATING LEMON BALM EXTRACT FOR ANTIOXIDANT AND PHOTOPROTECTIVE PROPERTIES

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Abstract:
Natural plant extracts are increasingly used in skincare owing to their diverse biological activities and favorable safety profile. In this study, a herbal sunscreen incorporating Melissa officinalis L. (lemon balm) extract was developed to provide both antioxidant and photoprotective benefits. The research involved (i) extraction of lemon balm via maceration, (ii) assessment of antioxidant activity using DPPH, ABTS, and phenanthroline assays, (iii) evaluation of photoprotective efficacy through Sun Protection Factor (SPF) determination, and (iv) formulation and characterization of the herbal cream. Lemon balm extract exhibited strong antioxidant activity, with IC_{50} values of 19.4 ± 1.3, 14.1 ± 1.6, and 1.92 ± 0.16 µg/mL for DPPH, ABTS, and phenantroline assays, respectively, surpassing the efficacy of the reference antioxidant, butylated hydroxytoluene (BHT).The Sun Protection Factor (SPF) analysis also revealed promising results, showing an SPF value of 45.11 ± 1.37. The final formulation demonstrated acceptable physicochemical and sensory properties, including pH, appearance, spreadability, viscosity, and skin tolerability. These results highlight that lemon balm extract can serve as a valuable natural ingredient in cosmetic formulations. Moreover, the developed sunscreen offers a safe and effective alternative to conventional synthetic photoprotective agents for skin protection and care.

Key words: lemon balm, extract, sunscreen, antioxidant, photoprotective.

GREEN SYNTHESIS OF NEW (E)-3-METHYL-6-((NAPHTHALENE-1-YLIMINO) METHYL) BENZO [D] THIAZOL-2(3H)-ONE SCHIFF BASE, ADME STUDY

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Abstract:

Because of their diverse biological and pharmacological properties, heterocyclic molecules remain important in current organic and medicinal chemistry. Among these, benzothiazolinone derivatives have gained popularity due to their prospective uses in medicine development and agriculture. These scaffolds are recognized for their antibacterial, anticancer, and antioxidant characteristics, which make them extremely useful in pharmaceutical research. Schiff bases, which include an imine (-C=N-) functional group, have emerged as versatile compounds with a variety of bioactivities, including antibacterial, antifungal, and anticancer properties. Their ease of synthesis and structural tunability make them ideal candidates for developing novel therapeutic agent. In light of these concerns, we synthesised a new imine-based benzothiazolinone derivative, (E)-6-(((4-methoxyphenyl) imino)methyl)-3-methylbenzo[d]thiazol-2(3H)-one with a condensation reaction between 3-methyl-2-oxo-2,3-dihydrobenzo[d]thiazole-6-carbaldehyde and primary aromatic amine, utilizing an ultrasound-assisted ethanol reaction. This green chemistry technique allowed for the efficient and high-yield production of the target product with minimum environmental effect and no need for further purification processes. The structure was verified by FT-IR, ^{1}H NMR, and ^{13}C NMR analysis. Furthermore, the compound's drug-likeness was assessed using ADME prediction tools, which yielded favorable results consistent with Lipinski's rule of five.

Key words: Schiff base, ADME study, benzo[d]thiazol-2(3H)-one.

ELABORATION AND VALIDATION OF NEW METHOD FOR METFORMIN DETERMINATION IN RAT SAMPLE AND ITS APPLICATION IN PHARMACOKINETIC STUDY

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Abstract

This study reports the development, optimization, and validation of a novel, rapid, selective, and sensitive HPLC-UV method for the quantification of metformin in plasma samples. Sample preparation involved a simple protein precipitation step using acetonitrile. The chromatographic separation was performed on a reversed-phase phenyl column (NUCLEOSIL, 15 cm × 4.6 mm, 5 µm) with UV detection at 232 nm. Acebutolol was employed as the internal standard. The mobile phase consisted of a mixture of methanol and phosphate buffer (KH_2PO_4 0.05 M) in a ratio of 80:20 (v/v), adjusted to pH 7. The flow rate was maintained isocratically at 0.9 mL/min at a temperature of 25°C. The method was validated according to standard parameters including stability, specificity, sensitivity, linearity, accuracy, precision, and robustness. No endogenous compounds were found to interfere with the peaks of metformin or the internal standard. The calibration curve showed good linearity over a concentration range of 30–4000 ng/mL, with a coefficient of determination (R^2) of 0.998. The lower limit of quantification (LLOQ) was established at 30 ng/mL, with a coefficient of variation of 1.34%. Extraction recoveries ranged from 73.42% to 103.49% for metformin and from 9.58% to 13.4% for the internal standard. The relative errors for all concentrations tested were within 5%. The validated method was successfully applied to a pharmacokinetic study of metformin in rat plasma following administration of metformin hydrochloride.

Keywords: HPLC-UV method; Plasma analysis; Metformin hydrochloride; Method validation; Pharmacokinetics; Rat model.

EFFICACITÉ DES CAROTÉNOÏDES DU SOUS-PRODUIT DE PIMENT DANS L'AMÉLIORATION DE LA THERMO-RÉSISTANCE DES HUILES ALIMENTAIRES

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Abstract
La pâte de piment (Harissa) est un condiment qui occupe une place importante dans notre alimentation grâce à ses nombreuses propriétés culinaires, nutritionnelles et médicinales. Le sous-produit de la pâte de piment peut être valorisé en utilisant ses antioxydants naturels afin d'améliorer la stabilité des huiles alimentaires, riches en acides gras polyinsaturés, les rendant sensibles à l'oxydation et nécessitant ainsi une supplémentation. Cette étude visait à évaluer l'utilisation des caroténoïdes extraits du sous-produit de piment pour l'enrichissement de l'huile de soja raffinée. Les huiles de soja préparées avec l'extrait de caroténoïdes et le β-carotène (contrôle positif) à des concentrations similaires (0,5 et 0,2 ppm), ainsi que l'huile témoin, ont été évaluées durant un traitement thermique (170 °C pendant 10 heures par jour durant 5 jours) en suivant les coefficients d'absorption UV, l'acidité, l'indice de peroxyde, l'indice d'iode et les substances réactives à l'acide thiobarbiturique. De plus, l'effet sur le profil en acides gras a été analysé par chromatographie en phase gazeuse couplée à un détecteur d'ionisation de flamme (GC-FID). Les résultats ont révélé que les caroténoïdes issus du sous-produit de piment réduisaient l'incidence de la thermo-oxydation de l'huile de soja, comme le montre l'amélioration des caractéristiques physicochimiques et des profils en acides gras. Cette protection s'est révélée d'autant plus efficace que la concentration en caroténoïdes augmentait, la concentration de 0,5 ppm étant la plus performante pour protéger l'huile contre l'oxydation. Les caroténoïdes extraits du sous-produit de piment ont donc démontré leur efficacité à améliorer la stabilité thermique de l'huile de soja.

Mots-clés : Sous-produit de piment, caroténoïdes, huile de soja raffinée, stabilité thermique

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FINITE-TIME BLOW-UP AND STABILIZATION OF A DYNAMICAL SYSTEM

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Abstract:
he flexible marine riser is a key component in offshore oil production, serving as the link between the platform and the wellhead, and is generally used as a fluid-conveying pipe. We study the stability of a flexible beam clamped at one end and free at the other, with an attached mass at the free end. To stabilize this system, a boundary control force is applied at the free end of the beam. We prove that the closed-loop system is well-posed and exponentially stable. The dynamics of the flexible marine riser are modeled by partial differential equations (PDEs) coupled with boundary conditions and ordinary differential equations (ODEs). In this work, we establish an energy decay result to reduce vibrations in the marine riser system. Furthermore, we discuss the boundary control design via Lyapunov's direct method, which guarantees closed-loop stability of the marine riser under both internal and external disturbances.

Key words: Flexible beam, Boundary control, Stability, Dynamic system, Marine riser

CHARACTERIZATION OF THE ANTIOXIDANT ACTIVITY OF ALGERIAN PUNICA GRANATUM (SEFRI VARIETY) COMBINED WITH A MOLECULAR DOCKING STUDY

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Abstract:
Natural antioxidants have a variety of biological benefits, including fertility. Pomegranate (Punica granatum L.) is a rich source of polyphenolic components. The purpose of this study was to characterize the antioxidant activity (DPPH method) of the peel of pomegranate and confirmed their fertility effect by docking molecules of various bioactive compounds (gallic acid and ellagic acid). Our results showed that pomegranate peel extract was rich in polyphenol and flavonoid content. As well as having a high antioxidant activity. In the docking study, the interaction between compounds (gallic acid and ellagic acid) and biological targets, in this case 17beta-dehydrogenase, was studied to determine binding energy, binding affinity, and stability. The results showed that gallic acid and ellagic acid had significant interaction with the lowest binding energy of -5.7 to -8.5 Kcal/mol and the lowest RMSD value of 0 (Å), so that this can be said to have good interaction stability with the protein target. The 3D molecular structure of these two compounds also shows the presence of hydrogen bonds and effective interactions with amino acids as well as low toxicity and favorable affinity energy. Based on these results, gallic acid and ellagic acid were identified as potential candidates in the development of drugs to enhance sexual behavior in human beings. In this study it is possible to identify all the active compounds in pomegranate using a computer method, to determine its effectiveness as a sexual stimulant, and to use it as an alternative to the chemicals medecins.
Keywords: Pomegranate; phenolic composition; antioxidant activity; molecular docking; fertility.

SYNTHESIS, CHARACTERIZATION AND ANTIMICROBIAL ACTIVITY OF A SCHIFF BASE LIGAND DERIVED FROM 2,4-DIAMINOPYRIMIDINE DERIVATIVE (TRIMETHOPRIM) AND ITS PALLADIUM COMPLEX

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Abstract:
In this study, a Schiff base ligand was synthesized from 2,4-diamino-5-(3,4,5-trimethoxybenzyl)pyrimidine (Trimethoprim) and 2-hydroxynaphthaldehyde, and subsequently complexed with Pd(II). The resulting ligand and its palladium complex were characterized using various spectroscopic techniques.
Spectroscopic analyses confirmed the chemical structures of both the Schiff base and its metal complex. UV Vis spectrophotometry was used to determine the geometry around the central metal ion, suggesting a square planar geometry for the palladium complex. IR spectroscopy revealed that the ligand coordinates in a bidentate manner via the nitrogen atom of the imine group and the oxygen atom of the hydroxyl group. The antimicrobial activity of the ligand and its Pd(II) complex was evaluated in vitro against four bacterial strains—two Gram-negative (Escherichia coli, Klebsiella pneumoniae) and two Gram-positive (Staphylococcus aureus, Pseudomonas aeruginosa) as well as a fungal strain of the Aspergillus genus. The results were compared to standard antimicrobial agents, namely Ampicillin and the azole antifungal Ketoconazole. The findings demonstrated that both the ligand and its complex exhibit significant inhibitory effects on certain bacterial strains and particularly strong antifungal activity against Aspergillus. This study highlights the potential of Schiff base complexes derived from Trimethoprim as promising antimicrobial agents.
Key words: Shiff base ligand, Trimethoprim, Palladium complexes, Antimicrobial activity.

A COPARATIVE STUDY OF THE CURATIVE PROPERTIES OF CERATONIA SILIQUA AND PUNICA GRANATUM IN RATS

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Abstract:
The present study was conducted to evaluate the nutritional and pharmacological activities of Punica granatum L. (pomegranate) and the carob (C. siliqua L.). A total of twenty Wistar albino male rats were separated into four groups. The first group (control group) received only vehicles and had free access to food and water. Group two was supplemented with 100 mg/kg P. granatum peel. While groups three and four were given 100 mg/kg and 300 mg/kg of carob, respectively. The animals were given the various treatments orally for 2 months. Blood analysis included glycemia, lipid profile (cholesterol, triglyceride), AST and ALT, urea, creatinine, and testosterone hormone. Our results showed that no significant difference were found in glycemia, cholesterol, triglycerides, or testosterone level between treated and control $p > 0.05$, although, a slight increase in testosterone hormone was observed in pomegranate group the control group. Moreover, we noted that transaminases (ALT and AST), creatinine, and urea from the pomegranate and carob groups were non-significant when compared with the control group ($P>0.05$); this confirms that both the pomegranate and carob used in our experiment did not enhance any injury or toxicity in the rats. Nevertheless, this suggests that pomegranate and carob are non-nephrotoxic and do not have any adverse effects on the rats' health. It was concluded that the both plants should be considered as an excellent candidate for future studies on dyslipidemia and fertility. Further research can be undertaken for isolation, purification, and pharmacological validation of active constituents responsible for particular pharmacological activity.
Keywords: Punica granatum L. (pomegranate), Carob (C. siliqua L.), Biochemical analysis, Testosterone, Rats.

FIRST REPORT OF THE STUDY OF THE MAIN FACTORS PROMOTING THE CRYSTALLIZATION OF HONEY

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Abstract:
In addition to pollen and dust, thermal causes such as shock, agitation and thermal shock are factors that promote the crystallization of honey.
In order to determine the crystallization of 6 samples of honey from Kabylia, Tizi Ouzou (T1, T2, T3, T4,T5 and T6), 2 main indices determining the crystallization capacity of honey are retained, namely the Fructose/Glucose ratio (F/G) and the Glucose/Water ratio (G/E).
Fructose and glucose are determined by high performance liquid chromatography (HPLC) according to the AOAC method (1990). As for the water content, it is obtained by calculating the refractive index .
The results obtained show that only 2 samples T3 and T5 have an F/G ratio within the standards indicating the slowness of crystallization. The G/E ratio is the most adequate factor that confirms the state of crystallization of honeys.T6 honey, which has a high water content, shows a separation of two phases after crystallization.

Key words: Honey, crystallization, fructose/glucose ratio, glucose/water ratio.

GEOMETRICAL AND THERMAL EFFECT ON THE TOROIDAL VORTEX OF A CELL BIOREACTOR

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Abstract:
The problem of controlling cylindrical tank bioreactor conditions for cell and tissue culture purposes has been considered from a flow dynamics perspective. This numerical study investigates the phenomenon of secondary recirculating zone in a specific case of viscous and incompressible rotating flows with an open side. Several configurations of spherical bottoms are adopted to identify and analyse the secondary circulation under the effect of a flat free surface condition. This work focuses on exploring techniques for examining the progression of this interesting phenomenon by altering the boundary conditions upstream of the reverse flow. The numerical modelling has revealed a dissimilar composition of reverse regions, due to combined effects of the stationary and/or rotating boundaries. Specifically, the study demonstrates how to either remove or improve the appearance and area of the circulation region. Additionally, imposing a thermal gradient between the spherical end disks revealed that under the influence of a positive directed thermal gradient (Ra> 0), the reverse axial region is cancelled, whereas under the effect of a negatively directed thermal gradient (Ra< 0), the reverse axial region is enhanced. This model is well-suited to bioengineering application, as it can provide an ideal environment for cell growth with a minimum velocity in the cavity. Consequently; the power consumed is reduced without damaging the cells.
Key words: Free surface, Axisymmetric toroidal vortex,Conical flow system, ,Stratified fluid,Partial heating,Flow control, Lid-driven swirling flow

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EXTRACTION DES ANTHOCYANES D'HIBISCUS SABDARIFFA ET ÉTUDE DE LEUR STABILITÉ PHYSICO-CHIMIQUE

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Résumé :
Dans un contexte où la demande pour des produits naturels, sains et respectueux de l'environnement ne cesse de croître, les colorants naturels suscitent un intérêt croissant dans les industries alimentaire, cosmétique, pharmaceutique et textile. Parmi les plantes utilisées pour l'obtention de colorants naturels, la Roselle (*Hibiscus sabdariffa*), occupe une place de choix en raison de sa richesse en anthocyanes, des pigments naturels aux propriétés tinctoriales et antioxydantes.
Les anthocyanes extraits des calices de Roselle confèrent une couleur rouge à pourpre qui varie en fonction du pH, ce qui les rend particulièrement intéressants pour diverses applications industrielles. Toutefois, comme beaucoup de colorants naturels, les anthocyanes sont sensibles à plusieurs facteurs environnementaux tels que la lumière, la température, le pH et la présence d'oxydants, ce qui peut affecter leur stabilité et limiter leur utilisation.
Ce travail vise extraire des colorants naturels à partir de la Roselle, à évaluer leur efficacité, et à étudier les conditions influençant leur stabilité.
L'objectif de notre travail était d'améliorer la stabilité de l'extrait d'anthocyanines de fleurs de Roselle en étudiant l'effet des conditions de stockage, de la température et du pH.
Les résultats ont montré que l'extrait d'anthocyanines de Roselle présente une meilleure stabilité à pH faible. Par ailleurs, un stockage à basse température (4 °C) et à l'obscurité pendant 60 jours permet de maintenir une teneur élevée en anthocyanines.

Mots clés : Colorants naturels, stabilités, extraction.

RISK AND RELIABILITY ANALYSIS USING BAYESIAN NETWORKS FOR INDUSTRIAL PROCESSES

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Abstract:
The use of probabilistic modeling in industrial applications has gained significant relevance for addressing critical issues related to risk analysis, safety evaluation, and system dependability. Traditional risk assessment methods often fall short in capturing complex interdependencies, failure behaviors, and the inherent uncertainties present in industrial systems. This study examines the application of Bayesian Networks (BNs) as a powerful framework for industrial risk analysis. BNs offer a probabilistic approach that can model intricate relationships among systems, subsystems, and associated risk factors while representing uncertainties. By integrating heterogeneous data sources and expert knowledge, BNs enhance the predictive accuracy of risk assessments and provide a more comprehensive understanding of potential risks. The approach is demonstrated through a case study of a level control system, illustrating how BNs can effectively capture dynamic variations in processes, identify key risk contributors, and quantify their impacts. Additionally, sensitivity analysis reveals the potential of BNs in improving decision-making processes for reliability and safety management, making them a valuable tool for enhancing industrial risk management practices.

Keywords: Process safety, reliability, Bayesian Network, Spare gate

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MOLECULAR STRUCTURE CHARACTERIZATION OF ASPHALTENES USING XRD

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Abstract:
Asphaltenes is a fraction that tends to cause most of the issues during crude oil transport and refining. The molecular structure of asphaltenes is the least understood among all petroleum fractions. The asphaltenes aggregation and the formation of colloidal particles in crude oil can be attributed to a range of intermolecular interactions such as hydrogen-bonding, aromatic p–p stacking, polar–polar interactions and electrostatic attractions between asphaltenes molecules. Analytical techniques have been used to characterize the asphaltenes and to determine their molecular structures. X-ray diffraction (XRD) is used to provide valuable information concerning the internal structure of asphaltenes and to study the crystallite parameters of the asphaltene clusters. A pile of aromatic sheets can be formed due to the stacking of asphaltenes aromatic cores, which is possible to analyse by XRD because the asphaltenes stacking may form the crystallites.
In the present work, we attempted to provide novel insights into the stability and molecular structure of asphaltenes. Based on the structural parameters obtained from combined XRD and Fourier-transform infrared spectroscopy (FTIR). The glass transition temperatures points (T_g) of asphaltenes were determined using Differential Scanning Calorimetry (DSC).
The obtained results indicate that The XRD spectra do not show resolved XRD diffraction pictures but rather a single broad peak with maximum intensity at $2\theta = 21.5°$ due to scattering. X-rays from the periodic molecular structure of asphaltenes, implying a low crystallinity of this sphaltenic fraction [4]. This broad peak is accompanied by small peaks at 2°, 9°, 19°, 25° and 41°, these peak values indicating that these asphaltenes contain metals and aromatic sheets with an average diameter of 17A°.

Mots clés : asphaltènes de Hassi Messaoud ; floculation ; XRD ; FTIR.

FUZZY-BASED VIBRATION CONTROL FOR STRONGLY COUPLED AXIAL-TORSIONAL DYNAMICS IN ROTARY DRILLING SYSTEMS

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Abstract:
Coupled vibrations that impair the efficiency and security of rotary drilling systems frequently present significant difficulties for drilling operations. Stick-slip and bit bounce are examples of severe nonlinear effects that can be caused by these vibrations, which are primarily axial and torsional and are dynamically related. Designing and testing a fuzzy logic controller (FLC) that can reduce strongly coupled axial-torsional vibrations in rotary drilling systems is the aim of this study. The process entails creating a thorough nonlinear dynamic model that faithfully captures the phenomena of coupling between axial and torsional modes. The system response is then adaptively regulated under various downhole conditions and uncertainties using a fuzzy-based control algorithm. Simulation analysis results show that the suggested FLC improves drilling stability and drastically lowers vibration amplitudes. This study is unique because it applies an intelligent fuzzy control strategy to complicated coupled vibration problems, providing increased adaptability and robustness for practical drilling applications.

Key words: Rotary drilling system, axial–torsional coupling, fuzzy logic control, nonlinear dynamics, vibration mitigation, intelligent contro

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ROSCRATCHING OF WEAR-RESISTANT ALLOYS NI-CR-B-SI-C-W

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Abestract:
This study investigates the wear resistance of nickel-based alloys reinforced through recharging techniques an efficient solution for use in harsh industrial settings. Two standard alloys containing Cr, W, B, Si, and C were developed and examined through thermal analysis, microstructural characterization, and mechanical testing.
Microscopic analysis revealed three main phases: a Ni(γ) matrix, dark M7C3 carbides, and white M5B3 borides, each forming at distinct solidification temperatures. Scratch tests assessed hardness and specific energy relative to the groove width. Results revealed a pronounced "size effect": narrower grooves exhibited greater hardness and energy. The spatial distribution and volume of hard phases played a key role in abrasion resistance.
Even under low loads, the nickel matrix and hard phases displayed differing wear behaviors, allowing for targeted microstructural optimization to enhance durability. These findings provide valuable guidance for tailoring alloy compositions to improve performance in high-wear environments.

Key words: Metal coating ; Protective coatings ; Wear resistance ; Tribology.

EVALUATION OF ANTIOXIDANT AND ANTIBACTERIAL PROPERTIES OF ASTERACEAE EXTRACTS COLLECTED IN THE OUED SOUF REGION

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Abstract

The Asteraceae family encompasses a wide range of plant species known for their therapeutic potential. This study investigates the biological activities of extracts obtained from Asteraceae species naturally growing in the arid region of Oued Souf, Algeria. Hydroalcoholic extracts and their corresponding fractions (n-hexane, ethyl acetate, butanol, and aqueous) were prepared using a liquid-liquid extraction technique. The total phenolic content (TPC) was determined, and antioxidant and antibacterial activities were evaluated through the DPPH assay, total antioxidant capacity (TAC) method, and agar diffusion test. Results indicated a high phenolic content in the plant, with TPC reaching 71.89 mg gallic acid equivalents (GAE)/g extract. Among all fractions, the butanol extract exhibited the highest antioxidant potential, with a DPPH IC_{50} value of 0.17 mg/mL. All tested extracts demonstrated moderate to low antibacterial activity.

Keywords: Antioxidant, Antibacterial, Astraceae, Oued Souf.

ACTIVE VORTEX GENERATOR-INDUCED HEAT TRANSFER ENHANCEMENT OF MAGNETIC NANOFLUIDS IN MINICHANNELS UNDER A PERMANENT EXTERNAL MAGNETIC FIELD

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Abstract

This study analyzes numerically the role of active vortex generators in enhancing heat transfer and the flow structure of a magnetic nanofluid under the influence of a permanent external magnetic field. The nanofluid used consists of Fe_3O_4 nanoparticles (volume concentration of 0.5 to 1%) uniformly dispersed in water flowing through a two-dimensional microchannel heated from below. Simulations were performed for Reynolds numbers ranging from 170 to 210 and magnetic field strengths between 0 and 1200 G. Two configurations were studied: one with a magnetic source located 15 mm from the channel inlet and another with two sources at 7.5 mm and 15 mm. The results show that the external magnetic field acts as a vortex generator, modifying the velocity distribution, promoting fluid mixing, and consequently enhancing convective heat transfer. Furthermore, the permanent magnets reduce the friction coefficient by causing the nanofluid to detach from the heated surface, thus decreasing the fluid-surface contact area and consequently reducing the pressure drop. These results highlight the crucial role of magnetic fields in improving thermal performance in microchannels.

Keywords: Magnetic nanofluids, vortex, heat transfer, CFD, magnetic field

CRYSTALLIZATION, OPTICAL AND ELECTRICAL PROPERTIES CHANGE ON THE ANNEALING INDIUM OXIDE THIN FILMS PREPARED VIA SOL GEL SPIN COATING PROCESS

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Abstract
High-transparency indium oxide (In_2O_3) nanocrystalline thin films were successfully fabricated on glass substrates using a simple sol–gel method followed by spin coating. To investigate the effect of annealing temperature on the structural, optical, and electrical properties of the films, the annealing temperature was varied from 250 °C to 550 °C in increments of 100 °C. Film thickness decreased from 232 nm at 250 °C to 155 nm at 550 °C. Structural characterization using X-ray diffraction (XRD) revealed that the films exhibit a cubic crystal structure with a preferred orientation along the (222) plane. The average crystallite size increased from 12 nm to 23 nm with increasing temperature. UV–vis spectroscopy showed high optical transmittance ranging from 80% to 83% in the visible region, while the optical band gap decreased from 3.98 eV to 3.47 eV as the annealing temperature increased. Electrical measurements using the two-point probe method indicated a reduction in resistivity with increasing annealing temperature, with the lowest resistivity of 14.05 Ω·cm observed at 550 °C. These results demonstrate that annealing temperature plays a crucial role in tuning the properties of sol–gel-derived In_2O_3 thin films for potential optoelectronic applications.

Key words: Thin films, Indium oxide, Spin coating, Annealing temperature, Optical properties, Electrical properties.

SYNERGISTIC EFFECT OF LUFFA NATURAL FIBERS AND ALUMINA FILLER ON MICROSTRUCTURAL, THERMAL AND MECHANICAL PROPERTIES IMPROVEMENT OF POLYPROPYLENE COMPOSITES

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Abstract
This study focuses on the development of polypropylene (PP) composites with enhanced thermal and mechanical properties through the incorporation of luffa natural fibers as organic fillers and alumina as mineral fillers. For comparison, single-filler composites (PP/luffa fiber and PP/alumina) were also prepared. To improve compatibility with the polymer matrix, luffa fibers were alkali-treated with NaOH and further modified with stearic acid, while alumina particles were surface-coated with stearic acid. The composites, containing 2% and 5% filler loadings, were fabricated by melt mixing using a Brabender plastograph. FTIR and SEM analyses confirmed improved interfacial adhesion and homogeneous dispersion of fillers in the PP matrix due to surface treatments. XRD analysis revealed significant modifications in the filler microstructure, with stearic acid-treated luffa–alumina composites showing a notable increase in crystallinity. Thermal characterization by DSC and TGA demonstrated that treated filler composites achieved the highest thermal stability. Furthermore, Izod impact testing indicated that the binary luffa–alumina composites exhibited superior impact resistance compared to single-filler systems. These findings highlight the synergistic effect of combining organic and inorganic fillers, with stearic acid treatment playing a crucial role in achieving uniform distribution. The developed composites not only enhance material performance but also offer potential applications in construction and related fields, aligning with sustainable development goals (SDGs) 9 and 12.

Key words: Polypropylene composites, Luffa fibers, Alumina, Stearic acid, Thermal and Mechanical improvement.

THE IMPACT OF THE MACROSCOPIC - SCALE POLARIZATION ON THE PIEZOELECTRIC CHARACTERISTICS OF POLY (VINYLIDENE FLUORIDE) (PVDF

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Abstract

The impact of stretching temperature (T_s) and electric field (E) on piezoelectric characteristics was studied on polyvinylidene fluoride (PVDF) films prepared from solution using wide-angle X-ray diffraction (WAXS) and infrared spectroscopy (IR). The results were discussed based on the dependence of the piezoelectric constant (d_{33}) on the absorbance ratio D_β/D_α for different vibration modes.
The influence of the efficiency of crystalline phase transitions alpha to beta ($\alpha \rightarrow \beta$) is due to the treatments applied after sample stretching. Stretching also has a significant effect on the piezoelectric response, as it allows the axes to orient themselves along the direction of the stretching axis.
Increasing the temperature, by improving the dynamic flexibility of the macromolecular chain, favors the TG TG' conformation over the TT conformation. This conformational reorganization would be at the origin of obtaining the alpha (α) phase at high stretching temperature and the beta (β) phase at low temperature.

Key words: Crystallinity; piezoelectricity; polarization; polymer; poly (vinylidene fluoride); thermal treatment..

PROCESS ENGINEERING OF ENHANCED ADSORBENTS: NACL-ACTIVATED BENTONITE FOR SUSTAINABLE WATER TREATMENT

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Abstract

Large amounts of different chemical compounds, including dyes, are present in wastewater discharges from the textile industry. These compounds slow down photosynthesis, decrease the amount of sunlight that reaches the water, and gradually harm the health of living things.
Certain dyes cannot be treated using the traditional methods.Because it effectively removes organic contaminant s like the colors found in textile wastewater, the adsorption approach is the most often utilized treatment method .
The purpose of this project is to use Crystal Violet, an organic dye that is extremely harmful to both humans and the environment, to clean contaminated water.
The foundation of this treatment is the application of clay as an adsorbent substance.Clay is abundant in nature, which justifies interest in using it.Algerian bentonite clay is utilized.
This bentonite was refined and converted to sodium bentonite in order to maximize the use of locally available r esources.
The primary factors affecting this adsorption were optimized, including the impact of the initial solution's pH, th e mass of the adsorbate, the dye's initial concentration, the adsorption time, and the medium's temperature.

Key words: Bentonite, adsorption, textile industry, dye, clay

FUNCTIONAL NANOMATERIALS FOR NANOTECHNOLOGY APPLICATIONS

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Abstract
In recent years, functional nanomaterials have come to occupy an important place in new technology, thanks to their exceptional properties and nanoscale structures. Their integration into emerging technologies represents a major breakthrough for the generation of innovative devices in various fields such as energy recovery, smart sensors and biomedical applications. Indeed, the specific performances of nanomaterials, combining lightness, flexibility and electrical and piezoelectric responses, offer promising prospects for the development of miniaturized, portable and low-cost systems. In this context, the main objective of this work is to design a nanostructured, thin and flexible membrane, developed using the innovative electrospinning technique. This method enables the formation of polymeric nanofibers incorporating metal oxide nanoparticles synthesized by the sol-gel route, guaranteeing good dispersion and association between the organic matrix and the inorganic reinforcement. The resulting nanowire films boast outstanding flexibility, mechanical stability and functional electrical and piezoelectric properties. These characteristics make them particularly attractive for the development of portable, self-powered biomedical sensors, highlighting the decisive role of nanotechnologies in the evolution of connected health devices, sustainable energy and flexible electronics.

Key words: Nanomaterials, electrospinning, nanofibers, smart sensors, nanogenerators

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CHARACTERIZATION OF SWIRLING FLOWS IN AN OPEN ENCLOSURE OF A CELL BIOREACTOR

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Abstract
An open vertical disk-cylinder system, with a spherical bottom lid, is used to model numerically the characteristics of axisymmetric swirling flows with stagnation and associated flows reversal; commonly referred to as vortex breakdown. The flows are driven by the bottom disk uniform rotation and controlled by the competition between the no-slip and stress-free surface conditions applied at the top. Flow visualisation confirms the presence of vortex breakdown bubbles at Re=766, 1222, 2059, 2757 for an a radius ratio of 1.4.8. Depending on the radial extent of the free surface, distinct regions of toroidal, corner and on-axis vortex type flows were identified and mapped into a state diagram then discussed. These regions are formed due to the combined effects of the rotating and/or stationary boundaries, whose nature and number depend on the physical parameters $Re= \Omega_b R_2/\nu$ (the Reynolds number), $S= \Omega_t/\Omega_b$(the rotation ratio) and on the radius ratio of the enclosure $\Lambda= R_2/ R_1$ .In addition, the impact of the cavity aspect ratio on the onset conditions of stagnation and breakdown was highlighted. Moreover, the study explored the influence of a diffusion driven meridian circulation, induced by the sidewall differential rotation, which is revealed to constitute an effective non intrusive kinematic means of flow control.

Key words: Cylinder, Bottom Lid , Top-free surface, Vortex breakdown, Differential rotation, Reynomds Nummber.

EXPERIMENTAL APPROACH OF THE EFFECTIVENESS OF RESIDUAL OIL RECOVERY THROUGH THE INJECTION OF SILICATE AND CLAY NANOPARTICLES INTO RECONSTITUTED POROUS MEDIA BASED ON ASPHALTENE COATED SAND

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Abstract
Nanoflooding is a novel chemical enhanced oil recovery technique that aims to increase oil recovery. This study investigates the synergistic effects of silica nanoparticles, nanoclay, and their combination in the nanoflooding process to enhance oil recovery and mitigate asphaltene deposition. Two micromodel cases were studied: a cylindrical sand model and a cylindrical asphaltenic sand model. Various formulations including silica nanoparticles, nanoclay, biopolymer, and surfactant to enhance the displacement and reduce the interfacial tension. Experimental setups simulated reservoir conditions, focusing on nanoparticle interactions with reservoir fluids and rock surfaces. Core flood experiments revealed that silica nanoparticles alone increased the recovery factor, with further enhancements observed at higher concentrations (0.1%) and with the addition of biopolymer. Nanoclay also improved recovery. Performance was observed at a concentration of 0.005%, and its combination with biopolymer further enhanced the recovery factor. The highest recovery factors were achieved using nanocomposite (silica nanoparticle and nanoclay) and biopolymer combinations, supplemented with surfactant.

Key words: Nanoflooding, silica, clay, oil recovery, surfactant, interfacial tension

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GREEN STRATEGIES FOR THE SYNTHESIS OF NIO AND ZNO NANOPARTICLES: TOWARDS SUSTAINABLE NANOTECHNOLOGY

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Abstract
Nickel oxide (NiO) and zinc oxide (ZnO) nanoparticles are among the most explored metal oxides. This is mainly because they find use in so many areas. These areas include photocatalysis, energy storage, and some biomedical fields. Although conventional chemical methods such as sol-gel, hydrothermal, and simple precipitation are still common, they rely on strong chemicals and heavy processing conditions. In recent years, researchers have increasingly turned to green synthesis. In this method, plant extracts, microorganisms, or biopolymers act as both reducing and stabilizing agents. In this review, we examine the latest developments in the green synthesis of NiO and ZnO nanoparticles and compare them to traditional chemical approaches.Several studies indicate that biomolecules, like flavonoids, amino acids ans proteins, do more than just replace lab chemicals. They actually interfere with the process: they can change the way crystals form, shift the particle size distribution, and sometimes even move the optical band gap. In other words, there is a kind of bio-assisted control that helps tune structure and optical behavior without adding complex reagents. Still, the green route is not simple. Extracts from plants are never exactly the same; they depend on the species, the place where they grow, the season, and so on. Because of that, reproducibility becomes a real challenge, and scaling the process up is even harder. Yet, even with these drawbacks, green synthesis keeps pushing the field toward a more sustainable direction. It is promising, but it is also clear that more work must be done before it becomes routine at large scale.

Key words: NiO nanoparticles; ZnO nanoparticles; Green synthesis; Chemical synthesis; sustainable nanotechnology.

ROLE OF ALCOHOL IN THE ANODIZING PROCESS OF ALUMINUM ALLOY 5083: FORMATION OF POROUS ANODIC ALUMINA

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Abstract

One-step anodizing treatment is a widely employed method for protecting aluminum and its alloys against corrosion, due to its high efficiency and low cost. During the anodizing process, a controlled oxide layer is formed on the aluminum surface, enhancing its corrosion resistance. The quality of this oxide layer is influenced by several factors, including the chemical composition of the substrate and anodizing parameters such as current density, temperature, applied voltage, and the nature of the additives used in the electrolyte.

The objective of this study is to investigate the effect of ethanol as an additive on the electrochemical behavior of oxide layers formed on aluminum alloy 5083 through sulfuric acid anodizing. Anodization was carried out in a sulfuric acid electrolyte containing varying concentrations of ethanol. The corrosion behavior of the anodized samples was evaluated using electrochemical impedance spectroscopy (EIS), potentiodynamic polarization techniques, and open circuit potential (OCP) measurements. The results indicate that the presence of ethanol in the anodizing bath significantly influences the electrochemical performance of the oxide layers. Specifically, increases in ethanol concentration were found to enhance the corrosion resistance, lower the corrosion current density, and shift the corrosion potential toward more noble values.

Key words: AA5083, Corrosion, Anodizaing, Additif, NaCl

MODELISATION DFT ET TDDFT DE LA STRUCTURE ET DU COMPORTEMENT OPTIQUE D'UN COMPLEXE DE NICKEL

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Abstract

La chimie des complexes de Nickel(II) fait actuellement l'objet d'une attention croissante, grâce aux propriétés uniques de ce métal, exploité aussi bien en chimie inorganique que dans les sciences biologiques, biochimiques et pharmacologiques . Une large gamme de complexes peut être formée par le Ni(II), avec des géométries privilégiées telles qu'octaédrique, tétraédrique ou plan carré. À l'état cristallin, la conformation la plus fréquente reste l'octaédrique. Les structures des complexes de Ni(II) sont généralement octaédriques à l'état solide.

Nous présentons ici une étude théorique des complexes à base de nickel en phase gazeuse. Les calculs ont été réalisés dans le cadre de la théorie de la fonctionnelle de la densité (DFT) et de sa version dépendante du temps (TD-DFT), afin d'évaluer les propriétés structurales et énergétiques ainsi que les spectres d'absorption UV-Visible. Deux fonctionnelles, à savoir B3LYP et MPW1PW91, ont été utilisées en combinaison avec les bases de type SDD et LANL2DZ. L'ensemble des calculs a été effectué à l'aide du programme Gaussian 09**,** en s'appuyant sur l'interface graphique GABEDIT, développée par A. R. Allouche. »

La comparaison entre les résultats théoriques et les données expérimentales pour le complexe $[Ni(NH_2CH_3CHCOO)_2(H_2O)_2]\cdot 2H_2O$ met en évidence une bonne concordance. Parmi les fonctionnelles testées, B3LYP se distingue par sa capacité à reproduire les résultats expérimentaux avec une meilleure précision que les autres.

Key words: complexes de Ni, DFT, TDDFT, GAUSSION 09, GABEDIT

ENERGY DECOMPOSITION ANALYSIS OF ETHYLENEDIAMINE DISUCCINIQUE (EDDS)

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Abstract
This study leverages the Amsterdam Density Functional (ADF) program and its Energy Decomposition Analysis (EDA) functionality to deeply understand intermolecular interactions. EDA, a method refined by Ziegler and Rauk, meticulously breaks down the total interaction energy (ΔEint) into distinct, physically meaningful components: ΔEint = ΔEorb + ΔEelect+ΔEpauli
orbital interaction (ΔEorb), representing stabilizing electron sharing; electrostatic interaction (ΔEelect), quantifying charge-based attractions; and Pauli repulsion (ΔEpauli), a destabilizing effect from electron overlap. The primary aim was to quantitatively assess the relative importance of ionic and covalent interactions within M-EDDS coordination bonds (where M = Ni, Zn, Fe). The results in table provide precise indications on the nature of the metal-ligand bond (M-EDDS) :

	ΔE_{int}	ΔE_{pauli}	ΔE_{elect}	ΔE_{orb}	ΔE_{σ}	ΔE_{π}	ΔE_{rest}
Fe-EDDS	-1312.80	399.04	-1016.59 (60%)	-695.42 (40%)	47.54%	45.45%	6.99%
Ni-EDDS	-1216.09	234.09	-724.49 (60%)	-491.61 (40%)	64.26%	15.46%	20.27%
Zn-EDDS	-1047.51	91.75	-805.24 (77%)	-242.2 (23%)	60.04%	18.04%	21.90%

The analysis revealed that while all complexes benefit significantly from electrostatic interactions, the nature of their bonding varies. Notably, the Fe-EDDS complex stands out with a predominantly covalent bond, driven almost entirely by orbital interactions and a strong π-bond contribution. EDA's ability to provide such detailed, quantitative insight into the physical forces governing molecular interactions is invaluable for advancing chemical understanding.
Key words: EDA, DFT, EDDS

INFLUENCE OF PROSTHESIS GEOMETRY ON THE FREQUENCY RESPONSE OF THE MIDDLE EAR: INSIGHTS FROM FINITE ELEMENT ANALYSIS

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Abstract
This research investigates the biomechanical performance of a middle ear prosthesis using finite element modeling under a 90 dB acoustic load across a frequency range of 250–8000 Hz. The study focuses on the effect of prosthesis geometry on the stress–displacement behavior of the auditory system. Three prosthesis lengths were analyzed (PN1 = 3 mm, PN2 = 4 mm, PN3 = 6 mm) to evaluate how structural configuration influences stability, stress distribution, and vibration transmission. The stress–displacement curves reveal that the intermediate model, PN2, exhibits superior mechanical performance, reaching a peak stress of 4.0E−09 MPa with minimal displacement, which represents an improvement of nearly 33% compared to PN3 (3.0E−09 MPa) and about 100% compared to PN1 (2.0E−09 MPa). This configuration provides the optimal balance between rigidity and deformability. In contrast, PN1, the smallest geometry, shows the weakest response, while PN3, despite being the largest, demonstrates reduced mechanical efficiency. These findings contradict the common assumption that larger cross-sections always enhance strength, showing instead that the best structural proportion—rather than maximum size—yields optimal stress distribution and stability. Overall, prosthesis geometry significantly affects performance, with the 4 mm model (PN2) offering the most balanced mechanical behavior, confirming that optimized geometric design is essential for reliable and efficient middle ear reconstruction.
Key words: Middle ear prosthesis , Finite element analysis , Biomechanical modeling , Prosthesis geometry , Stress–displacement behavior , Acoustic frequency response.

ENHANCING FLEXIBLE STEEL-BASED SOLAR CELLS: THE TECHNICAL ROLE OF TIN FILMS

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Abstract

Flexible thin-film solar cells are poised to revolutionize the renewable energy; the replacement of glass substrates is currently the subject of numerous studies, notably stainless steel substrates. This study delves into the use of titanium nitride (TiN) as a barrier to impede the diffusion of metallic ions present in the substrate due to crystallization temperature during the deposition of the back molybdenum contact. Employing radio frequency (RF) active magnetron sputtering for TiN film deposition, two distinct temperatures were investigated (ambient and 500°C). X-ray diffraction (XRD) of the TiN layer deposited on the steel substrate exhibit a polycrystalline structure, with two peaks observed at (111) and (002), showing relatively better crystallinity at low deposition temperature. It is worth noting that TiN optimization layer deposited on MgO shows epitaxial growth at 500°C. Energy-dispersive X-ray spectroscopy (EDS) analysis of the Mo back contact demonstrates a considerable reduction in iron content, decreasing from 9.7% without TiN to 1.9% with TiN integration. Chromium content also significantly decreases from 3.8% to 0.5% with TiN barrier incorporation. Moreover, the TiN layer enhanced the roughness morphology of the substrate. This finding is promising for consolidate photovoltaic efficiency.

Key words: TiN, stainless steel 316, MgO, Substrate temperature, crystalline system

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SUSTAINABLE SYNTHESIS OF BIOACTIVE WOLLASTONITE

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Abstract

This study investigates the solid-state synthesis of bioactive wollastonite (CaSiO3) using chicken eggshell-derived CaO (≥98%) and silica fume (SiO2) as sustainable raw materials. A solid-state reaction was carried out at 1250 °C, and the synthesized powders were carefully characterized to evaluate their structure and bioactivity. XRF analysis was employed to determine the chemical composition of the starting materials and to identify the optimal calcination temperature for complete phase formation. At 1250 °C, pseudowollastonite was found to be the dominant crystalline phase with good thermal stability. To assess in vitro bioactivity, the powders were immersed in simulated body fluid (SBF) under controlled conditions. FTIR and SEM/EDX analyses confirmed the rapid nucleation of carbonated hydroxyapatite (CHA) on the wollastonite surface within only 4 h. After 15 days of immersion, the surface was completely covered with a continuous and uniform apatite layer, with a Ca/P ratio of 2.48, clearly indicating the successful formation of bioactive apatite. These findings demonstrate that eggshell-derived wollastonite possesses excellent bioactivity, making it a highly promising candidate for future bone tissue engineering applications.

Key words: Wollastonite; Chicken eggshells; Silica fume; Carbonated hydroxyapatite; Simulated body fluid.

OLIVE WASTE TO BIOMATERIALS: A BIO-BASED APPROACH FOR HEALTH AND SUSTAINABILITY

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Abstract
The global shift toward sustainable development and circular bioeconomy has driven growing interest in converting agricultural waste into high-value biomaterials. Among the most promising resources is olive waste**,** a by product of the olive oil industry that is abundant in Mediterranean and North African regions. Typically considered an environmental pollutant due to its high organic load and phytotoxicity, olive mill waste (including pomace, leaves, and wastewater) can instead serve as a valuable raw material for the production of biomaterials**.** This study explores how olive biomass can be transformed through green chemistry and biorefinery strategies into multifunctional materials that are biodegradable, biocompatible, and environmentally friendly. Olive-derived biomaterials, particularly those rich in polyphenols, lignin, and cellulose**,** show great potential in medical fields due to their antimicrobial, antioxidant, and anti-inflammatory properties. By turning a local waste problem into a bio-based opportunity, this study highlights the role of olive biomass valorization as a model for sustainable innovation in the Global South. We will discuss current research, technological pathways, challenges in standardization and commercialization, and future directions for integrating olive waste into a circular economy that aligns with the goals of public health, environmental stewardship, and economic resilience.

Key words: Olive waste; Antioxidant activity; Organosolv; Biomaterials.

IN VITRO DPPH SCAVENGING ACTIVITY OF GREEN-SYNTHESIZED NICKEL OXIDE NANOPARTICLES

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Abstract
The green synthesis of metal oxide nanoparticles has recently attracted considerable interest due to its simplicity, sustainability, and cost-effectiveness. In this study, nickel oxide nanoparticles (NiO NPs), renowned for their thermal stability, chemical resistance, and multifunctional properties, were synthesized using ascorbic acid, which acted both as a mild reducing agent for Ni^{2+} ions and as a stabilizing agent to prevent nanoparticle agglomeration. In the experimental procedure, a freshly prepared solution of ascorbic acid was added to nickel acetate. After 2 hours of stirring at 70 °C, the mixture was subjected to centrifugation, washing, drying and calcination, yielding nickel oxide nanoparticles. The obtained NiO NPs were subsequently characterized by X-ray diffraction (XRD), UV–Vis spectroscopy, and Fourier-transform infrared (FTIR) spectroscopy. Their antioxidant activity was further assessed through in vitro DPPH radical scavenging assays. The findings revealed a strong antioxidant capacity, with an IC_{50} value of 108 □g/mL; however, this was lower than that of ascorbic acid alone (IC_{50} = 14 □g/mL). In conclusion, this study demonstrates the effectiveness of green synthesis using naturally derived reducing agents and provides valuable insights into the functional evaluation of metal oxide nanoparticles.

Key words: Nanoparticles, NiO NPs, green synthesis, ascorbic acid, DPPH

ADSORPTIVE REMOVAL OF TRYPAN BLUE USING POLYANILINE/SNO_2 HYBRID NANOMATERIALS: SYNTHESIS, CHARACTERIZATION, AND MECHANISM ANALYSIS

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Abstract

The treatment of industrial effluents is critical for environmental protection and regulatory compliance, necessitating the development of efficient decontamination processes. Adsorption is a prominent technique, valued for its high efficiency, cost-effectiveness, and potential for adsorbent regeneration. This study focuses on the synthesis and application of innovative polyaniline/tin oxide (PANI/SnO_2) hybrid nanomaterials for the adsorptive removal of Trypan blue dye from aqueous solutions. The nanocomposite was comprehensively characterized using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), and nuclear magnetic resonance (NMR) spectroscopy, confirming its successful synthesis and structure. The adsorption efficiency was evaluated by investigating key physicochemical parameters, including contact time, solution pH, adsorbent dosage, initial dye concentration, and temperature. The process was further analyzed through adsorption isotherm, kinetic, and thermodynamic studies to elucidate the underlying mechanism. The results demonstrate that the PANI/SnO_2 nanocomposite is a highly effective adsorbent for Trypan blue removal, with the optimization of parameters efficiently monitored via UV-Visible spectroscopy. This work highlights the significant potential of polymer/metal oxide hybrids in advanced wastewater treatment applications.

Key words: Adsorption; wastewater treatment; hybrid nanomaterials; Polyaniline; Tin oxide (SnO_2); Trypan blue.

INHIBITION OF PHOTOCATALYTIC DEGRADATION IN GA- AND BI-CO-DOPED ZNO NANOPOWDERS: IMPLICATIONS FOR SUNSCREEN APPLICATIONS

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Abstract

The chemical sol-gel method was successfully used to synthesize ZnO semiconductor nanopowders co-doped with varying concentrations of Bi and Ga. This study investigates the effect of these dopants in suppressing the photocatalytic activity of ZnO for sunscreen applications. The structural and optical properties of Bi- and Ga-doped ZnO were characterized using X-ray diffraction (XRD), ultraviolet-visible reflectance spectroscopy (UV-Vis). XRD analysis confirmed the presence of the hexagonal wurtzite phase in the co-doped ZnOnanoparticle.. The crystallite size, estimated using the Williamson-Hall (W-H) plot, ranged from 24 to 10 nm. The UV-Vis spectrophotometer results show the bandgap increases with Bi and Ga co-doping. These increases inhibit the electron-hole pair recombination, thereby reducing the production of reactive oxygen species (ROS). Finally, Rhodamine B (Rh-B), a typical organic contaminant, is under sunlight irradiation. The results demonstrated that co-doped ZnO exhibits lower photocatalytic efficiency compared to undoped ZnO, confirming its suitability for sunscreen applications.

Keywords: ZnOnanopowders ; Sol-Gel ; co-doping ; Photocatalytic properties ; Sunscreens

ECO-FRIENDLY SYNTHESIS OF ZNO NANOPARTICLES USING MEDICINAL PLANT EXTRACT FOR EFFICIENT WASTEWATER TREATMENT

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Abstract

Environmental sustainability relies on developing greener and ecological methods to manage pollutants and contamination from industrial wastewater, which pose significant risks to human health. The biosynthesis of nanoparticles using plant extracts has attracted great interest as a simple, cost-effective, eco-friendly, and non-toxic process. Zinc oxide nanoparticles (ZnO-NPs), particularly those obtained through green synthesis, represent a promising solution due to their photocatalytic activity and environmental compatibility. In this work, ZnO-NPs were synthesized via an ecological route using aqueous leaf extract of a medicinal plant as reducing, capping, and stabilizing agents. The biosynthesized ZnO-NPs were characterized by X-ray diffraction (XRD), and Fourier transform infrared spectroscopy (FTIR). The analyses confirmed the formation of ZnO with a wurtzite crystalline structure, an average crystallite size of ~27.8 nm, while FTIR spectra revealed the presence of Zn–O vibration peaks at 375 cm^{-1}. The photocatalytic performance of ZnO-NPs was evaluated through the degradation of Basic Fuchsin (BF) dye (15 ppm) under sunlight irradiation, achieving up to 96% efficiency with a catalyst dosage as low as 40 mg and 30 min under sunshine irradiations. These findings demonstrate that biosynthesized ZnO-NPs derived from medicinal plants constitute an effective and eco-friendly photocatalyst for wastewater treatment.

Key words: Water pollution, Green synthesis, Medicinal plants, ZnO NPs, Photocatalysis, Dye degradation.

ULTRASONIC PREPARATION OF NEW NANOCOMPOSITES : STRUCTURAL, MORPHOLOGICAL AND THERMAL PROPERTIES

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Abstract

This work focuses on the preparation and characterization of new poly(GMA)@Fe_3O_4 and poly(GMA)@Fe_3O_4-NH_2 nanocomposites. Firstly, magnetite was synthesized and functionalized with different aminosilanes (mono-, di-, and triamine); then, varying percentages of these materials were dispersed in the poly(GMA) matrix using ultrasound. The structural, thermal and morphological properties of the obtained composites were evaluated. For this, various characterizations, including Fourier transform infrared spectroscopy, X-ray diffraction, X-ray photoelectron spectroscopy, scanning electron microscopy, and thermogravimetric analysis, were employed. It was shown that the aminosilanes nature, the percentage of nanofillers and the use of ultrasonic treatment play a very important role in the structural, thermal and morphological properties of the obtained composites. The results show that Fe_3O_4 and NH2-Fe_3O_4 functionalized by monoamine as nanofillers made the best compounds that were more stable. The compounds that were made had very high results in a shorter reaction time. This is mostly because of the sonication process. Ultrasound also helped keep the epoxy ring, which is known for being very flexible and easy to open. This is a huge benefit that will make it possible to change these materials for any use.

Keywords: Characterization, aminosilanes, polymers, ultrasonic

KERATIN WOOL-BASED SUSTAINABLE MATERIALS FOR GAS SENSING APPLICATIONS

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Abstract
Keratin, a natural and biodegradable protein extracted from sheep wool, has recently attracted growing interest as a sustainable material for sensor applications. This work focuses on the extraction of keratin from sheep wool using the alkaline hydrolysis method. The prepared sensitive layer was characterized to evaluate their performance for ethanol gas detection. UV-Visible spectroscopy revealed a strong absorption band at 282 nm, corresponding to aromatic amino acids. FTIR analysis confirmed the presence of three amide bands (I, II, and III), which are characteristic of proteins. Morphological analysis showed that the keratin surface exhibits a porous structure, which is favorable for gas adsorption. To determine the optimal operating temperature of the pure keratin-based sensors, electrical impedance measurements were carried out at different temperatures (50 °C – 210 °C). The fabricated devices were then tested in an ethanol gas detection system at various concentrations (50 ppm, 70 ppm, 100 ppm, and 200 ppm) at a frequency of 1 kHz. The detection results revealed an increase in sensitivity with rising temperature, reaching a maximum value at 110 °C. Beyond this temperature, a gradual decrease in sensitivity was observed for the keratin-based sensor. Furthermore, it was found that the maximum sensitivity was achieved at the same temperature, regardless of the ethanol gas concentration. This work provides a new approach for utilizing renewable resources in the design of sustainable gas sensors for environmental and industrial applications.

Key words: keratin, wool, biopolymer, gas sensor

LA GRAVURE AU FLUORURE D'AMMONIUM : UNE APPROCHE INNOVANTE POUR UNE HIERARCHISATION OPTIMALE DE TS-1

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Abstract

Depuis sa découverte en 1983 par Taramasso, la titanosilicate (TS-1) de type MFI s'est avérée très prometteuse comme catalyseur d'oxydation en chimie fine et pétrochimie et a montré d'excellentes performances dans diverses réactions d'oxydation, à savoir, la désulfuration des sulfures. Son activité catalytique provient principalement de Ti^{+4} inséré dans sa charpente zéolithique qui active facilement les molécules oxydantes (comme H_2O_2) dans des conditions douces. Cependant, des inconvénients majeurs résultent de la taille étroite des micropores (environ 0,54 nm) imposant des chemins diffusionnels très longs, qui souvent, réduisent leurs performances catalytiques (désactivation rapide du catalyseur). En effet, le développement de zéolithes à porosité hiérarchisée permet de diminuer le chemin diffusionnel et d'augmenter l'accessibilité de molécules volumineuses aux sites actifs. Dans la présente communication nous présenterons une nouvelle technique permettant le développement de porosité hiérarchisée dans la TS-1. Cette stratégie est basée sur un post-traitement en utilisant le fluorure d'ammonium. La TS-1 hiérarchisée présente des propriétés texturales améliorées (création de mésopores et macropores) et une activité catalytique très remarquable dans la sulfoxydation du Thioanisole, atteignant une conversion totale au bout de 30 minutes de réaction pour la TS-1 hiérarchisée et 105 minutes pour TS-1 parente.

Key words: zéolithes, TS-1, hiérarchisation, désulfuration.

ETUDE COMPARATIVE D'UN BIOMATERIAU A BASE D'AMIDON DE POMME DE TERRE ET CELUI DE SES EPLECHURES

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Abstract
L'objectif principal de ce travail est la valorisation de la biomasse par préparation du plastique biodégradable à base d'amidon des épluchures de pomme de terre et celui de pomme de terre, dont le but de palier l'utilisation des polymères traditionnels qui sont une source de pollution de l'environnement.
Différentes analyses ont été réalisés sur les différents échantillons pour l'évaluation de la qualité du produit, tels que l'analyse par FTIR, DRX, taux d'humidité et test de biodégradabilité.
Le rendement du bioplastique à base d'amidon de pomme de terre, évalué à environ 80,1%, est légèrement supérieur à celui du bioplastique obtenu à partir des épluchures de pomme de terre, dont le rendement atteint 78%.
On observe une accélération significative du processus de dégradation, avec un taux de dégradation atteignant 80% pour les films bioplastiques à base d'amidon de pomme de terre, tandis que ceux élaborés à partir des épluchures de pomme de terre présentent un taux encore plus élevé, proche de 86%.

Key words: Bioplastique, pomme de terre, épluchures, amidon, films plastique.

HYDROTHERMAL SYNTHESIS, STRUCTURAL AND OPTICAL CHARACTERIZATION OF COPPER OXIDE-DOPED MCM-41 MESOPOROUS NANOMATERIAL

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Abstract

Nanoparticles exhibit remarkable physical and chemical properties, which are significantly influenced by their size and fabrication technique, making them suitable for various applications, including environmental remediation, hydrogen production, and the therapeutic field.
This study reports the hydrothermal synthesis of modified mesoporous silica CuO-MCM-41. The material's structural and optical properties were examined employing a multi-technique methodology, including X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy with energy-dispersive spectroscopy (SEM/EDS), X-ray photoelectron spectroscopy (XPS), and ultraviolet-visible (UV-Vis) spectroscopy. XRD patterns confirmed the successful incorporation of CuO into the MCM-41 structure. FTIR spectra showed Si-O-Si and Cu-O stretching vibrations, indicating strong interactions between the copper oxide phase and the silica matrix. SEM images revealed a homogeneous surface morphology with well-dispersed CuO nanoparticles. EDX elemental analysis determined the presence of Si, Cu, and O, suggesting the high purity of the sample. Additionally, XPS analysis indicates the presence of Si (IV) and Cu (II), as well as oxygen species, on the material's surface. UV–Vis diffuse reflectance measurements revealed a band gap energy of 1.50 eV, enabling efficient absorption in the visible light range.

Key words: CuO; MCM-41; hydrothermal; doped; mesoporous silica.

THE EFFECT OF TRAINING FUNCTIONON PREDICTING THE PERMEABILITY OF POLYMER INTRINSIC MICROPOROSITY (PIMS)

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Abstract

The fastest training function is generally trainlm, and it is the default training function for feed forward net. The quasi-Newton method, trainbfg, is also quite fast. Both of these methods tend to be less efficient for large networks (with thousands of weights), since they require more memory and more computation time for these cases. As also, trainlm performs better on function fitting (nonlinear regression) problems than on pattern recognition problems. When training large networks, and when training pattern recognition networks, trainscg and trainrp are good choices. Their memory requirements are relatively small, and yet they are much faster than standard gradient descent algorithms. As an illustration of how the training works, consider the simplest optimization algorithm gradient descent. It updates the network weights and biases in the direction in which the performance function decreases most rapidly. Our PIM database containing 120 polymeric membranes of intrinsic microporosity (PIMs), with their gas permeability collected from literature for three gases (N_2, CH_4, and CO_2). After the step of molecular descriptors calculated byalvaDesc software, we obtain 1143 descriptors.

Key words: polymer of intrinsic microporosity, training function, model performance.

CONCENTRATIONS OF HYDROGEN DURING THE HOT-FILAMENT CHEMICAL VAPOR DEPOSITION PROCESS

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Abstract

In this study, the concentration of species was calculated inside the reaction chamber of a HFCVD reactor. The gas-phase homogeneous reactions are represented by a simplified reaction mechanism. A two-dimensional model was adopted to study the HFCVD reactor. The equations of heat, momentum, and mass transfer were solved numerically; the simulation was performed using a program in FORTRAN language. Species concentration of H distributions were similar at the filaments and they were also similar between the filaments. The comparison between the variations of H concentrations as a function of z at the vertical planes of the filaments for n = 3 and n = 4 shows that the concentrations have approximate values; the difference is about 1.31% to 0.86%, the concentration of for n = 4 is higher than that of n = 3. Between the filaments the concentration of n = 3 is higher than that of n = 4, the difference is 3.13% to 2.95%.

Key words: Chemical vapor deposition, Fluid model, CH_4/H_2 gas mixture, Chemical reaction, Diffusion, Concentration.

MICROSTRUCTURAL CHANGES IN DUCTILE IRON INDUCED BY CHROMIUM, NICKEL AND MOLYBDENUM ADDITIONS

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Abstract

The influence of alloying elements chromium (Cr), nickel (Ni), and molybdenum (Mo) on the microstructural evolution of ductile cast iron has been investigated and compared to a standard ductile cast iron. The studied ductile cast iron was produced in an industrial environment. Cr, Ni and Mo and were finely crushed and added in powder form. Metallographic analysis, including optical microscopy and scanning electron microscopy (SEM), was conducted to characterize microstructural features, while energy-dispersive X-ray spectroscopy (EDS) was used to determine the distribution of alloying elements. The results show that the microstructure of the standard ductile cast iron consists of a matrix containing ferrite and pearlite with spheroidal graphite. The addition of Cr, Ni, and Mo leads to the formation of M_6C-type carbides within the matrix. Furthermore, these alloying elements cause an increase in the pearlite fraction and a decrease in the ferrite content. This microstructural evolution indicates that Cr, Ni, and Mo promote matrix hardening and contribute to the refinement and stabilization of the overall microstructure.

Key words: Ductile cast iron, Addition elements, Microstructure.

INFLUENCE OF THE NAOH/NA_2SIO_3 RATIO ON THE STRENGTH OF GEOPOLYMER MORTARS

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Abstract

This study investigates the influence of the volumetric ratio of $NaOH/Na_2SiO_3$ in the activating solution on the mechanical performance of geopolymer mortars synthesized from natural zeolite. Two volumetric ratios of the activating solutions, approximately 1 and 2, were considered in order to examine the effect of alkaline to silicate balance on the reactivity of mordenite-rich tuff. The formulated mortars were subjected to compressive strength tests at 7 and 28 days. The results clearly demonstrate that the composition of the activator solution plays a decisive role in the geopolymerization process, strongly influencing both the kinetics and the final strength of the mortars. To better understand the underlying mechanisms, additional characterizations were performed using XRD and FTIR. These analyses revealed structural transformations of the zeolitic framework, the dissolution of reactive phases, and the progressive formation of geopolymeric gels and crystalline products. The findings confirm that achieving an appropriate balance between hydroxide and silicate species is essential for optimizing the reactivity of natural zeolite, enhancing geopolymer network formation, and improving long-term mechanical performance.

Key words: Geopolymer; activating solution; $NaOH/Na_2SiO_3$ ratio; compressive strength.

CUO NANOPARTICLES: BIOSYNTHESES, CHARACTERIZATION AND ANTIBACTERIAL ACTIVITY

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Abstract
The biosynthesis of copper oxide (CuO) nanoparticles (NPs) was studied. The aims of this research were biosynthesis of CuONPs from a Cu^{2+} ion solution using a green syntheses method with Rosmarinus officinalis plant extract as reducing and stabilisant agent and its application as antibacterial agent against Escherichia coli. CuONPs characterized using FTIR spectroscopy, SEM, EDAX, UV-vis spectrophotometry and X-Ray diffractometer. UV-visible spectroscopy revealed SPR peaks at 708 nm, confirming the formation of CuONPs. The XRD pattern agreed with the reported data for Cu metal, with an average crystallite size of 17.5nm. SEM image shows spherical shape of nanoparticles and EDAX spectra confirm the presence of Cu. The CuNPs were calcined at 500°C and the XRD confirmed the formation of CuO phase. Moreover, the biosynthesized CuONPs exhibited promising antibacterial activity against Escherichia coli using two methods: disk diffusion and microdilution. The result shows at concentrations of 5 mg/mL the average inhibition zone diameter of 20 mm was obtained. In addition, MIC of the CuONPs was 0.312 mg/mL.

Key words: CuO Nanoparticles, Green syntheses, Antibacterial activity, Escherichia coli.

FIRST-PRINCIPLES ANALYSIS OF IR_3SC IN CUBIC AND HEXAGONAL PHASES: STABILITY, MECHANICAL, ELECTRONIC AND THERMODYNAMIQUE PROPERTIES

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Abstract
In this work, the structural, mechanical, electronic, and thermodynamic properties of the Ir_3Sc intermetallic compound in its cubic ($L1_2$) and hexagonal ($D0_{19}$ and $D0_{24}$) phases are presented. The outcomes of the simulation rely on density functional theory (DFT) within the Perdew-Burke-Ernzerhof (PBE) generalized gradient approximation (GGA) based on the full-potential linearized augmented plane wave (FP-LAPW) approach. The existing study was performed on the $L1_2$ cubic phase, in addition to hexagonal $D0_{24}$ and $D0_{19}$ phases, which may be relative but differ in the way that the atomic layers are stacked. The calculated total, cohesive energy, and heat formation suggest that the Ir3Sc compound can be stable in the $D0_{24}$ phase because of an overlap between the $L1_2$ and $D0_{24}$ phases with a total energy difference of around 0.026 eV/atom. From elastic constants calculations, it reveals that the studied compound is mechanically stable and harder in the cubic phase than in the hexagonal phase. However, Ir_3Sc has the lowest hardness due to its relative ductility. It was observed that the Ir_3Sc compound has an elastic anisotropy based on the three-dimensional Young's modulus surface.
The total density of state (TDOS) calculations shows that Ir_3Sc compound which might undergo a martensitic transition. Moreover, the thermodynamic properties are calculated and analyzed with temperature and pressure. via the quasi-harmonic Debye model within the Gibbs computational code.

Key words: Phase stability, Ductility, Intermetallic, L12, $D0_{19}$, $D0_{24}$

MORPHOLOGICAL AND ELECTROCHEMICAL STUDY OF $NI_{90}FE_{10}$

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Abstract

$Ni_{90}Fe_{10}$ alloy deposit was successfully synthesized by electrochemical methods, employing both cyclic voltammetry (CV) and chronoamperometry (CA). Cyclic voltammetry was first used to investigate the electrochemical behavior of the Ni–Fe system. In addition to the inevitable appearance of intense anodic and cathodic peaks associated with the oxidation and reduction of water, a potential range suitable for Ni–Fe alloy deposition was identified. On this basis, $Ni_{90}Fe_{10}$ deposits were obtained by chronoamperometry at a fixed deposition time of 120 s. The applied potentials in this study varied between –1300 mV and –1600 mV vs (Ag/AgCl). The nucleation mechanism was examined using the Scharifker–Hills model, which demonstrated a transition from instantaneous nucleation at lower current densities to progressive nucleation as the applied deposition current increased. This behavior highlights the strong dependence of nucleation kinetics on the electrochemical driving force Energy-dispersive X-ray spectroscopy (EDX) confirmed the targeted alloy composition of $Ni_{90}Fe_{10}$, although slight fluctuations were observed, consistent with the well-documented phenomenon of anomalous codeposition in Ni–Fe systems. Scanning electron microscopy (SEM) analysis revealed homogeneous and compact deposits, with surface morphologies dominated by spherical particles, indicative of uniform growth under the selected deposition conditions. These findings confirm the effectiveness of electrochemical methods for producing Ni–Fe alloys with controlled composition and morphology, while also providing further insight into the nucleation mechanism and the influence of anomalous codeposition on film uniformity.

Keywords: Ni–Fe alloys; Electrochemical deposition; Anomalous codeposition; SEM; EDX

A HIGHLY SENSITIVE VOLTAMETRIC DETECTIONOF KONGO RED USING $COFE_2O_4$/GLASSY CARBON MODIFIED ELECTRODE

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Abstract

An advanced electrochemical biosensor has been developed to measure the amount of kongo red in fluids accurately using $CoFe_2O_4$ nanoparticles modified glassy carbon electrode. This sensor uses $CoFe_2O_4$ as a core material that has been analysed using X-ray diffraction (XRD) with (hkl) plans (111), (220), (311), (222), (400), (422), (511), and (440) were observed at 18.3°, 30.22°, 35.5°, 37.26°, 43.14°, 53.69°, 57.21°, and 62.55° (JCPDS card no. 22–1086) and scanning electron microscopy (SEM). The sensor has a $CoFe_2O_4$ layer that allows it to detect uric acid at trace levels. In this study, it has been confirmed that the detection limit (LOD), limit of quantification (LOQ) and sensitivity of the sensor using cyclic voltammetry (CV) electrochemical method is significantly more sensitive and effective than previous literature. The sensitivity is 0.00485-µA µM-1 cm-2 and LOD is 221.45µM and LOQ is to be 738.16 µM;This confirms that the electrochemical method using our modified electrode is significantly rapid, effective and high sensitive.

Key words: Kongo red, LOD, X-ray diffraction, $CoFe_2O_4$, SEM, Sensor.

REDUCING OF THE PREPARATION TIME AND IMPROVING THE CRITICAL TEMPERATURE OF THE BI-2212 SUPERCONDUCTING PHASE USING THE PHOTOPOLYMERIZATION REACTION.

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Abstract

Two bulk samples of the $Bi_2Sr_2CaCu_2O_{8+\delta}$ Superconducting compound known as the Bi-2212 phase, was prepared using The conventional Solid State Reaction method (SSR) and the photo-polymerization reaction (PPR) as an alternative method. Both SSR and PPR samples displayed an orthorhombic structure of Bi-2212 phase with lower phase formation of Bi-2201 and Bi-2223 phase in the SSR sample, with an an improvement of the preparation time of the PPR sample lower of 30 hours. SEM micrographs showed grains alignment with an average grain size of 7.0 μm . The electrical transport behavior for the two prepared samples confirm the transition from metallic to superconducting state with a single step feature where the offset temperature, where we note that the critical temperature Tc(PPR) is higher than the Tc(SSR) since it was 83K for PPR case and 79K in SSR case. The PPR method will open the door for a shorter preparation of the bulk superconducting ceramics.

Keywords: Photo-Polymerization, BSCCO system, Bi-2212 phase, Superconductors, HTSC, Solid State Reaction.

CORRELATION BETWEEN CRYSTALLINE STRUCTURE AND ALUMINA THERMAL BEHAVIOR OBTAINED BY SOL-GEL

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Abstract

In order to study and better understand the relationship between thermal behavior and the crystal structure of alumina, a white alumina powder has been synthesized by the Sol-Gel method, a soft chemistry technique. Aluminum nitrate has been used as a precursor and aluminum source, citric acid as a complexing agent, and distilled water as a solvent. After two hours of heating with magnetic agitation, a homogeneous gel was obtained, then divided into two fractions. The first fraction was subjected to a thermal analysis coupled DTA/GTA (differential thermal analysis and thermogravimetric analysis), while the second was calcined at different temperatures with a view to obtaining the final alumina powder. Complementary analyzes by infrared spectroscopy to Fourier transformed (FTIR) and X -ray diffraction (XRD) were then carried out on the samples. The DTA/TGA analysis revealed two main mass losses, 51 % and 21 % respectively, accompanied by two endothermic peaks and an exothermic peak, indicating the decomposition of organic residues. The FTIR analysis highlighted characteristic bands attributed to Al-O, Al-O-Al and O-H confirming the presence of alumina as well as residual traces of water. Finally, XRD analysis has shown the exclusive presence of the alpha crystalline phase of alumina (α-Al_2O_3), testifying to complete crystallization after calcination.

Key words: behavior; structure; alumina; synthesized; sol-gel.

SYNTHESIS AND STUDY OF ELECTROCHEMICAL BEHAVIOR OF PANI/(ZNO,ZRO_2, TIO_2)COMPOSITE APPLIED IN ANTI-CORROSION EPOXY COATINGS

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Abstract

This research is part of the development of innovative and environmentally friendly anti-corrosion coatings. The main objective is to evaluate the electrochemical efficiency of new polymer materials based on polyaniline (PANI) combined with metal oxides such as ZrO_2, ZnO, and TiO_2, as a sustainable alternative to zinc phosphate, a pigment traditionally used but with environmental and economic drawbacks.

Polyaniline, a conductive polymer, was chosen for its ability to form a passive layer on metals thanks to its redox properties. The combination with metal oxides enhances protection through synergistic effects: physical barrier, thermal stability, and increased chemical resistance.

Hybrid composites were synthesized, formulated into coatings, and then applied to metal substrates. Their anti-corrosion performance was evaluated using various electrochemical techniques : open-circuit potential (OCP), cyclic voltammetry, Tafel curves, electrochemical impedance spectroscopy (EIS), and linear polarization resistance.

The results showed that PANI/oxide systems, particularly PANI/ZrO_2/ZnO/TiO_2, offer significantly superior protection to zinc phosphate, with improved corrosion resistance and increased durability.

Key words: composite polymers, PANI/(ZnO,ZrO_2,TiO_2), EIS,CV, coating.

MICRO-DEFECT DETECTION IN TRANSPARENT CERAMICS VIA TRANSMISSION INTERFEROMETRY

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Abstract

In this work, we propose a method based on transmission interferometry for the detection of micro-defects on the surface of transparent ceramics. This non-destructive technique enables theevaluation of both the optical and mechanical properties of the material.

The aim is to develop a simple yet effective detection tool capable of revealing low-contrast defects that are often challenging to identify using conventional methods. The approach utilizes interferometry by superimposing microscopic periodic gratings. A reference grating is compared with an image transmitted through the sample, illuminated by a collimated laser beam. The interaction between the two gratings produces interference fringes, whose distortions indicate local perturbations in the transmitted wavefront, thereby revealing the presence of defects.

The shape and displacement of these fringes provide a means to characterize the nature of thedetected defects and to assess the optical and mechanical quality of the transparent ceramics.Owing to the high resolution of the system, defects can be detected and analyzed at the submicron scale.

This method offers rapid, real-time characterization, making it particularly suitable for industrial quality control applications. It is especially effective for both qualitative and quantitative assessment of transparent ceramic surfaces.

Key words: Ceramic transparent, Fringes, Interferometry, Microdefect, detection, gratings.

ÉTUDE DES PROPRIETES STRUCTURALES ET MORPHOLOGIQUES D'UNE CATHODE DE PILE A OXYDE SOLIDE

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Abstract
Le travail réalisé est consacré à la synthèse et à la caractérisation de ferro-cobaltites de lanthane en tant qu'un matériau d'électrode de pile SOFC. Une série d'échantillons à structure pérovskite est élaborée par la méthode Sol-gel et caractérisée par différentes techniques telles que la diffraction des rayons X (DRX), la microscopie électronique à balayage (MEB), la microanalyse par énergie dispersive de rayons X (EDX), la spectroscopie infrarouge à transformée de Fourier (FTIR) et l'analyse thermogravimétrique (ATG). Les résultats obtenus de la DRX et du MEB nous donnent une idée sur les caractéristiques de la structure cristalline obtenue et l'évolution microstructurale des grains. L'identification des phases présentes est faite par le logiciel X'pert HighScore. L'affinement des paramètres structuraux et l'indexation des raies sont réalisés par le logiciel Jana 2006. Les diffractogrammes obtenus sont affinés dans le groupe d'espace R-3c pour les composés LSCF et LNSCF et le groupe d'espace Pm3m pour LSSCF. Le traitement d'image de micrographie pour l'échantillon dopé au samarium est effectué à l'aide du logiciel Image-J afin d'avoir une idée sur la distribution, la surface et la taille moyenne des particules, suivi par l'analyse EDAX qui nous donne des informations sur la composition élémentaire de l'échantillon et le pourcentage atomique de chaque constituant. L'ensemble des spectres IR présente deux bandes d'absorption qui sont attribuées aux vibrations de déformation angulaire et d'élongation de la liaison Co(Fe)-O. L'ATG montre que l'échantillon dopé au samarium présente une meilleure stabilité thermique avec une faible perte de masse estimée à 2.5%.

Key words: Phase LSCF, PAC, Sol-gel, Dopage, SOFC.

SUSTAINED VALSATAN RELEASE FROM POLYCAPROLACTONE MICROSPHERES

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Abstract

To increase the bioavailability of certain active ingredients, a therapeutic approach consists of encapsulating the active substance in biodegradable polymers. This technique helps protect the active ingredient and control its release in the body, thereby reducing side effects associated with a massive release and prolonging the therapeutic effect, which decreases the number of doses. Therefore, this investigation aimed to develop Biodegradable polycaprolactone (PCL) microspheres, which provide better control of valsartan release. A single emulsion solvent evaporation method by varying two factors namely drug amount and organic phase volume prepared the drug-containing microspheres. The drug release study showed that the optimal formulation, prepared with 65,76 mg of valsartan and 9.45 ml of dichloromethane, improved valsartan release in simulated gastric fluid for the first 2 h, while it provided a sustained release, in phosphate buffered saline (pH 6.8). The formulations prepared with a lower organic phase volume (4 ml) have reduced the burst effect and therefore provided better control of valsartan release.

Key words: Valsartan; PCL; biodegradable; polymer; sustained release.

ELECTROCHEMICAL SENSOR BASED ON POLYMERS AND NANOMATERIALS FOR MEDICAL MONITORING

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Abstract

This work details the creation of a novel electrochemical sensor for the selective and sensitive detection of dopamine. This sensing platform is developed using a poly(3,4-ethylenedioxythiophene):polystyrene sulfonate-polypyrrole-reduced graphene oxide (PEDOT:PSS-PPy-rGO) nanocomposite. The sensor is fabricated through a one-step electrochemical deposition onto a flexible screen-printed carbon electrode. This process incorporates a molecularly imprinted polymer (MIP) technique to form a 3D hybrid material, The structure and morphology of the sensor were thoroughly characterized using scanning electron microscopy (SEM) energy-dispersive spectroscopy (EDS) and Fourier-Transform Infrared Spectroscopy (FTIR). The electrochemical behavior of this sensor was investigated through cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). The electrochemical sensor exhibits a broad linear detection range for dopamine, spanning from 0.1 nanomolar (nM) to 12 nM. Its detection limit was quantified at 8.47 picomolar (pM). To validate its practical applicability, the sensor was used for the analysis of dopamine in real samples, specifically an extract from bovine brain samples diluted with phosphate-buffered saline (PBS) under controlled conditions. Furthermore, this three-dimensional molecularly imprinted polymer nanocomposite demonstrates remarkable characteristics in terms of selectivity, reproducibility, and stability. The high recovery efficiency observed during the real sample tests collectively confirms the suitability of this developed sensor for a wide array of practical analytical applications.

Key words: Dopamine, Electrochemical sensors, Molecular imprinting, Flexible electrode, Voltammetry

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ÉLABORATION ET CARACTERISATION MICROSTRUCTURALE D'UN BIOCOMPOSITE A MATRICE PLA RENFORCE PAR DES NOYAUX DE DATTES

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Abstract

Dans cette étude, un matériau composite biodégradable à matrice d'acide polylactique (PLA), renforcé par de la poudre de noyaux de dattes (ND), a été élaboré à l'aide d'une technique de métallurgie des poudres. Les matières premières (PLA et les noyaux de dattes) ont été préalablement broyées sous forme de poudres. Un mélange PLA/ ND a ensuite été consolidé par pressage à chaud à 180 °C, sous une pression de 10 MPa pendant 5 minutes. Les caractérisations microstructurales par microscopie électronique à balayage (MEB) ont révélé que les particules de PLA présentent des formes irrégulières à l'échelle micrométrique, tandis que la poudre de noyau de datte affiche une morphologie granuleuse avec une surface rugueuse, favorable à l'ancrage dans la matrice. L'analyse par spectroscopie infrarouge à transformée de Fourier (FTIR) a mis en évidence l'apparition de nouveaux groupes fonctionnels, indiquant des interactions chimiques entre les macromolécules du PLA et les constituants organiques de la poudre de noyau de datte. Par ailleurs, les analyses calorimétriques différentielles (DSC) ont montré des changements significatifs des points de transition thermique, ainsi que des variations des énergies associées, témoignant de la formation de nouveaux composés chimiques différents de ceux présents dans les constituants de départ pris séparément.

Mots clés: Composite biodegradable, noyau de datte , PLA , DSC , MEB

STRUCTURAL CARACTERISATION OF $ZN_{1-X}MG_XO$ THIN FILMS PREPARED BY SOL-GEL DIP COATING TECHNIQUE

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Abstract

hin films were prepared on glass substrates using the sol-gel dip-coating technique. The influence of magnesium incorporation on the structural and optical properties of ZnMgO was investigated. Structural, morphological, and optical characteristics were analyzed using X-ray diffraction (XRD), Atomic Force Microscopy (AFM), and UV-Visible spectroscopy. The results showed that all films retained a wurtzite crystal structure. With increasing Mg content, the lattice parameter a increased while c decreased. The films exhibited varying levels of optical transmittance in the visible region, ranging from 31% to 89%. Specifically, transmittance increased with Mg content in the 6.25% to 25% range, while it decreased between 31.25% and 37.5%. Additionally, the film surfaces were observed to be dense, uniform, and free of cracks. Ultraviolet photodetector measurements demonstrated improved sensitivity in ZnMgO films, indicating a higher generation of charge carriers in response to UV irradiation.

Key words: Electronic properties, optical properties, wurtzite Zn1-xMgxO, Sol-gel method.

ELABORATION AND CHARACTERIZATION OF NICHRONE POWDERS PREPARED BY MECHANICAL ALLOYING.

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Abstract

Ni-Cr based alloys have been known for a long time, are intensively studied and are used in many applications. A binary nickel-chromium alloy ($Ni_{67}Cr_{33}$) produced by high-energy grinding and sintering. The samples studied were produced by compressing the base powders under a 15T load and then sintered at 800°C for 3h. They were then cooled in a furnace. For characterization, several types of analyses were performed: X-ray diffraction (XRD), metallographic observation, and Vickers microhardness testing. The results of the analyses XRD revealed the existence of the $NiCr_2$ phase and the Ni(Cr) solid solution, which has a nanometric structure. Metallographic observation revealed some information about the microstructure of our samples, including the heterogeneity and dispersion of micropores as well as the existence of two different contrasts. The microhardness study highlights that the grinding time of 4 hours seems optimal to maximize hardness via structural refinement and efficient densification.

Key words: Ni-Cr alloys, high-energy mechanical milling, sintering, XRD.

THERMAL AND MECHANICAL PROPERTIES OF PHBV/SPANISH BROOM FIBRE BIOCOMPOSITES AFTER CHEMICAL TREATMENT OF SBF

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Abstract
For a number of years, there has been an increasing level of interest in natural fibre composites. It is evident that natural fibres exhibit numerous advantages over synthetic fibres, namely their environmental friendliness, low density, biodegradability, low cost, and exceptional mechanical properties. The hydrophilic character of natural fibres represents the primary disadvantage associated with the utilisation of these fibres as reinforcements within composite materials. A number of techniques for chemical and physical modification of natural fibres have been examined by researchers with a view to enhancing compatibility with hydrophobic polymer matrices. Compatibilisers, surface modification techniques such as alkaline, silane and acetylation treatments...etc. In this study, a new biocomposite was developed. It used poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBV) as a matrix, with the addition of Spanish broom fibres (SBF) for reinforcement. Spanish broom fibers, used as the reinforcement, were exposed to different types of surface modification methods such as alkali and alkali-silane treatments. The PHBV/SBF biocomposites were prepared by melt compounding. The present study investigates the effects of SBF treatment on the thermal and mechanical properties of biocomposites. The findings demonstrated a decrease in Tcc with biocomposites incorporating treated fibres. On the other hand, an improvement in tensile properties; the Young's modulus increased from 4609 MPa for the biocomposites with untreated fibre to 4671 MPa and 4920 MPa for biocomposites with fibres treated with alkali and alkali-silane treatments, respectively. This enhancement was attributed to the presence of strong fibre-matrix interfacial adhesion.

Key words: Biocomposites, PHBV, Natural fibres, Surface modification, Compatibility, Interfacial adhesion.

PREPARATION AND CHARACTERIZATION OF PURE AND MG^{2+} (10 MOL%) DOPED $CATIO_3$ POWDERS BY SOL-GEL METHOD: OPTICAL AND PHOTOCATALYTIC INSIGHTS

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Abestract
This study focused on the synthesis and characterization of CaTiO3 powders doped with Mg^{2+} (10 mol%) and co-doped with various ratios of Mn^{2+} (0, 2, 4, 6, 8, and 10 mol%), which were prepared via a low-cost sol–gel method and calcined at 900 °C for 3 h. These nanopowders were investigated for their potential as improved photocatalysts. The powders were comprehensively analyzed using X-ray diffraction, Fourier transform infrared spectroscopy, Raman spectroscopy, photoelectron spectrometry, scanning electron microscopy, energy dispersive X-ray spectroscopy, Brunauer–Emmett–Teller analysis, UV–visible spectroscopy and differential scanning calorimetry. The experimental results indicated that all diffraction peaks correspond to the orthorhombic phase of $CaTiO_3$ with no impurity phases detected. These was corroborated by FTIR, Raman spectroscopy, and XPS analysis. The crystallite size, influenced by the doping levels, was estimated to range from 25 to 34 nm. Increasing the doping concentration reduces the band gap energy of the doped samples, introducing new energy levels within the band structure. Furthermore, the photocatalytic activity result shows that the $CaTiO_3$ doped with Mg^{2+} (10 mol%) and co-doped with Mn^{2+} (10 mol%) is an effective photocatalyst for the degradation of crystal violet dye under UV light irradiation.

Key words: Perovskite; calcium titanat; powders; photocatalytic activity.

ETUDE DES PROPRIETES PHYSICO-CHIMIQUES D'UNE ARGILE ALGERIENNE DE LA REGION DE TAMANGHASSET

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Abstract

Les propriétés minéralogiques et physico-chimiques des argiles suscitent un intérêt particulier dans de nombreuse d'applications telles que le traitement des eaux, peinture, barrière pour les polluants, adsorbant, catalyseur, etc. Actuellement, de nombreuses recherches ont porté un intérêt à l'étude des argiles. Cette importance des argiles est justifiée par l'abondance de ces minéraux dans la nature, leur coût modéré, la présence de charges électriques à leur surface, leur porosité, et surtout par la capacité d'échange des cations interfoliaires. Dans ce travail, nous avons étudiés les propriétés physico-chimiques d'une argile naturelle de la région de Tamanghasset. Les propriétés physico-chimiques de notre échantillon ont été déterminées en mesurant son pH, son taux d'humidité, son colloïdalité et sa perte au feu. Les analyses structurale et texturale ont été effectuées en utilisant la diffraction des rayons X et la méthode d'adsorption-désorption de N2 à -196°C. Les résultats obtenus soulignent la nature basique de notre argile. Il a été constaté que l'échantillon étudié est principalement constitué d'un mélange de kaolinite, de quartz en proportion significative, et de calcite. L'analyse texturale met en évidence la présence de structures mésoporeuses dans l'échantillon examiné.

Key words : Argile, Caractérisation, Diffraction X, Adsorption.

STUDY AND FORMULATION OF FUEL OIL IFO30 FROM HEAVY FUELS IFO80, 180, 380 AND DIESEL

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Abstract:
Fuel-oil is a petroleum-derived combustible widely used as a fuel in sectors such as agriculture, fishing, and public works. The aim of this study was to formulate a 30 cSt fuel-oil from heavier residual fractions by reducing their viscosity through diesel blending. Three base fuels (IFO 80, IFO 180, and IFO 380) were tested using a dilution method. Each mixture was prepared by weighing the desired mass fraction of fuel, adding diesel, and maintaining mild stirring for 30 minutes at near-ambient temperature to avoid light-fraction evaporation. Compatibility tests were conducted to evaluate the stability of the mixtures and detect any precipitation of asphaltenes. The best-performing formulation was obtained from 60 % IFO 380 and 40 % diesel, yielding a kinematic viscosity of 25.76 cSt at 50 °C, density of 891.1 kg/m³, and flash point of 84 °C. The blend also showed a sulfur content of 1.88 % (m/m), CCAI of 789.6, and carbon residue of 6.54 %, all within the limits specified by ISO fuel-oil standards. The mixture remained stable without any phase separation, confirming good compatibility between the paraffinic (diesel) and resinous–asphaltenic (fuel) components. Overall, the developed 60/40 blend successfully meets the target viscosity of 30 cSt, complies with fuel specifications, and demonstrates both technical and economic feasibility for use in diesel engine systems.

Key words: Fuel oil, diesel, flow point, viscosity.

VALORIZATION OF TENDLA SAND RESOURCES: A COMBINED ACID-LEACHING AND THERMAL TREATMENT METHOD FOR INDUSTRIAL-GRADE SILICA PRODUCTION

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Abstract
This study investigates the thermo-chemical purification of silica sand from Tendla dunes using a multi-stage protocol involving acid leaching (HCl/HNO_3), high-temperature calcination (900°C), and HF/HCl treatment. The process was carefully optimized to ensure maximum removal of impurities while preserving the structural integrity of the silica. Advanced characterization techniques, including X-ray fluorescence (XRF), X-ray diffraction (XRD), and scanning electron microscopy (SEM), confirmed a significant enhancement in silica purity, increasing from an initial 90% to an exceptional 99%. Metallic impurities such as Fe_2O_3 and Al_2O_3 were drastically reduced to levels below 0.1%, meeting stringent industrial requirements. XRD analysis revealed a complete phase transformation to α-quartz, with distinct peaks observed at 20.8° and 26.6°, indicating high crystallinity. SEM imaging further demonstrated improved particle morphology, with smoother surfaces and more uniform grain distribution. These findings highlight the effectiveness of the purification protocol in producing high-quality silica sand suitable for advanced applications. The purified sand exhibits exceptional properties that align with the demanding standards of the photovoltaic and semiconductor industries, where ultra-high-purity silica is essential for optimal performance. This study not only presents a viable method for sand purification but also underscores the potential for valorizing local sand resources, reducing reliance on imported materials. Future research could explore scaling up the process for industrial production while further optimizing cost-efficiency and environmental sustainability.

Key words: Silica sand purification, Thermo-chemical treatment, XRF analysis, XRD characterization, SEM imaging, Tendla dunes, High-purity silica.

UV IRRADIATION EFFECTS ON PMMA-BASED PHOTOVOLTAIC ELECTRODES

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Abstract
The replacement of the glass which represents the famous photovoltaic protective facades with a mechanically resistant material represents a major technical and economic challenge in the installation of the cells. The idea in this work is to investigate two kinds of transparent electrodes to replace the glass, on one side a PMMA layer doped with zinc oxide ZnO and on the other side, a 2 mm thick PMMA plate is also proposed. We sought to study the thermal, optical and photocatalytic properties of the polymer matrix. Three ratios are introduced to deposit the films: 5%, 10% and 15%. ATD–TG analyzes show a significant improvement in the thermal resistance of the loaded polymer, however a qualitative improvement is obtained by doping ZnO into the polymer. 65% of photocatalytic degradation by UV irradiation was observed. Otherwise, the PMMA plates show excellent transmittance despite a series of chemical attack was carried out, moreover, on the mechanical level, Conservation of the bending stress is noted in particular for the weakly attacked samples. It can be said that these Results are encouraging and give a positive impression of the use of this matrix, especially with its ecological aspect.

Key words: PMMA, UV irradiation, photovoltaic transparent electrodes, transmittance, photocatalytic

DESIGN AND APPLICATION OF A 2.45 GHZ MICROWAVE HEATING SYSTEM FOR HIGH-TEMPERATURE SYNTHESIS AND SINTERING OF CERAMIC MATERIALS

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Abstract

Microwave-assisted processing has emerged as a promising alternative to conventional high-temperature techniques for the synthesis and densification of ceramics. Despite its potential, the development of systems capable of achieving and sustaining the high temperatures required for ceramic processing has remained relatively limited. Microwave heating offers unique advantages over conventional methods, including rapid heating kinetics, reduced energy consumption, and the ability to achieve very high heating rates (>100 °C/min) without inducing thermal shock damage. These characteristics contribute to shorter processing times, lower sintering temperatures, refined microstructures, and improved mechanical and electrical properties of the final materials. In this study, a domestic 2.45 GHz multimode microwave oven was modified and adapted to function as a high-temperature processing system suitable for ceramic synthesis and sintering. The modified setup was designed to provide stable and uniform heating within the cavity, enabling the processing of functional oxide ceramics. As a case study, $BaTiO_3$ powders doped with various molar concentrations of Fe_2O_3 (7, 15, and 20 mol%) were synthesized and sintered at 1200 °C for 20 minutes. The microwave-sintered samples exhibited significantly higher densification compared to those processed under conventional furnace heating. The improved densification was attributed to the enhanced diffusion kinetics and localized field interactions associated with microwave heating. These results confirm the effectiveness of the developed microwave system for high-temperature ceramic processing and highlight its potential for energy-efficient, rapid, and scalable fabrication of advanced ceramic materials.

Keywords: microwave processing, high-temperature heating, synthesis, sintering, $BaTiO_3$ ceramics

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A CHARACTERIZATION STUDY OF BIOMATERIALS BASED ON PHBV/PLA/LIGNIN

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Abstract

Biopolymers, naturally derived macromolecules, are emerging as a sustainable alternative to synthetic polymers due to their biodegradability, biocompatibility, and renewable sourcing. Applications in biomedical engineering, packaging, agriculture, and pharmaceuticals demonstrate their potential to replace conventional plastics while addressing global sustainability challenges. Recent advancements in biotechnology and materials science have further enabled the development of biopolymers by enhancing their properties and expanding their commercial viability. In this regard, the present work focuses on the preparation of biomaterials based on Poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBV), Poly(lactic acid) (PLA) and lignin using melt compounding. The chemical structure, as well as the thermal, mechanical, and thermo-mechanical properties of the biomaterials, were investigated using Fourier Transform Infrared (FTIR) spectroscopy, X-ray Diffraction (XRD), tensile testing, and Dynamic Mechanical Analysis (DMA). The antioxidant activity of the blends was evaluated using the 1,1-diphenyl-2-picrylhydrazyl (DPPH) assay. The results indicate a significant increase in Young's modulus, tensile strength, and storage modulus compared to the neat blend. The highest antioxidant activity was observed in the presence of lignin.

Key words: Biomaterials, Blend, Lignin, PHBV, PLA, antioxidant activity

THE CHEMISTRY OF DURABILITY: EXPLORING BASSIA INDICA FIBERS FOR ECO-FRIENDLY COMPOSITES

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Abstract
This work investigates the potential of Bassia Indica (BI) fibers as a sustainable reinforcement for adobe bricks, aiming to improve their mechanical and durability performance. The study addresses the context of increasing demand for eco-friendly and low-cost construction materials by evaluating natural fibers as alternatives to synthetic reinforcements. The main objective is to characterize the morphological, physical, chemical, thermal, and mechanical properties of BI fibers and assess their suitability for composite and building applications. A comprehensive methodology was employed, combining advanced techniques such as Fourier Transform Infrared Spectroscopy (FTIR), X-ray Diffraction (XRD), Thermogravimetric Analysis (TGA), Scanning Electron Microscopy (SEM), and Energy Dispersive X-ray Spectroscopy (EDX). Mechanical tests, including tensile strength and Young's modulus measurements, were performed alongside statistical analyses based on the Weibull distribution to validate the reproducibility of results. The results revealed that BI fibers possess a high cellulose content (67.37%) and low density (1.065 g/cm³), conferring lightweight and hydrophobic characteristics. Their tensile strength (417.5 MPa) and Young's modulus (17.46 GPa) are comparable to several established natural fibers, while thermal stability up to 210 °C makes them suitable for composite fabrication. SEM images showed rough surfaces with microfibrillar structures, enhancing fiber–matrix adhesion. The originality of this study lies in the first detailed characterization of Bassia Indica fibers and their demonstrated potential as reinforcement in adobe bricks and polymer composites, contributing to sustainable material development in construction engineering.

Key words: Bassia Indica; Natural fibers; Chemical composition; Thermal stability; Mechanical properties; Sustainable materials

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RECOVERY OF MECHANICAL STRENGTH AND OPTICAL TRANSMITTANCE IN SANDBLASTED GLASS WITH SOL-GEL ZIRCONIA (ZrO_2) COATINGS

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Abstract:
Sandblasting is a primary cause of glass degradation in arid regions such as the Sahara, severely compromising optical and mechanical properties. This deterioration was experimentally simulated by projecting 200 g of sand onto soda-lime glass, which reduced its optical transmittance to approximately 62% and its mechanical strength to 45 MPa.
This study presents a remediation strategy using zirconia (ZrO_2) thin films deposited via the sol-gel process. Although the ZrO_2 coatings significantly enhanced mechanical strength by 200%, they also reduced optical transmittance to around 10%.
To overcome this limitation, a hydrofluoric acid (HF) pre-treatment was applied to the sandblasted substrates before coating deposition. This optimized protocol resulted in a notable restoration of properties, achieving a transmittance of 75% and a mechanical strength of 135 MPa—an increase of 300% over the damaged state. These findings demonstrate that combining HF pre-treatment with sol-gel ZrO_2 coating effectively restores the functional properties of sandblasted glass

Key words: Glass; Sandblasting; Sol-Gel; Zirconia, Transmittance, Strength

THE INFLUENCE OF KAOLIN CONTENT ON THE PHYSICAL AND MECHANICAL PROPERTIES OF CERAMIC FLOOR TILES

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Abstract:
This study examines the influence of kaolin content on the physical and mechanical properties of ceramic floor tiles. The ceramic bodies were formulated from a mixture composed mainly of clay, kaolin, feldspar, and quartz, with kaolin content varying from 10 wt% to 40 wt%. The specimens were fabricated using a solid-state sintering process at 1150 °C. A series of tests were carried out to assess the overall performance of the ceramics. The findings reveal that increasing the kaolin content leads to a decrease in both viscosity and density. This behavior can be attributed to the high aluminosilicate content of kaolin, which promotes the formation of a more porous structure during sintering. Moreover, the residue rate increases with higher kaolin content, rising from 6.11% at 10% kaolin to 13.8% at 40% kaolin. Among the tested samples, the composition containing 40% kaolin exhibited the lowest mass loss. The microstructural evolution at higher kaolin levels suggests a more stable crystalline phase, which may account for the reduced material degradation. Notably, the formulation with 30% kaolin demonstrated the most favorable balance of properties, achieving the lowest water absorption rate (4.2%) and the highest flexural strength (29 N/m²), making it the most suitable choice for improving the performance of ceramic floor tiles. However, this composition also shows a relatively low shrinkage rate (5.1%) compared to other samples, which may result in increased energy consumption during processing. Overall, these results indicate that optimizing kaolin content is critical for achieving both mechanical performance and manufacturing efficiency in ceramic floor tile production.

Key words: kaolin, flexural strength, viscosity, water absorption, shrinkage

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EFFECT OF CORE-TO-SHELL RATIO ON NATURAL CONVECTION OF NANO-EPCM SLURRY IN A SQUARE CAVITY

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Abstract:
Phase change materials (PCMs) are widely employed in thermal management systems due to their high energy storage density and ability to regulate temperature through latent heat. However, their low thermal conductivity limits heat transfer performance. To overcome this drawback, nano-encapsulated PCMs (NEPCMs) have been developed, combining latent heat storage with improved transport properties. In this study, the natural convection of an NEPCM slurry in a square cavity is numerically investigated. The NEPCM consists of an n-eicosane core and a ZnO shell, with the core-to-shell weight ratio R varied to assess its influence on flow and heat transfer.
Results show that the dispersion of NEPCM particles modifies the effective thermophysical properties of the base fluid. At low Rayleigh numbers, heat capacity dominates the heat transfer enhancement, while at higher Rayleigh numbers the role of latent heat diminishes in favor of thermal conductivity. These findings highlight the importance of the core-to-shell ratio in balancing latent heat storage and conduction enhancement for optimized thermal performance.

Keywords: PCM; Nano-encapsulated PCM (NEPCM); Natural convection; Core-to-shell ratio;; Heat transfer enhancement..

DEVELOPMENT OF A BIOPLASTIC BASED ON A MIXTURE OF PLASTICIZED STARCH AND POLY (LACTIC ACID).

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Abstract:
The importance of plastics in our lives has increased thanks to advances in polymer technology. However, as their use increases, so does the problem of managing end-of-life solid waste. Biodegradable polymers, derived from renewable resources like starch, are a crucial research topic for preventing solid waste pollution. However, starch-based materials have insufficient mechanical properties for commercial use, requiring blends with other high-performance biodegradable polymers such as poly lactic acid (PLA).
The main objective of our study is to develop a fully biodegradable bioplastic based on PLA and starch in the molten state, using an internal mixer and a thermopress. The starch was plasticized using water and glycerol as plasticizers. The resulting thermoplastic starch (TPS) was blended with PLA (30:70%). To improve compatibility, various compatibilizers were used (Polyethyleneglycol (PEG), Triethylcitrate (TEC)), as well as chemical modification of the starch with its plasticization by acetylation (TPAS). Different films were developed and characterized by various techniques (FT-IR, ATG, DSC, tensile tests, optical microscopy). Infrared spectroscopy (FTIR) confirmed starch acetylation with picks at 1750 cm^{-1} associated to the presence of ester groupments. The results revealed good compatibility with improved mechanical properties for PLA/TPAS acetylated starch-based films and for PLA/PEG/TPAS with PEG as compatibilizer (young modulus: 2.54GPa and 1,78GPa respectively) compared to PLA/TPS with 1.35GPa, showing the efficience of chemical modification and using PEG as plasticizer in improving compatibility thus properties.

Key words: Polylactic acid, starch, bioplastic, acetylation, properties.

ELECTROKINETIC CHARACTERIZATION AND PHOTOCATALYTIC PERFORMANCE OF ZNO NANOPARTICLES FOR RHODAMINE B DEGRADATION IN ACIDIC MEDIUM

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Abstract
Zinc oxide (ZnO) nanoparticles were successfully synthesized via the sol–gel method, and their electrokinetic and photocatalytic properties were systematically investigated. X-ray diffraction analysis confirmed that the obtained ZnO nanoparticles crystallize in a hexagonal wurtzite structure with a preferred (101) orientation, indicating good crystallinity. The surface electrokinetic behavior was characterized by zeta potential and electrophoretic mobility measurements. The nanoparticles exhibited positive zeta potential values of +19 mV with a mobility of +1.554 µm·cm/V·s at pH 2, and +29 mV with a mobility of +2.311 µm·cm/V·s at pH 4, confirming their stability and surface charge dependence on the acidic medium. The photocatalytic degradation of Rhodamine B (RhB) under UV irradiation was found to be strongly influenced by the solution's pH. The degradation efficiency increased with decreasing pH, achieving a maximum of approximately 97% at pH 2, demonstrating the enhanced photocatalytic activity of ZnO nanoparticles in acidic conditions.

Key words: Zinc oxide, Wurtzite, Zeta potential , Rhodamine B, Photocatalityc.

ELECTROCHEMICAL STUDY ON THE SYNTHESIS PROCESS OF Co–Ni ALLOY NANOPARTICLES

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Abstract:
The electrocrystallisation of Co, Ni and Co–Ni alloys on ruthenium surface from chloride baths has been studied by cyclic voltammetry and chronoamperometry measurements. The structural and magnetic properties were studied by X-ray diffraction and alternating gradient force magnetometer techniques respectively. The Co–Ni alloys were deposited from solution with molar ratios (Co/Ni) of 5 : 1, 1 : 1 and 1 : 5. From cyclic voltammetry measurements, for all molar ratios for electrodeposited Co–Ni, preferential deposition of Co occurs and anomalous codeposition takes place. Therefore, variation in the composition of thin films alloy is possible depending on the deposition potential. The Scharifker and Hills model was employed to analyse the current transients. For both Co and Co–Ni alloys, the nucleation was a good agreement with the instantaneous model followed by threedimensional diffusion limited growth. However, for Ni after tmax, the nucleation process changes from progressive to instantaneous model. It is evident that the compositions of the electrolyte do not have influence on the type of nucleation for Co–Ni alloys. X-ray diffraction measurements indicate a small crystallite size with the presence of a mixture of hcp and fcc Co–Ni structures. The hysteresis loops with a magnetic field in the parallel and perpendicular directions showed that the easy magnetisation axis of Co–Ni thin film is in the film plane.

Key words: Electrodeposition, Co–Ni, Nucleation, Properties

PREPARATION OF MAGNESIUM FERRITE ($MgFe_2O_4$) NANOPARTICLES BY ULTRASONIC SPRAY PYROLYSIS METHOD

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Abstract
Magnesium ferrite ($MgFe_2O_4$) nanoparticles were successfully synthesized using the ultrasonic spray pyrolysis (USP) technique. A solution prepared from ferric nitrate and magnesium nitrate as precursors was sprayed onto a glass substrate preheated to 450 °C. X-ray diffraction (XRD) analysis revealed that the resulting layers are polycrystalline in nature and exhibit a single-phase cubic spinel structure. The average crystallite size, calculated from the XRD data, was found to be 24 nm, confirming the nanocrystalline nature of the synthesized compound. Electrical measurements indicated a relatively high resistivity, on the order of $4.57 \times 10^3\ \Omega\cdot$cm. Scanning electron microscopy (SEM) analysis showed a well-developed surface morphology, with small agglomerates of nearly spherical fine particles, averaging about 25 nm in size. This value is consistent with the crystallite size obtained from the XRD analysis. Optical characterization revealed a strong absorption coefficient, close to $10^4\ cm^{-1}$, and an estimated optical band gap of 2.92 eV. Room-temperature photoluminescence measurements demonstrated that the synthesized $MgFe_2O_4$ emits in the visible range, with three emission bands attributed to violet, blue, and green emissions. Room-temperature vibrating sample magnetometry (VSM) analysis confirmed the soft ferromagnetic behavior of the synthesized $MgFe_2O_4$ thin films.

Keywords: Nanoparticles, $MgFe_2O_4$, Synthesis, Thin films, Ultrasonic spray pyrolysis.

FIRST PRINCIPLES INSIGHT ON THE STRUCTURAL, MECHANICAL, MAGNETIC, ELECTRONIC AND OPTICAL PROPERTIES OF KMgNS HEUSLER ALLOY

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Abstract:
The structural stability as well as the mechanical, magnetic, electronic and the optical properties of KMgNS Heusler alloy were investigated using first principles study on the basis of the density functional theory (DFT) within Wien2k package. The exchange correlation correction is analyzed by Perdew-Burke-Ernzerhof generalized gradient approch (GGA-PBE). The negative formation energy of this compound reveals thermodynamic stability. Additionally, the elastic constants indicate that the material at hand is mechanically stable and can be synthesized experimentally. Besides, the 3D plots of the mechanical parameters evidence the anisotropic behavior of KMgNS alloy. The density of states (DOS) shows that the studied material is half-metallic ferromagnets (HMF) with an integer magnetic moment of 2.00 μB , which satisfied the Slater–Pauling rule (SPR). Curie temperature is also calculated reaching the value 733 K. Further, the optical properties including the complex dielectric function, optical conductivity and optical absorption, etc, were also calculated. The optical spectra reveal that KMgNS compound behaves as metal at low energies and as semiconductor at high energies. Interestingly, KMgNS show prospective absorption properties in the ultraviolet region. High Curie temperature, high spin polarization and optical properties suggest KMgNS Heusler alloy as promising material for spintronic applications and optoelectronic devices.

Key words: Heusler alloy, first principles, half-metallic, spin polarization, spintronic

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PREPARATION AND CHARACTERIZATION OF AN AGRICULTURAL WASTE (ORANGE PEELS) AS A BIOSORBENT MATERIAL FOR WATER TREATMENT

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Abstract:
The aim of this work is to present the results of a series of analyzes carried out on the characterization of an agricultural waste (Orange peels) for their use as a biosorbent material for water treatment. After preparation of the material, a series of analyzes including: elemental and biochemical analysis; thermo-gravimetric analysis; infrared spectroscopic analysis and the determination of porosity have been taken. Biochemical analysis showed that the hollocellulose fraction constitutes the major element of the material (51 %). Thermo-gravimetric analysis revealed the presence of four steps of weight loss due to the degradation of hemicelluloses, cellulose and lignins. Orange peels have a porosity of 57.4 % approximately. Les resultants de la caractérisation ont montrés que les peaux d'orange présentent une forte potentialité d'etre utilisées comme matériau biosorbent à bas prix pour le traitement des eaux. The results of the characterization showed that orange peels have a high potential to be used as a low-cost biosorbent material for water treatment.

Keywords: Orange peels, characterization, sorbent materials, water treatment

ENHANCING RUTTING RESISTANCE AND VOID STRUCTURE OF ASPHALT MIXTURES THROUGH LUCOBIT 1210A POLYMER MODIFICATION AND DUNE SAND INCORPORATION

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Abstract
This study primarily explores the influence of Lucobit 1210A polymer modification on the physical and mechanical properties of bituminous mixtures, with a secondary focus on the role of dune sand content. A series of asphalt mixtures were prepared, including a control sample (BB) and polymer-modified variants (BBM-0SD, BBM-5SD, BBM-10SD, BBM-15SD, and BBM-20SD), all containing a constant dosage of Lucobit 1210A and varying percentages of dune sand. The main objective was to evaluate the impact of polymer modification—particularly its contribution to rutting resistance and void structure under high-temperature conditions typical of road construction environments.
To assess compaction behavior and internal air voids, Gyratory Shear Press (GSP) tests were conducted, followed by rutting resistance tests simulating repeated traffic loads. Results were analyzed against standard specifications to determine compliance and performance.The findings confirm that the addition of Lucobit 1210A significantly enhances the elastic behavior, reduces permanent deformation, and improves overall mechanical performance of the mixtures. While dune sand contributed to better compaction at moderate levels, its excessive use led to performance degradation. Nonetheless, the polymer's effect remained dominant in enhancing rutting resistance and mixture durability.
In conclusion, Lucobit 1210A plays a critical role in improving asphalt mixture performance, and its optimization alongside controlled use of dune sand offers a promising solution for constructing resilient pavements in hot climates.

Keywords: Polymer Modification; Sand Dune; Asphalt Mixture; Rutting; GSP.

ASSESSMENT OF TENSILE BEHAVIOR AND DAMAGE EVOLUTION IN GFRP COMPOSITES USING DIC AND SEM.

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Abstract:
Glass fiber reinforced polymer (GFRP) composites have emerged as promising alternatives to traditional construction materials due to their high strength-to-weight ratio, corrosion resistance, and durability. Their applications in bridges, building rehabilitation, and structures exposed to aggressive environments highlight their versatility. To advance their use in structural engineering, this study investigates the mechanical behavior and failure mechanisms of GFRP composites fabricated by the hand lay-up technique. Tensile testing was carried out following ASTM D638-14, while digital image correlation (DIC) provided full-field strain maps, and scanning electron microscopy (SEM) enabled fracture surface analysis. Results demonstrated repeatable tensile stress–strain behavior characterized by three stages: an initial linear-elastic response, nonlinear damage initiation from fiber–matrix debonding, and final failure dominated by fiber breakage and pull-out. The average tensile strength was 151.12 MPa with 2.7% strain at failure. SEM observations confirmed irregular fiber distribution and fiber pull-out, while DIC identified localized strain concentrations near fracture zones.

Key words: GFRP, Composites, Polymers, Glass Fiber, DIC, SEM.

A DFT STUDY OF PHYSICAL PROPERTIES OF GRAPHENE MATERIAL

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Abstract:
The development of modern nanotechnology requires the use of techniques and new materials that have desired electrical properties, with the continuous push toward miniaturization in modern electronics, graphene and similar materials present exciting opportunities for researchers to move beyond the limitations of conventional Si-based technologies due to their excellent properties.
Graphene is a single layer of sp^2-hybridized carbon atoms arranged in a honeycomb lattice, exhibiting the properties of a zero-bandgap semiconductor or semimetal. The unique mechanical and electronic properties of carbon-based nanostructures are important for a wide range of potential applications in catalysis, solar energy conversion, lithium cell electrodes, opto-electronics, and energy-storage devices, which is why we give special attention to them. In this work the structural and energetic stability, electronic, and magnetic properties of the graphene nanoribbons (GNRs) are investigated. This magical material has been studied with edges saturated by hydrogen atoms using density-functional theory (DFT). As a result of simulations using siesta code calculations, it has been determined that the state of Na-GNRs graphene nanoribbons affects significantly the magnetic and electronic properties.

Key words: Nanostructures; DFT; doped Graphene; nanoribbons; siesta code.

BIOCOMPOSITE IPN BEADS BASED ON ALGINATE/POLYACRYLAMIDE AND SEPIOLITE CLAY

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Abstract
Nowadays growing attention is given to the development of novel interpenetrating polymer networks (IPN) from the hydrogel loaded with natural clay. In this work, we used the eco-friendly IPN strategy to develop novel hydrogel biocomposite beads, made of alginate. Hydrogel alginate double biocomposite network (DBN) beads were prepared at different sepiolite loads, via the diffusion of acrylamide monomer (AAM) inside alginate single biocomposite network (SBN) beads, followed by *in situ* free radical polymerization of AAM. The as-elaborated DBN beads were then characterized by ATR-FTIR, ATG, XRD and SEM characterization. FTIR results demonstrated that NaS and pAAM were successfully incorporated into alginate biocomposite beads, whilst ATG analysis revealed an enhancement in the thermal stability. Whilst, partially exfoliated morphology has been obtained with XRD analysis which revealed the enhancement of fibrous clay dispersion, even at relatively high sepiolite load. Furthermore, SEM microscopy confirmed the porous spongy morphology of DBN beads. Additionally, delayed biodegradability properties were found improved.
This work showed high-performance alginate biocomposite beads as a promising system to be used in different fields such as wastewater, agriculture and biology.

Keywords: Biocomposite Polymers, Alginate Xerogel Beads, Sepiolite, porous structure, sepiolite dispersion

IMPACT OF AGGRESSIVE HYDROCARBONS ON HDPE GAS PIPES

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Abstract:
Buried HDPE plastic pipes remain one best solution for transporting corrosive fluids because they are more resistant, durable and cost-effective than metallic materials. While they are proven to work well for water and natural gas, more research is needed to understand their behavior in contact with other fluids containing hydrocarbons. This study focuses on the results of impact strength tests (Charpy test) conducted on arc-specimens taken from a 200 mm (OD) HDPE gas pipe. The specimens were prepared at the AMM Company (EN Sider, Annaba), using machining conditions adapted to thermoplastics to minimize permanents deformations. The experimental protocol consisted of aging HDPE specimens by immersing them in three different media: Algerian crude oil (Sahara Blend), fuel oil (diesel), and gasoline (refined naphtha). The aging was carried out in glass containers for periods of 7, 14, and 28 days. Analysis revealed that HDPE absorbs differently these fluids, and the phenomenon is being particularly pronounced with gasoline. Consistent with theoretical predictions, absorption is explained by the diffusion of liquids within the polymer, which is accompanied by solubilization and extraction of the shorter molecular chains. It results in degradation of mechanical properties in all configurations, especially after the longer exposures. Thus, the selection of HDPE for hydrocarbon transportation requires increased vigilance to prevent the risk of localized damage and uncontrolled cracking.

Keywords: HDPE pipe; Chemical Ageing; Fuels; Crude Oil; Impact testing; Cracking

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OPTIMIZED NON-UNIFORM CFRP CONFINEMENT FOR ENHANCED STRENGTH AND DUCTILITY OF CONCRETE CYLINDERS

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Abstract:
The use of composite materials, particularly carbon fiber-reinforced polymers (CFRP), has emerged as an innovative and sustainable solution for strengthening and confining concrete. Owing to their lightweight nature, high strength, and excellent durability, CFRPs provide an effective alternative to conventional reinforcement methods. In this study, an experimental campaign was carried out on concrete cylinders to evaluate the efficiency of different confinement configurations. Three main series were analyzed: the two-layer full confinement (FC2) and two optimized non-uniform layouts (NUC3.1 and NUC1.3), all using the same total amount of CFRP.
The results demonstrate substantial improvements in axial strength and ductility compared to unconfined specimens. In particular, the NUC3.1 and NUC1.3 series exhibited strength gains of +10% and +15% compared to the FC2 configuration, while maintaining comparable deformation capacities (0% and –3%). The very low dispersion of results (COV < 0.5%) confirms both the reliability of the experimental protocol and the consistency of the observed behavior.
These findings highlight the potential of optimized non-uniform CFRP layouts as a rational solution to enhance mechanical performance while reducing material consumption, thereby offering an efficient and sustainable approach for the strengthening of concrete structures.

Key words: Carbon Fiber-Reinforced Polymer (CFRP), Concrete confinement, Non-uniform layout, Axial strength, Ductility, Experimental study

NUMERICAL STUDY OF PARAMETERS ENHANCINGCOMPOSITE PATCH DEBONDING IN STRUCTURAL REPAIRS

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Abstract:
Three-dimensional numerical modeling of the patch/adhesive/plate system clarifies four essential physical parameters related to interfacial debonding in composite patch repairs of damaged structures: debonding resistance, plate bending deflection, plate displacement trajectory, and interfacial shear stresses. These characteristics and their interactions give full insights into the mechanics of interfacial damage, including the onset and spread of patch debonding and fractures issuing from notches in the repaired plate. This study investigates at how these factors, influenced by the mechanical and viscoelastic characteristics of the adhesive contact, affect the degradation of the adhesive junction. Specifically, the investigation demonstrates that the type of the adhesive determines the initiation and course of debonding, with stiff interfaces failing abruptly while ductile interfaces degrade gradually. It also identifies preferential sites of debonding at free edges and notches, where maximum shear stresses occur, facilitating the prediction of patch separation and the relaxation of interfacial stresses.

Key words: Debonding; Damage; Crack Propagation; Adhesive Interface; Composite Patch; Structural Repair.

SOLUBILITY CHANGES OF MIXTURE COMPONENTS DURING MELT MIXING: EFFECT OF CATALYST

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Abstract:
The first evidence on the course of exchange reactions between tow polyesters: the polycarbonate (PC) and the polyethylene terephthalate (PET) during melt mixing is provided by the results of the solubility test, which consists of immersing a representative portion of the mixture in a solvent that solubilizes the PC but not the PET, it provides a fairly accurate approach to the rate of structural changes occurring in a system. Therefore, solubility measurements can provide very useful information on the rate of exchange reactions and the structure of the copolymer formed (block or random structures).
In this context, and in order to obtain information on solubility changes due to the structural evolution of the mixture components during melt mixing, samples of different formulations of mixtures PC/PET prepared with and without a transesterification catalyst, the samarium (III) acetylacetonate hydrate ($Sm(acac)_3$), with a mass of 0.10 g (m_0), were stirred for 24 hours at room temperature in a volume of a solvent, dichloromethane (CH_2Cl_2).
The results show that no transesterification reaction occurred between PC and PET prepared without catalyst. Or, after the introduction of different catalyst levels in 70PC/30PET blends. The solubility variations of solvent show a decrease followed by an increase with increasing catalyst level, which is explained by the production of more active exchange reactions between PC and PET, accompanied by a structural modification within the copolymer, and consequently the formation of an alternating or random copolymer.

Key words: Solubility, transesterification reaction, polyesters, Catalyst

MECHANICAL PROPERTIES OF MATERIAL BI(PB)2223

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Abstract:
This research presents a detailed investigation of the mechanical properties of bismuth cuprate material (Bi(Pb)2223), using high-frequency acoustic microscopy. The study employed ultrasonic waves at 600 MHz frequency, with water serving as the coupling medium to minimize wave attenuation and ensure precise measurements. Through this advanced non-destructive technique, we successfully determined three fundamental mechanical parameters: Y'oung's modulus, which characterizes the material's stiffness; Shear modulus representing its resistance to shear deformation and Poisson's ratio, describing its lateral contraction under axial strain.
The acoustic microscopy approch proved particularly effective for analyzing this complex material, offering significant advantages over conventional mechanical testing methods. The water coupling medium played a crucial role in maintaining signal integrity at the high operating frequency, enabling accurate property determination without damaging the delicate sample.
These findings provide valuable insights into the elastic behavior of Bi(Pb)2223, which are essential for both theoretical understanding and practical applications in superconducting technologies.
The methodology demonstrates the potential of ultrasonic techniques for techeniques for characterizing advanced materials, particularly in cases where traditional methods may compromise sample integrity or provide insufficient resolution.

Key words: Physical properties, bismuth cuprate, ultrasonic waves, Young's modulus, Shear modulus.

THIN FILMS OF ZnO AND NiO SYNTHESIZED BY THE SOL-GEL TECHNIQUE AND DIP COATING PROCESS FOR PHOTOCATALYTIC USE

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Abstract:
Semiconductor materials zinc oxide (ZnO) and nickel oxide (NiO) have broad band gaps of around 3.37 eV and 3.8 eV, respectively. A variety of methods, including spray pyrolysis, sol-gel, hydrothermal, magnetron sputtering, atomic layer deposition, and others, were employed to create thin films. ZnO and NiO have several uses, including gas sensors, light-emitting diodes, photocurrent, photocatalysis, magnetic, Electrochemical, transistors, solar cells, and corrosion prevention, among others. Thin film samples for photocatalysis applications were made in this study using the sol-gel technique. Dip coating was used to create the starting material, which was subsequently applied to a glass substrate to create thin films, after ten minutes of drying at 300°C on a hot plate, the films were heated in an oven to 500°C. X-ray diffraction (XRD) analysis showed that NiO films have a face-centred cubic structure (FCC) rock salt structure (ICDD No. 00-0471049), while ZnO films have a hexagonal wurtzite structure (ICDD No. 00-036-1451). From the transmittance of UV-visible analysis we observed that, the produced film's spectra show good transparency in the visible region. In the FESEM and EDS images of ZnO and NiO, the morphology of ZnO is spherical particles with a smooth surface, with an average diameter of about 26 nm, and the surface of NiO is uniformly distributed nano-grains in the form of spherical particles with a smaller grain size with an average diameter of about 21 nm. The use of photocatalysis to remove harmful compounds from wastewater using ZnO and NiO thin films is a green technology of environmental importance.

Key words: ZnO and NiO thin films, photocatalytic use, dip coating process.

NUMERICAL EVALUATION OF NANOFLUID FLOW AND THERMAL BEHAVIOR IN COUNTER-FLOW COAXIAL HEAT EXCHANGERS

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Abstract:
Heat exchangers play a vital role in thermal systems across various industries, serving as key components for transferring energy between fluids at different temperature levels. Among the many configurations, concentric double-pipe heat exchangers are particularly appreciated for their simple design, mechanical strength, and ability to operate under high pressure conditions. In recent years, the emergence of nanofluids - conventional base fluids augmented with suspended nanoparticles - has offered promising opportunities to enhance heat transfer rates and improve the overall performance of such systems.
In this work, a numerical study is carried out on a coaxial counter-flow heat exchanger employing several types of nanofluids. The computational model was first validated with experimental data, confirming its accuracy in predicting both thermal and hydraulic behavior. A comparative analysis with the parallel-flow arrangement further demonstrated the superior heat transfer capability of the counter-flow configuration.
Five nanofluids - Al_2O_3, TiO_2, CuO, MgO, and Ag - were examined under different flow regimes. Based on their performance and practical considerations, Al_2O_3 was selected for detailed investigation due to its availability, stability, and frequent adoption in heat transfer research. A parametric evaluation of particle concentration highlighted the importance of optimizing the volume fraction to achieve the best thermal performance.
The findings of this study underline the potential of nanofluids - and Al_2O_3 in particular - as effective working fluids for enhancing the thermal performance of heat exchangers. By determining the most efficient concentration range, the work provides useful insights for designing energy-efficient and economically viable thermal management systems.

Key words: CFD; nanofluids; heat transfer; double pipe heat exchangers

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BIOBASED FORMULATION WITH BIOSURFACTANTS FOR CLEANING AND BIODEGRADING PETROLEUM-DERIVED RESIDUES

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Abstract:
The improper disposal of petroleum-derived solvents and oily residues poses a persistent environmental and occupational challenge. This study proposes a sustainable cleaning alternative through the development of a biobased formulation combining biosurfactants and microbial lipases. Bacterial strains isolated from petroleum-contaminated environments were morphologically, biochemically, and molecularly characterized. Their hydrocarbon-degrading capacity was confirmed by gravimetric assays using crude oil as the sole carbon source. Biosurfactants were extracted, purified, and assessed for surface tension reduction, oil displacement, and emulsification index (E24%), demonstrating high emulsifying activity. To enhance cleaning efficiency, microbial lipases were incorporated and encapsulated in biodegradable biopolymeric matrices, ensuring catalytic stability and controlled release. The resulting formulation synergistically combines biosurfactants and lipolytic enzymes, enabling both emulsification and biodegradation of hydrophobic contaminants. These results demonstrate the applicability of eco-compatible, biodegradable formulations as viable alternatives to conventional organic solvents in laboratory and industrial cleaning processes.

Key words: Biodegradation, Biosurfactants, Crude oil, Microbial lipases, Bioremediation, Sustainable cleaning.

INFLUENCE OF FILM THICKNESS ON THE STRUCTURAL, OPTICAL, AND PHOTOCATALYTIC PROPERTIES OF $BiMnO_3$ THIN FILMS

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Abstract:
In this work, $BiMnO_3$ thin films were successfully prepared by the sol–gel dip-coating method on glass substrates with different layer numbers in order to investigate the influence of film thickness on their structural, optical, and photocatalytic properties. X-ray diffraction (XRD) analysis revealed that all films crystallize in the monoclinic $BiMnO_3$ pur phase, with an improvement in crystallinity and peak intensity as the thickness increases. UV–Vis spectroscopy showed that thicker films exhibit stronger absorption in the visible region and a slight decrease in the optical band gap (1-1.2eV).
The photocatalytic degradation performance of the BMO thin films for Methylene Blue (MB) increased with the increase in thickness, reaching almost 94 % after 180 min under sunlight irradiation.These findings demonstrate that controlling the film thickness is a key parameter to optimize the structural order and enhance the photocatalytic performance of $BiMnO_3$ thin films for solar-driven applications.

Key words: $BiMnO_3$, Photocatalytic, Thin films, Sun Light and Sol gel.

SYNTHÈSE, CARACTÉRISATION ET ÉTUDE DE GONFLEMENT D'UN HYDROGEL HEC-G-POLY(AA-co-AMPS)/ZnO

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Résumé
Les hydrogels intelligents, capables de retenir de grandes quantités d'eau et de répondre à des stimuli externes tels que le pH, suscitent un intérêt croissant dans les domaines biomédical et pharmaceutique, notamment pour la libération contrôlée de médicaments. Dans ce travail, nous avons élaboré un hydrogel superabsorbant composite, basé sur la cellulose hydroxyéthylée (HEC) greffée par copolymérisation radicalaire de l'acide acrylique (AA) et du 2-acrylamido-2-méthylpropane sulfonique (AMPS), en présence de N,N'-méthylène-bisacrylamide (MBA) comme agent réticulant et du persulfate d'ammonium (APS) comme initiateur. Des nanoparticules d'oxyde de zinc (ZnO) ont été incorporées afin d'améliorer la stabilité et les performances fonctionnelles du matériau. La caractérisation (FTIR, DRX, ATG/DTG et MEB) a confirmé le greffage, la diminution de cristallinité, une stabilité thermique accrue et une morphologie poreuse favorable au gonflement. Les essais de gonflement ont montré une forte dépendance vis-à-vis du pH, de la force ionique et de la température, avec une amélioration notable de la capacité et de la cinétique de gonflement en présence de ZnO. Ces résultats confirment le potentiel des hydrogels hybrides polysaccharidiques pour des applications biomédical et la libération contrôlée de substances actives.

Mots-clés: Hydrogel composite,Copolymérisation radicalaire,pH-sensible,Nanoparticules de ZnO

CHEMICAL CHARACTERIZATION AND BIOMATERIAL POTENTIAL OF WOOD BARK

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Abstract:
Bark residues are increasingly recognized as valuable resources for biopolymer applications owing to their chemical diversity and richness. This study provides a detailed chemical characterization of the inner and outer bark of *Eucalyptus camaldulensis* cultivated in Algeria. Extractives were isolated using Accelerated Solvent Extraction (ASE) and identified by Gas Chromatography–Mass Spectrometry (GC-MS). The cellulosic polysaccharide and free sugar monomer contents of pre-extracted bark were determined by Gas Chromatography (GC), while hemicellulose composition and content were analyzed after acid methanolysis and GC. Lignin was quantified gravimetrically via the Klason method, with acid-soluble lignin assessed spectrophotometrically. Formic and acetic acids were measured by HPLC following alkaline hydrolysis.
The results showed comparable extractive contents in outer (0.85%) and inner bark (0.88%). Cellulose was more abundant in the outer bark (33.4%) than in the inner bark (28.7%). Similarly, lignin and total hemicelluloses were higher in the outer bark (31.7% and 26.2%) compared to the inner bark (28.6% and 19.3%). Conversely, free sugar monomers were slightly more concentrated in the inner bark (4.4%) than in the outer bark (3.8%). Differences in acetic acid, formic acid, and ash content between outer (1.5%, 0.006%, 2.5%) and inner bark (1.3%, 0.005%, 2.4%) were minimal.
Overall, these findings highlight the potential of *Eucalyptus camaldulensis* bark as a promising feedstock for lignocellulosic biopolymer production and as a source of bioactive compounds for diverse industrial applications.

Key words: biopolymer; Eucalyptus camaldulensis; inner bark; outer bark; waste.

ELABORATION ET CARACTERISATION MECANIQUE DYNAMIQUE D'UN NANOCOMPOSITE ZEOLITE/POLY(ACIDE LACTIQUE)

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Abstract:
L'utilisation des polymères biodégradables de grade alimentaire est devenue une tendance incontournable sous l'influence des contraintes environnementales et des exigences de l'emballage des produits alimentaires. Dans ce contexte, la présente étude vise à formuler, par la méthode solvent-casting, un film biodégradable à base de polylactique (PLA) enrichi de différentes teneurs en argile nanométrique de type zéolite sodique (Z_{Na}). Trois concentrations de zéolite ont été incorporées : 1%, 3% et 5%. Les films obtenus ont ensuite été soumis à diverses analyses et caractérisations, notamment des essais mécaniques dynamiques.
Les résultats obtenus révèlent la fluctuation du module de perte G″ pour les formulations chargées (PLA/Z_{Na}), à partir d'une fréquence d'environ 30 Hz (soit 200 rad/s), on observe un changement notable dans le mode de comportement de l'amortissement. Ce phénomène indique un changement dans l'arrangement moléculaire des formulations. Cette transition suggère que sous l'influence de la fréquence accrue, les interactions entre les chaînes polymériques et les charges additives subissent une réorganisation, modifiant ainsi les propriétés viscoélastiques du matériau.

Keywords: Polymères, biodégradabilité, polylactique, argile nanométrique, zéolite sodique, analyses mécaniques dynamiques.

COMPARATIVE STUDY ON CORROSION RESISTANCE OF CHROMIUM AND MOLYBDENUM ALLOYED STEELS USING GREEN INHIBITORS

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Abstract
In this comparative study, four types of alloyed steels (13% Cr, 18% Cr, 21% Cr, and 13% Cr + 2% Mo) were exposed to a corrosive medium composed of 3.5% NaCl, under both ambient air and CO_2-enriched atmospheres. A rigorous methodological approach was applied to evaluate their corrosion behavior using physicochemical techniques (EDX, XRD), microscopic observations, and electrochemical analyses (OCP, Tafel, EIS). The results show that increasing chromium content enhances corrosion resistance, while the addition of molybdenum improves structural stability. The 13% Cr steel exhibited significant degradation, in contrast to steels with higher chromium content or those enriched with molybdenum. Electrochemical tests confirmed improved polarization resistance, although with a higher corrosion potential. The introduction of bio-based inhibitors such as lignin, combined with antimony tartrate or ammonium heptamolybdate, achieved inhibition efficiencies of up to 94%. These inhibitors act as mixed protective barriers, impacting both anodic and cathodic reactions. This study proposes a sustainable approach to protecting steels in aggressive environments.

Keywords : Stainless steels, corrosion resistance, chromium alloys, molybdenum, CO_2 atmosphere, lignin-based inhibitors, green corrosion inhibitors, passivation layer, synergistic effects, polarization resistance, NaCl medium, sustainable materials

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BIODEGRADABLE BIOMATERIAL FILMS DERIVED FROM BIOMASS SOURCES

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Abstract:
This study aimed to explore the application of galactomannan-based films, specifically those from spruce galactoglucomannan (GGM) and guar gum, for food packaging. The objective was to justify the selection of these polysaccharides as renewable and biodegradable film-forming materials. A key challenge with GGM is that it requires a significant amount of plasticizer to form cohesive films, which often results in poor mechanical performance. Crosslinking with Borax was investigated as a strategy to improve film cohesion and functional quality without compromising biodegradability.
A critical property for food packaging materials is oxygen barrier capability, as reducing oxygen permeation inhibits microbial growth and extends food shelf-life. The oxygen permeability (OP) and oxygen transmission rate (OTR) of the films were measured at 25 °C and 50% relative humidity (RH). The results demonstrate that crosslinked GGM/guar gum-based films exhibit excellent oxygen barrier properties, highlighting their potential as sustainable, high-functional-quality materials for food packaging applications.

Key words: Films, Galactoglucomannan (GGM), Guar Gum, Oxygen Permeability (OP), Relative Humidity (RH)

STUDY OF STRUCTURAL, ELECTRONIC AND MAGNETIC PROPERTIES OF Ti SUBSTITUTED RUTILE-GeO2 FROM FIRST PRINCIPLES.

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Abstract
We present here a first principles study within density functional theory of Ti-doped rutile-GeO2 ultra-wide semiconductor, using the Projector Augmented Wave (PAW) method [1]. The calculations have been performed through the Quantum ESPRESSO code [2,3]. In a first step, this investigation is carried out within the widespread PBE-GGA functional [4]. As well known, standard DFT functional (like LDA and GGA) fail in reproducing the observed band gaps. To cure this drawback, the utilization of hybrid functional, which currently represent the state-of-the-art in the DFT framework, is necessary. So, in second step, our calculations have been performed using the recently introduced HSE hybrid functional [5].
The main part of the work is to explore the effect of Ti-substitution on the electronic structure of rutile-GeO2 and possible emergence of ferromagnetic ordering. Two different substitution amounts have been considered corresponding to the two following ordered alloys: Ti0.5Ge0.5O2 and Ti0.25Ge0.75O2. Starting with GGA spin-polarized ferromagnetic solutions, the electronic structure calculations lead to a ferromagnetic metal in the former case, while a half-metallic ferromagnetic behavior has been obtained in the former. Ti0.5Ge0.5O2 turns to be a ferromagnetic half-metal. On the other hand, Ti0.25Ge0.75O2 behaves as semiconductor. Both behaviors, if confirmed experimentally, could lead to important practical applications in spintronics.

MODELISATION NUMERIQUE DE L'ECOULEMENT STATIONNAIRE D'UN FLUIDE NON NEWTONIEN À TRAVERS UNE CONDUITE STÉNOSEE

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Abstract:
L'étude de l'écoulement sanguin dans les vaisseaux du système cardiovasculaire dépend à la fois des propriétés rhéologiques du sang et de la déformation des parois artérielles. Le sang est un fluide complexe en raison de la nature de ses composants et des interactions qui existent entre eux. Il présente un comportement non newtonien, particulièrement marqué dans les vaisseaux de petit calibre, dans des géométries complexes ou en présence de certaines pathologies. Ce comportement reste encore mal compris, notamment dans les régimes d'écoulement à très faible ou à très fort taux de cisaillement. Cela rend difficile l'établissement d'une loi rhéologique unique capable de décrire l'ensemble des observations expérimentales sur toute la plage des taux de cisaillement. L'étude est menée par simulation numérique en régime stationnaire, pour une plage de nombres de Reynolds généralisés Reg allant de 0.20 à 13.66. Le comportement du fluide est modélisé à l'aide du modèle rhéologique non newtonien de
Herschel–Bulkley. Cette étude permet d'analyser l'influence de la géométrie et du caractère non newtonien du fluide sur les profils de vitesse, les pertes de charge, ainsi que sur la résistance à l'écoulement. Les résultats montrent que la résistance à l'écoulement diminue avec l'augmentation du nombre de Reynolds généralisé, et qu'elle est plus faible dans un tube sténosé que dans un tube droit de même diamètre moyen. Au niveau de la sténose, une corrélation entre le nombre d'Euler et le nombre de Reynolds généralisé a également été établie.

Mots clés : Sténose, fluide, non newtonien, modèle de Herschel Bulkey, les pertes de charge

EFFECT OF THE NATURE OF FILTAGE AND THE NUMBER OF NETS ON THE DENTAL STRUCTURE

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Abstract:

Aim The purpose of this work is to develop a new three-dimensional model of a dental prosthesis.Methods A dental prosthesis is subjected to one of the three load of mastication (coronoapical, disto-mesial and lingual-oral), applied on the occlusal surface of the crown. The simulation is determined numerically in 3D by the finite element method using the Abaqus calculation code. Results This numerical analysis allowed us to show the effect of the number of threads and the nature of the thread on the variation of the equivalent stress in the close vicinity of the bone/implant interface. These interfacial constraints are evaluated on the outside and at the bottom of the net. The triangular thread creates more intense stresses than the rectangular and trapezoidal threads on the outside because it has a sharp angle to the outer part.Conclusion It is important to know the effects of these factors to ensure, on the one hand, the stability and immobility of the dental implant in the alveolar bone and, on the other hand, the mechanical strength of the cortical bone.

Key words: bone, implant, thread, number of threads, von Mises stress, interfacial stress, MEF

EVOLUTION OF CONCRETE ADMIXTURES AND THE IMPACT OF PHASE CHANGE MATERIALS (PCM) ON MECHANICAL PROPERTIES

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Abstract:

Since the advent of Portland cement concrete in the 19th century, extensive research has been conducted to enhance its properties through the addition of various admixtures such as accelerators, retarders, water repellents, and air-entraining agents. The development of these admixtures has led to progressive standardization and quality recognition through the NF Adjuvants certification. Moreover, in response to climate challenges and the growing energy consumption in the building sector, Phase Change Materials (PCMs), such as wax and paraffin, have attracted increasing interest. Thanks to their ability to store and release thermal energy, they contribute to improving thermal comfort while reducing energy demand. However, most existing studies focus primarily on the thermal performance of concrete incorporating these PCMs, often overlooking their mechanical characteristics. This thesis addresses this gap by presenting a comparative study between ordinary concrete and two types of concrete modified with wax or paraffin. The results show an improvement in workability by 14,5%, attributed to the lubricating effect of wax and the smooth surface of paraffin. In terms of mechanical performance, the modified concretes exhibit compressive and tensile strengths reaching 62% and 94% of those of ordinary concrete, respectively, indicating a significant improvement in tensile strength. Although only a single, relatively low incorporation rate was used, the results suggest promising potential for PCMs, particularly in improving concrete compactness.

Key words: concrete, wax, paraffin, phase change materials (PCM), slump, mechanical strength, thermal.

THE CHEMICAL AND THERMAL MODIFICATION OF CALCIUM PHOSPHATE BIOCERAMIC POWDERS

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Abstract:
Among the various biomaterials currently used for bone regeneration, calcium phosphate (CaP) bioceramics are widely used in the biomedical field. Controlling the microstructural properties of calcium phosphate bioceramics, such as porosity, crystal size, and morphology, is crucial for their use as bone substitutes. Therefore, this study aimed to develop CaP-based bioceramic powders with different microstructural characteristics by chemical and thermal modification of their structure, by adding a natural biodegradable biomaterial such as gelatin, and varying the calcination temperature. CaP-gelatin (CaP-Ge) bioceramic was prepared by mixing a quantity of gelatin with a colloidal solution of CaP synthesized by sol-gel process. After drying, the powders were calcined at different temperatures. The physicochemical characterization of the bioceramic powders was carried out by X-ray diffraction (XRD) analysis, Fourier transform infrared spectroscopy (FT-IR) and field emission scanning electron microscopy (FE-SEM). The microstructural study showed that the materials obtained after incorporation of different amounts of gelatin were chemically modified. Indeed, the X-ray diffractograms and infrared absorption bands recorded on the prepared bioceramic powders mainly showed the presence of a hydroxyapatite phase with different degrees of crystallinity. The morphological examination by FE-SEM showed that the incorporation of gelatin into the CaP bioceramic influenced its porosity. Thus, unlike other studies, in this work a simple approach was adopted for the elaboration of bioceramics with different degrees of crystallinity and porosity. Indeed, the combined effects of CaP and gelatin lead to the formation of bioceramic powders with a well-defined microstructure, only by varying the calcination temperature and the amount of gelatin added.

Key words: Biomaterial, Bioceramic, Calcium phosphate, Gelatin, Microstructure.

ENHANCED SENSITIVITY IN Cu-BASED SURFACE PLASMON RESONANCE SENSORS VIA HYBRID INTEGRATION OF HALIDE PEROVSKITE $FASnI_3$ AND 2D MATERIALS

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Abstract:
This study presents an innovative surface plasmon resonance (SPR) biosensor design incorporating a BK7 glass prism, a copper (Cu) plasmonic layer, and hybrid architectures combining halide perovskite (FASnI3) with two-dimensional (2D) materials—black phosphorus (BP), graphene, and transition metal dichalcogenides (TMDCs: MoS_2, $MoSe_2$, WS_2, WSe_2) to enhance breast cancer cell detection. By optimizing layer thicknesses (e.g., Cu: 48 nm, FASnI3: 5 nm, BP: 0.53 nm), the sensor achieves exceptional performance through numerical modeling based on the transfer matrix method (TMM) and attenuated total reflection (ATR) analysis of reflectance properties. The integration of FASnI3 and 2D materials into the BK7/Cu/medium configuration demonstrates a remarkable improvement in sensitivity (459.28°/RIU) and figure of merit (ZT: 123.11 RIU^{-1}), representing a 338.45% enhancement compared to conventional structures. Notably, the BK7/Cu(48nm)/FASnI3(5nm)/BP(0.53nm) architecture exhibits superior performance, offering high sensitivity and tunable optical properties due to the synergistic effects of perovskite and 2D materials. This approach highlights the potential of hybrid plasmonic-2D systems for ultrasensitive biosensing applications in biomedical diagnostics.

Key words: Surface plasmon resonance, Biosensor, Halide Perovskite (FASnI3), 2D materials, Sensitivity, Transfer matrix method.

ENCAPSULATION OF AAHII TOXIN IN CHITOSAN NANOPARTICLES: PHYSICOCHEMICAL CHARACTERIZATION AND REDUCTION OF TOXICITY IN A LUNG CANCER MODEL

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Abstract:
The therapeutic application of bioactive peptides such as AahII toxin from *Androctonus australis hector* is limited by their systemic toxicity. In this study, we investigated the encapsulation of AahII into chitosan nanoparticles (CNPs) to reduce its toxicity and enhance its therapeutic effect in a murine model of urethane-induced lung adenocarcinoma.
Nanoparticles were synthesized using the ionic gelation method and characterized by Fourier Transform Infrared Spectroscopy (FTIR), dynamic light scattering (DLS), and zeta potential measurements. FTIR confirmed successful toxin incorporation through shifts in characteristic peaks, while DLS analysis revealed a mean particle size around 298 nm with a narrow distribution. The surface charge was strongly positive, ensuring good colloidal stability and mucoadhesive properties.
In vivo studies demonstrated that free AahII was highly toxic when administered directly, with mice failing to tolerate the treatment. However, AahII-loaded nanoparticles significantly reduced systemic toxicity and improved animal survival. Moreover, the encapsulated formulation enhanced the antitumor effect, as observed by histological reduction in tumor cell proliferation.
This work highlights the potential of nanocarrier systems for the safe and efficient delivery of venom-derived bioactives. The physicochemical properties of the AahII-CNPs played a key role in improving biocompatibility and therapeutic efficacy, making them a promising tool for targeted cancer therapy.

Key words: Chitosan nanoparticles, Lung adenocarcinoma, Toxin delivery, Toxicity mitigation

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PHOTOCATALYTIC PERFORMANCE OF CO-DOPED $ZnAl_2O_4$: A COMPARATIVE STUDY OF CHROMIUM AND COBALT VARIANTS

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Résumé
Samples of pure zinc aluminate (ZnAl2O4) and co-doped ZnAl2O4 with Chromium (Cr^{3+}) at different ratios (2, 4, 6, 8, 10 mol%) and a constant amount of Cobalt (Co^{2+}: 10 mol%), were synthesized by the citrate sol–gel technique, and then annealed at 900◦C for 3h. To investigate the structural, thermal, and properties, different characterization methods were used, such as powder X-ray diffraction (XRD), differential scanning calorimetry (DSC), Fourier transform infrared spectroscopy (FTIR), Ultraviolet-visible spectroscopy (Uv-Vis), and Raman spectroscopy. Analysis by X-ray diffraction revealed the presence, in all samples, of the cubic, single-phase ZnAl2O4 without any impurity phases, with a nanometric crystallite size. These results were confirmed using the Fourier transform infrared and the Raman spectroscopy. Also, the Uv-Vis showed how Co-Cr co-doping narrows the band gap energy of pure Gahnite.
Furthermore, the photocatalytic study for different samples of ZnAl2O4 revealed their potential as proficient photocatalysts and adept adsorbents for the degradation of Methylene Blue in aqueous solutions

Keywords : $ZnAl_2O_4$, Spinel, Sol-Gel, XRD, Uv-Vis, Photocatalysis

ADVANCEMENT OF BIO-DERIVED POLYURETHANE FOAMS FOR SUSTAINABLE THERMAL INSULATION

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Abstract:
The rising need for sustainable materials has heightened interest in bio-based polymers, especially polyurethanes sourced from renewable vegetable oils. Traditional petroleum-derived polyurethanes, while extensively used, substantially exacerbate environmental issues owing to their fossil fuel origins. This work seeks to synthesis and assess green polyurethanes derived from vegetable oil-based polyols as eco-friendly options for thermal insulation applications. The polyols were synthesized by the chemical alteration of natural oils, then polymerized with diisocyanates to produce polyurethane foams. Characterization was conducted using Fourier Transform Infrared Spectroscopy (FTIR), Thermogravimetric Analysis (TGA), Differential Scanning Calorimetry (DSC), and Scanning Electron Microscopy (SEM). The FTIR data validated the effective creation of urethane linkages, whilst TGA and DSC investigations indicated excellent thermal stability and appropriate glass transition temperatures for insulating efficacy. SEM pictures demonstrated a consistent cellular architecture, a crucial element in efficient thermal insulation. The foams demonstrated low thermal conductivity that was equivalent to or exceeded that of traditional petroleum-based alternatives. The results underscore the technological viability and ecological benefits of vegetable oil-based green polyurethanes, establishing them as sustainable and high-performance substitutes for industrial thermal insulation.

Key words: Green Polyurethane, Vegetable Oil, Bio-based Polyol, Thermal Insulation, Sustainable Materials

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ECO-FRIENDLY ROUTE TO SnO_2 NANOPARTICLES: STRUCTURAL AND MORPHOLOGICAL INVESTIGATIONS

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Abstract
The development of environmentally sustainable routes for nanomaterial production has gained increasing attention as alternatives to conventional chemical synthesis. In this study, we report the green synthesis of tin oxide (SnO_2) nanoparticles using *Ficus carica* leaf extract as a natural reducing and stabilizing agent. The synthesis was carried out by reacting tin chloride dihydrate with the aqueous extract, followed by annealing at 500 °C to obtain crystalline SnO_2 powders. Structural and morphological characterizations were performed using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), UV–Vis absorption, and scanning electron microscopy (SEM). XRD results confirmed the formation of rutile tetragonal SnO_2 with an average crystallite size of 17.87 nm, indicating the efficiency of the green route in producing nanoscale particles. FTIR analysis revealed the presence of Sn–O bonds along with residual functional groups from the leaf extract, which likely contributed to nanoparticle stabilization. UV–Vis spectra confirmed strong absorbance in the UV region, consistent with the wide band gap nature of SnO_2. SEM micrographs showed spherical and homogeneously distributed nanoparticles with smooth surface morphology. Compared to conventional synthesis, the green method offers advantages in terms of safety, cost-effectiveness, and sustainability by avoiding toxic chemicals. This work demonstrates that *Ficus carica* extract can serve as a viable bio-template for producing phase-pure SnO_2 nanomaterials, suitable for applications in catalysis, sensors, transparent conducting oxides, and environmental remediation.

Keywords: Green synthesis, *Ficus carica*, Tin oxide nanoparticles, Structural characterization, Sustainable nanomaterials.

PROCESS OPTIMIZATION AND BIOPOLYMER-BASED ENCAPSULATION *OF PISTACIA LENTISCUS* BERRIES ESSENTIAL OIL

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Abstract:
In this study, *Pistacia lentiscus* berries essential oil was extracted via hydrodistillation, with optimal conditions for extraction time and mass determined using a central composite design (CCD). Key process parameters, including time (ranging from 3 to 5 hours) and mass (100 to 200 g), were varied to optimize oil yield. The extracted oil was encapsulated using complex coacervation with biodegradable biopolymers, including soy protein isolate and sodium alginate, triggered by pH adjustments with acetic acid. The encapsulation process was validated using FTIR, and the resulting microcapsules were characterized for their dissolution profile using the dissolutest method under simulated intestinal conditions at pH 6.8. This research provides insights into process optimization for essential oil encapsulation and potential applications in therapeutic delivery systems.

Key words: essential oil, monoterpenes, Antibacterial activity, therapeutic effect, hydrodistillation.

DFT STUDY OF SILICENE NANORIBBONS FOR NEXT-GENERATION AI DEVICES

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Abstract:
In this work, we employ ab initio Density Functional Theory (DFT) to investigate the effect of hydrogen edge passivation on the stability and electronic properties of planar silicene nanoribbons (PLSiNRs) with armchair edges (PLASiNRs). The results demonstrate that hydrogen passivation provides an effective route to stabilize planar armchair SiNRs and to open their band gap. This process transforms bare PLSiNRs from metallic states into nonmagnetic semiconductors, with band gaps that vary with ribbon width. The band gaps of hydrogen-passivated PLASiNRs exhibit oscillatory behavior, which can be categorized into three branches: $Eg(3n + 1) > Eg(3n) > Eg(3n + 2)$, where n is an integer. These findings highlight edge passivation as a crucial factor for integrating PLASiNR-H into electronic devices such as short-channel ASiNR-based field-effect transistors (FETs). When combined with Artificial Intelligence (AI), these FETs can serve as highly sensitive biosensors for early disease detection and as efficient neuromorphic computing components. Optical analysis further reveals a dominant absorption peak at 5.17 eV for 7-PLASiNR-H systems, indicating strong absorption in the UV region. This makes them promising candidates for photovoltaic applications, offering clean energy solutions to power future AI technologies.

Key words: DFT, Planar Silicene NanoRibbon, edge passivation, electronic properties, AI systems.

SYNTHESIS AND CHARACTERISATION OF SEMICONDUCTOR MATERIALS BASED ON POLYPYRROLE AND ZnO NANOPARTICLES IN THE PRESENCE OF VARIOUS DOPANTS

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Abstract:
Scientific progress in the development of new polymer-based organic materials continues to grow, due to their many potential applications in various areas of everyday life, from household objects to miniaturised electronic components such as nanoprocessors. As a result, researchers and industrialists have been looking jointly at a new generation of materials combining the mechanical properties of traditional polymers (insulators) with the electrical properties of conductors, essentially related to metals. As a result, a new family of materials was born, commonly known as polymer-based organic semiconductor materials
In this study, polypyrrole (PPy) was synthesized via oxidative polymerization using ammonium persulfate (APS) in the presence of various dopants: hydrochloric acid (HCl), dodecylbenzene sulfonic acid (DBSA), and sodium dodecyl sulfate (SDS). PPy/ZnO Nanocomposites were subsequently prepared by in situ polymerization with varying ZnO contents, using DBSA and SDS as surfactants, respectively.Fourier transform infrared spectroscopy (FTIR) study confirmed the incorporation of surfactants into the PPy matrix and revealed the presence of specific interactions between the N–H groups of PPy and ZnO Nanoparticles. Thermogravimetric analysis (TGA) indicated a significant enhancement in the thermal stability of PPy when doped with SDS or DBSA, with further improvement upon the addition of ZnO. Scanning electron microscopy (SEM) showed that both the particle morphology and size were influenced by the choice of dopant and the presence of ZnO. UV–Visible spectroscopy indicates the changes in the PPy band gap upon the addition of SDS, DBSA, and ZnO. Finally, electrical conductivity, measured by the four-point probe method, was highest for SDS-doped PPy (0.11 $S \cdot cm^{-1}$) and further increased with the incorporation of ZnO, reaching a percolation threshold at 5% ZnO.

Key words: Polypyrrole (PPy), ZnO Nanoparticles (ZnO NPs), Scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR), surfactants, Electric conductivity (σ).

EFFECT OF THERMAL ANNEALING ON ZINC OXIDE THIN FILMS DEPOSITED BY SPRAY PYROLYSIS FOR PHOTOVOLTAIC AND OPTOELECTRONIC APPLICATIONS

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Abstract:
Thin films of zinc oxide (ZnO) were prepared using the spray pyrolysis technique with a 0.08 M solution of hydrated zinc chloride ($ZnCl_2 \cdot H_2O$) dissolved in deionized water, with a few drops of hydrochloric acid (HCl) added. The films were subjected to thermal annealing at temperatures ranging from 300 °C to 400 °C for 2 hours in air. The effect of annealing temperature on the structural, optical, and electrical properties of the films was investigated-X ray diffraction (XRD) analysis revealed a hexagonal wurtzite structure with a strong preferential orientation along the (002) plane, along with an increase in crystallite size as the annealing temperature increased. Optical transmittance spectra showed a maximum transmittance of 76% in the visible range for films annealed at 350°C. The direct optical band gap increased from 3.19 eV for the as-deposited films to 3.27 eV after annealing at 350 °C.Hall effect measurements indicated a significant decrease in resistivity, from 637.0 Ω.cm for the as-deposited films to 9.43 Ω.cm for films annealed at 350 °C.

Key words: Spray Pyrolysis, X-ray diffraction Optical Characteristics, the Hall Effect.

EFFICACITE DE LA RECUPERATION LUMINEUSE PAR DE NOUVEAUX MATERIAUX ORGANIQUES A BASE DE NITROTHIOPHENE

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Abstract:
L'analyse computationnelle des matériaux organiques émerge comme un outil incontournable pour explorer et prédire leurs propriétés moléculaires, essentielles à leur caractérisation et à leur fonctionnalisation. Elle permet également de réduire considérablement le recours à des expériences physiques souvent coûteuses.
Dans ce travail, nous avons étudié les propriétés structurales, électroniques et photophysiques de trois composés organiques à base de nitrothiophène : NTH1 et NTH2 ($C_{11}H_7ClN_2O_2S$) ainsi que NTH3 ($C_{17}H_{10}Cl_2N_2O_3S$). Les calculs ont été réalisés à l'aide de la théorie de la fonctionnelle de la densité (DFT), selon la méthode MPW1PW91/6-311G.
Les paramètres géométriques obtenus théoriquement montrent une bonne concordance avec les données expérimentales issues de la diffraction des rayons X. L'analyse a ensuite porté sur les niveaux d'énergie des orbitales frontières (HOMO-LUMO), le gap énergétique (E_g), l'efficacité de récupération lumineuse (LHE) et l'énergie de liaison électron-trou (E_b). Les résultats révèlent que ces composés présentent un comportement de semi-conducteurs organiques, aptes à convertir la lumière en énergie électrique. Parmi eux, le composé NTH3 se distingue par ses performances élevées, avec une efficacité de récupération lumineuse dépassant 73 % en présence de solvant. Cette forte capacité d'absorption suggère un fort potentiel pour des applications optoélectroniques, notamment dans les cellules solaires organiques.

Key words: nitrothiophène, DFT, diffraction des rayons X, MPW1PW91, semi-conducteur.

A CARACTERISATION STUDY OF THREE ROCKS SAMPLES FROM KHANGUET SIDI NADJI BISKRA

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Abstract:
In this study, three rock samples taken from the Khanguet Sidi Nadji area in Biskra Province were analyzed using a set of advanced analytical techniques, including X-ray fluorescence (XRF), X-ray diffraction (XRD), and thin-section petrography. These techniques aimed to determine the crystalline phase, crystal system, space group, and unit cell dimensions of the various mineral structures present in the studied samples. The X-ray fluorescence (XRF) analysis results clearly revealed that sample R03 consists of 98% quartz, while sample R05 exhibited a significantly high proportion of calcite. Meanwhile, sample R04 contained comparable ratios of both quartz and calcite, indicating a clear variation in mineral composition among the three samples. These results were entirely consistent with the X-ray diffraction (XRD) analysis conducted using the X'Pert Highscore software. The R03 sample showed a high concentration of quartz, characterized by a hexagonal crystal structure and belonging to the P3221 space group. In contrast, the R05 sample was dominated by calcite, which exhibits a rhombohedral crystal structure and belongs to the R-3c space group. This further confirms the mineralogical variation observed in the XRF analysis results. To verify the accuracy of these findings, thin-section petrography was applied to the studied samples. The results perfectly matched those obtained through both XRF and XRD techniques. This confirmation established that despite being collected from the same geographic location, the samples exhibit clear differences in both external appearance and internal composition, reflecting the local geological diversity of the Khanguet Sidi Nadji area.

Key words: Rocks, Thin blades, XRF, XRD

SYNTHESIS AND CHARACTERIZATION OF DOPED ZnO NANOPOWDERS VIA PRECIPITATION FOR ELECTRONIC APPLICATIONS

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Abstract:
This research presents the synthesis of zinc oxide (ZnO) nanoparticles via a controlled precipitation method, emphasizing the optimization of key parameters such as stirring time, bath temperature, and calcination conditions. The primary objective was to precisely control the morphology and crystalline structure of the nanoparticles. The obtained materials were comprehensively characterized using advanced techniques : scanning electron microscopy (SEM) for morphological analysis, X-ray diffraction (XRD) for crystalline structure determination, and Fourier-transform infrared spectroscopy (FT-IR) for chemical bond identification. These analyses confirmed the formation of nanoscale ZnO with the desired properties.
Furthermore, the study explored the impact of doping with oxides such as Bi_2O_3 and MnO_2, aiming to significantly enhance the electrical protection properties of the materials, particularly for varistor applications. A crucial aspect of this work was the identification of optimal sintering parameters. This step is essential for preserving the nanometric dimensions of the powders during shaping, thereby ensuring the functional integrity of advanced electrostatic discharge protection devices. These findings represent a valuable contribution to the development of tailored ZnO nanomaterials, paving the way for innovative applications in electronics and protective fields.

Key words: ZnO nanoparticles, precipitation synthesis, doping, sintering, electronic applications.

FIRST-PRINCIPLE STUDY OF CO ADSORPTION ON SnO_2 (110) SURFACE WITH OXYGEN VACANCY

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Abstract:

The adsorption of CO molecules on stoichiometric and partially reduced SnO_2(110) surfaces have been investigated using density functional theory (DFT) with the hybrid B3LYP functional and effective core pseudopotential (ECP) implemented in CRYTAL17 program. SnO_2(110) surface was modelled by a periodic slab of three-layer (3L) with a p(4x1) supercell to investigate 1/4 monolayer coverage (ML). CO molecule was adsorbed on five-fold coordinated tin site (Sn_{5c}). Surface relaxation, adsorption energy, charge transfer, band structure, density of states and vibrational modes were calculated and discussed.

The results show that the absolute value of the adsorption energy increases from 0.54 to 0.79 eV in the presence of an oxygen vacancy on the surface, accompanied by substantial donation from the surface to the CO molecule. Our results reveal that CO adsorption increases the band gap energy from 2.81 and 1.28 eV for the clean stoichiometric and partially reduced SnO_2 (110) surfaces to 2.86 and 1.36 eV, respectively. Furthermore, we found a significant shift in the CO vibrational frequency ($\Delta\omega \approx 38$ cm^{-1}) in the presence of oxygen vacancy. A comparative analysis of adsorption energies and electronic structures indicates that oxygen vacancies significantly enhance CO adsorption on SnO_2 (110) surface.

Key words: SnO_2(110) surface, oxygen vacancy, adsorption, CO molecule, monolayer coverage, DFT calculation.

PRODUCTION OF BIOCOMPOSITE MATERIAL OF DATE PALM

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Abstract:

This study presents experimental results on the mechanical behavior of a composite material, a subject of growing interest in various industrial and civil engineering sectors. The investigated composite is developed from date palm leaf waste collected at the University of Biskra (Algeria) and combined with a white gum matrix. Two types of specimens were fabricated in the form of plates measuring 160 × 15 × 10 mm and 20 × 20 × 20 mm, with varying fiber content. The samples were produced using liberator molding technology, which ensures proper fiber impregnation within the matrix. To evaluate mechanical performance, three-point bending and compression tests were conducted, allowing for the determination of the elastic modulus and assessment of how fiber reinforcement influences material stiffness and strength. The obtained results were compared with values from the literature to validate the composite's mechanical performance. This research contributes to the valorization of agricultural waste by promoting the development of eco-friendly, lightweight materials suitable for non-structural applications such as construction and urban furniture.

Key words: Bio-composite material, petiole Agglomerate, Three-point bending, Flexibility modulus.

APPLICATION OF FLOTATION PROCESS FOR IMPROVING KAOLIN QUALITY BY REMOVING IRON AND MANGANESE OXIDES

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Abstract

This research focuses on improving the quality of kaolin ore from the Djebel Debbagh deposit by removing its impurities using the flotation process. The chemical, mineralogical, and microscopic analysis using XRF, XRD, and SEM were performed. The results showed that this kaolin is mainly composed with kaolinite, but contaminated with impurities, such as Fe_2O_3 (0.56 %) and MnO (0.85 %). To carry out the flotation tests necessary for decontamination and to liberate the kaolin particles from their impurities; crushing, grinding and classification were carried out. The flotation results revealed that the impurities can be removed from this kaolin ore using oleic acid as the main collector for Fe_2O_3 and MnO. The optimal dimensions that can be introduced in the flotation process to achieve the maximum impurities removal are between 10 and 75 µm. In this dimensions; it's can be concluded that the impurities are in free-state. The flotation process to remove impurities is very effective, especially for the fine fractions, while for large particles it's less effective (low particle liberation). Additional grinding of particles larger than 100 µm seems necessary to liberate kaolin particles from their impurities.

Keywords: Flotation, Oleic Acid, Fe_2O_3, MnO, Djebel Debbagh kaolin.

BIO-REINFORCED THERMOPLASTICS: THERMAL AND MECHANICAL PERFORMANCE WITH TREATED VEGETABLE FIBERS

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Résumé
Ce travail a exploré l'influence d'un modification chimique sur les fibres d'Ampelodesmos mauritanicus (Diss) sur les propriétés adhésives d'un composite à base d'un polymère biodégradable.
Le PLA est un polymère respectueux de l'environnement grâce à sa biodégradabilité et sa biocompatibilité. De plus, il constitue un matériau précieux pour de nombreuses applications (par exemple, dans l'emballage de produits alimentaires) grâce à ses propriétés physicochimiques
Une approche méthodologique rigoureuse a été adoptée, commençant par la caractérisation intrinsèque des fibres d'Ampelodesmos mauritanicus, brutes et chimiquement modifiées, à l'aide de la spectroscopie infrarouge à transformée de Fourier (FTIR), de la calorimétrie différentielle à balayage (DSC) et de l'analyse thermogravimétrique (TGA).
Par la suite, des composites PLA contenant 20 % en poids de fibres, qu'elles soient non traitées (PLA/UTFD) ou traitées (PLA/TFD), ont été fabriqués et soumis à une série de caractérisations approfondies. Celles-ci comprenaient la DSC, la TGA, la microscopie électronique à balayage (MEB), des évaluations de la stabilité dimensionnelle et des tests mécaniques pour déterminer leurs propriétés de traction et de choc.
La caractérisation des biocomposites à matrice PLA renforcée par des fibres de Diss non traitées et traitées a mis en évidence que l'amélioration de l'adhésion interfaciale, résultant du traitement chimique, conduit à une cristallinité de la phase PLA supérieure à celle observée dans les composites renforcés par des fibres non traitées. Ainsi, il a été observé que certaines propriétés mécaniques telles que l'allongement à la rupture, la résistance à la traction et le module de Young ont été améliorées.
Key words: poly(lactic acid) (PLA); Ampelodesmos mauritanicus **;** Chemical treatment; Bicomposite.

STUDY OF THE MECHANICAL BEHAVIOR OF A COMPOSITE BASED ON INJECT 812 EPOXY RESIN AND MONTMORILLONITE K10

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Abstract:
This research focuses on the analysis of the mechanical behavior of a composite made from Inject 812 epoxy resin (from Granitex in Algeria) and montmorillonite K10, a commercial clay. The main objective is to study the impact of adding this clay at different rates, ranging from 0% to 10%, on the mechanical properties of the composite, particularly the stress, elongation at break, and elastic modulus.
The results show that the incorporation of MMTK10 significantly improves the maximum stress and the elastic modulus, especially at low loading rates. The maximum stresses of the loaded samples increase significantly compared to the unfilled resin, with a remarkable improvement from the addition of low loading rates. At 10% MMTK10, the stress reaches 32.64 MPa, which is an increase of more than 282% compared to the unfilled resin. However, the elongation at break of the loaded samples decreases significantly, reaching a minimum value of 6.18% at 2% loading, which is a reduction of more than 70% compared to the unfilled samples. Regarding the elastic modulus, an increase is observed with the addition of MMTK10, reaching a maximum value of 1.93 GPa at a 6% loading rate, corresponding to a gain of more than 260% compared to the unfilled resin. These results demonstrate that the addition of MMTK10 significantly improves the mechanical properties of the composite at low loading rates, while suggesting a trade-off between stress, elongation at break, and elastic modulus.

Key words: Composite, inject 812 epoxy resin, montmorillonite K10, mechanical behavior.

ETUDE DES PERFORMANCES PHOTOCATALYTIQUES DES COUCHES MINCES DE ZnO/Cu_2O SUR LA DEGRADATION D'UN COLORANT ORGANIQUE (BLEU DE METHYLENE)

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Abstract:
La pollution de l'environnement représente aujourd'hui un défi majeur pour les sociétés modernes, notamment la pollution de l'eau qui demeure l'un des problèmes les plus préoccupants en raison de son impact direct sur la santé humaine et l'équilibre des écosystèmes aquatiques. Parmi les principales sources de cette pollution figurent les industries textiles, qui consomment d'énormes quantités d'eau et rejettent dans le milieu naturel des eaux usées fortement chargées en colorants synthétiques. Ces colorants, souvent complexes, stables et difficilement biodégradables, confèrent une toxicité notable aux effluents et altèrent la qualité de l'eau même à très faibles concentrations. C'est dans ce contexte que les procédés d'oxydation avancée (POA), notamment la photocatalyse hétérogène, ont suscité un intérêt croissant.
Ce travail a pour objectif d'étudier l'efficacité de la photocatalyse dans le traitement des eaux usées industrielles contenant des colorants, en utilisant deux semi-conducteurs distincts, à savoir l'oxyde de zinc (ZnO) et l'oxyde de cuivre (Cu_2O), déposés séparément sur un substratconducteur de type FTO, tout en comparant leurs performances sous irradiation visible. En complément, nous avons également élaboré une structure hybride ZnO/Cu_2O a fin d'évaluer l'éventuel renforcement de l'efficacité photocatalytique globale. Chacun de ces deux matériaux offre donc des avantages spécifiques pour la dépollution des eaux usées colorées et leur performance peut varier en fonction des conditions expérimentales.
La caractérisation par la diffraction des rayons X (DRX) montre l'obtention de la structure hexagonale de type wurtzite de ZnO avec une orientation préférentielle selon le plan (002). Ainsi que pour le dépôt de Cu_2O présente la phase cristalline cubique avec une orientation préférentielle selon le plan (111).Il a été montré que les films obtenus présentent un gap optique de l'ordre de 3,4 eV pour le ZnO et de 2.1 eV pour le Cu_2O. La microscopie électronique à balayage (MEB) montre l'obtention une structure hexagonale sous forme de nanorods de ZnO. Les images 2D et 3D de la micrographie AFM montrent que la nanostructure de Cu_2O se présente sous forme d'octaèdres bien ordonnés. L'étude photocatalytique a également été réalisée pour évaluer l'efficacité des matériaux photocatalyseurs obtenus sous irradiation d'une lampe xénon de 150 w de puissance avec un faisceau lumineux incluant le domaine UV et ceux du visible.
Key words: Photocatalyse, semiconducteur, oxyde de cuivre, oxyde de zinc.

ÉTUDE DES PROPRIÉTÉS DES NANOPARTICULES DE CeO_2 ET DES COMPOSITES CeO_2-x%LiF : VERS UNE UTILISATION COMME CAPTEURS D'HUMIDITÉ

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Abstract:
Les nanoparticules de CeO_2 pures et renforcées ont été largement étudiées pour leur potentiel en tant que capteurs d'humidité. Dans cette étude, nous avons synthétisé des nanoparticules de CeO_2 pures en utilisant la méthode sol-gel. Afin d'améliorer les propriétés de détection d'humidité de ce matériau, des composites ont été préparés en incorporant différentes proportions (X%) de fluorure de lithium (LiF) dans les nanoparticules de CeO_2.
Des pastilles à base de CeO_2 pur et de CeO_2-X%LiF ont été pressées à l'aide d'une presse axiale et frittées à une température de 1100°C. Les propriétés structurelles et électriques des nanoparticules de CeO_2 pures et des composites ont été analysées à l'aide de techniques de caractérisation telles que la diffraction des rayons X (DRX) et la spectroscopie infrarouge à transformée de Fourier (FTIR).
Les résultats des caractérisations électriques ont montré que l'incorporation de X% de LiF améliore significativement les capacités de détection d'humidité des nanoparticules de CeO_2. Ces matériaux présentent des propriétés optimisées pour la détection d'humidité, ouvrant ainsi de nouvelles perspectives pour leur utilisation dans des dispositifs de détection d'humidité efficaces et sensibles.
Key words: CeO_2, nanocomposites, fluorure de lithium, sol-gel, capteur d'humidité, spectroscopie d'impédance.

SIMULATION OF ARGON DIELECTRIC BARRIER DISCHARGE : THE ROLES OF SURFACE REACTIONS

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Abstract
This paper presents a comparative study of one of the most important physical parameters in plasma chemistry. A one-dimensional model of barrier discharges was constructed to test the effect of secondary electron emission coefficient (SEC) related to surface chemical reactions $Ar^+ \rightarrow Ar$ and $Ars \rightarrow Ar$ at the electrodes. The applied voltage to the cathode is sinusoidal and the anode is grounded. The optimal values of discharge current, electric field strenght, electron temperature, electron density, Ars density, Ar^+ density , are found at 0.07 SEC of $Ar+ \rightarrow Ar$ at the anode, while the optimal values of electron current density, ion current desnity and deposited capacitive power are found for 0.05 SEC of $Ar+ \rightarrow Ar$ at the anode, considring the SEC of $Ars \rightarrow Ar$ constat. In addition, the optimal values of discharge current, electron temperature, electron density, Ar^+ density, ion current density, are found for 0.03 SEC of $Ars \rightarrow Ar$ at the cathode, while the optimal values of electric field strengh, electron current density, and deposited capacitive power are foun at 0.02 SEC of $Ars \rightarrow Ar$ at the cathode, 0.02 SEC of $Ars \rightarrow Ar$ at the anode.

Key words: Anode, Cathode, Secondary electron emission, Surface reactions, Plasma.

TIO_2-MODIFIED BENTONITE AS A COST-EFFECTIVE SUPPORT FOR NICKEL-BASED CATALYSTS IN DRY REFORMING OF METHANE

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Abstract
The potential of TiO_2-modified bentonite as a cost-effective support for nickel-based catalysts in the Dry Reforming of Methane (DRM) is highlighted. The comparison of a nickel catalyst supported on natural bentonite and one prepared on TiO_2-modified bentonite revealed a significantly different behavior between the two catalysts under diluted and concentrated DRM reaction conditions. The unmodified bentonite catalyst, 15Ni/Na-Bent, exhibits high activity under diluted conditions ($20CH_4$:$20CO_2$:60He) but deactivates quickly under concentrated DRM conditions ($40CH_4$:$40CO_2$:20He). On the other hand, 15Ni/TiO_2-Bent is less active at diluted conditions but demonstrates superior stability and activity in concentrated conditions. In situ XPS analysis of the O 1s, Al 2p, Si 2p, and Ti 2p regions of the calcined, reduced, and post-DRM samples revealed that TiO_2 stabilizes the clay structure and prevents nickel reoxidation. The formation of TiO_{2-x} species after reduction creates oxygen vacancies that trap oxidizing species in the reaction medium, thus limiting nickel reoxidation and reducing carbon deposition on the surface. Moreover, these TiO_{2-x} species migrate to the nickel surface, forming a thin protective layer that partially encapsulates the nickel, improving metal–support interactions and providing resistance against sintering and reoxidation. In addition to XPS spectroscopy, which provided insights into the nature of the metal-support interactions in the 15Ni/Na-Bent and 15Ni/TiO_2-Bent catalysts, the materials were also characterized using XRF, XRD, SEM, BET, TPR-H_2, and Raman spectroscopy. These techniques offered complementary structural, textural, and morphological information, leading to a more comprehensive understanding of the catalysts' physicochemical properties.

Keywords: Dry reforming, nickel, TiO_2 modified clay, SMSI, coke resistance, in situ XPS.

ANFIS-BAESED INTELLIGENT CONTROL OF A PHOTOVOLTAIC SYSTEM FOR EFFICIENT MPPT

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Abstract
This work presents an intelligent control approach utilizing an adaptive neuro-fuzzy inference system (ANFIS) to achieve maximum power point tracking (MPPT) from a photovoltaic system. The effectiveness of the ANFIS control is then compared to a traditional control, which is the Perturb and Observe (P&O). This control was developed for dealing with rapid step changes in solar irradiation. Through the combination of the learning ability of the neural network with the inferential qualities of the fuzzy logic, the ANFIS controller is endowed with robustness and adaptability for rapidly varying conditions. In order to test this approach, the MPPT strategy was applied to a PV system equipped with a DC-DC boost converter and evaluated using MATLAB/Simulink, to evaluate the performance of this control against the traditional P&O method. The results demonstrate that the ANFIS controller effectively and steadily tracks the maximum power point, thereby enhancing energy conversion efficiency and, confirming its suitability for real PV systems applications. As future work, the neuro-fuzzy control strategy will be tested under various irradiation conditions, including partial shading, to ensure its efficiency and effectiveness in extracting the maximum available power under different operating scenarios.

Key words: photovoltaic (PV), MPPT, Intelligent Control, ANFIS, dc-dc boost converter.

A SYNRG-BASED WIND POWER SYSTEM: ADVANCED CONTROL WITH MODEL-FREE AND ANT COLONY OPTIMIZATION APPROACHES

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Abstract
Wind energy is one of the key drivers of the global shift toward renewable energy. With its rapid industrial growth, wind turbines have become essential in supplying clean electricity to power grids. Traditionally, technologies such as permanent magnet synchronous machines (PMSM) and double-fed induction generators (DFIG) have been widely used in wind power systems. However, these machines face certain drawbacks, including dependence on rare-earth materials and reduced efficiency at high speeds. In this work, I focus on synchronous reluctance generators (SynRG) as a promising alternative for wind energy conversion. SynRGs offer several advantages, most notably the elimination of magnets and the ability to maintain good efficiency over a wide speed range. The main objective of my research is to enhance the efficiency of energy conversion and improve control in wind power systems. To achieve this, I propose a new control strategy that combines model-free control (MFC) with ant colony optimization (ACO). This approach is designed to optimize the energy captured from wind turbines while minimizing power fluctuations and harmonic distortions. The paper presents the modeling, simulation, and validation of the SynRG-based wind power system under the proposed control method. The results demonstrate significant improvements in robustness, accuracy, and overall efficiency. These findings highlight the potential of SynRG to contribute to more sustainable and high-performance wind energy systems.

Key words: Wind power systems, synchronous reluctance generators, model-free control, ant colony optimization.

DATA-DRIVEN REGRESSION MODELS FOR IONIC CONDUCTIVITY AND ARRHENIUS BEHAVIOR

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Abstract
In this work, we explore the ionic transport properties of antiperovskitesmaterials using a comprehensive machine learning framework. The workflow involved data collection, generation of features from elemental descriptors, selection of the top 50 most relevant features, and the application of various regression models. Among these, the Random Forest model exhibited the best performance, yielding a mean absolute error (MAE) of about 0.511 $S \cdot cm^{-1}$. To further assess the model's reliability, we extended the analysis to lithium-based antiperovskites (Li_3HX, X = S, Se, Te) under both high- and low-temperature conditions. The predicted ionic conductivities showed deviations of 14.5%, 7.19%, and 9.97% for Li_3HS, Li_3HSe, and Li_3HTe, respectively, when compared to experimental data.Furthermore, the ability of the model to predict Arrhenius plots highlights its potential to accelerate the discovery of novel materials for solid-state batteries.
Key words: Machine learning, Regression models, Random forest regression, Antiperovskites, Solid state batteries.

HYDROGEN AS A KEY TECHNOLOGY FOR CLEAN ENERGY AND LONG-TERM STORAGE

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Abstract
This work examines the role of hydrogen as an emerging technology for clean energy production and large-scale energy storage. Green hydrogen is produced through electrolysis, a process in which water is split into hydrogen and oxygen using electrical energy. When powered by renewable sources such as solar, wind, or hydropower, electrolysis provides a sustainable pathway to generate a carbon-free energy carrier. Unlike conventional fuels, hydrogen can be stored for long periods, transported over long distances, and applied across multiple sectors, making it a reliable solution for balancing intermittent renewable energy and enhancing energy security.Moreover, hydrogen extends its value beyond electricity storage. It provides opportunities to decarbonize heavy industries such as steelmaking through direct iron reduction and ammonia production for fertilizers. When combined with captured carbon dioxide, it enables the creation of carbon-neutral fuels that further support global climate strategies. Hydrogen can also be used in fuel cells for clean electricity generation, in heating applications, and as a flexible backup source to stabilize modern power grids.However, large-scale deployment of hydrogen technologies still faces challenges related to efficiency, production cost, and infrastructure development. Recent advances in electrolysis, including improved system design, advanced materials, and integration with renewable energy, are beginning to address these challenges and enhance commercial feasibility. This work emphasizes that with ongoing innovation and supportive infrastructure, hydrogen can evolve into a cornerstone of future low-carbon energy systems, serving not only as a clean fuel but also as a transformative technology for secure and flexible global energy networks.

Key words: Green hydrogen, Electrolysis, Renewable energy, Energy storage.

QBLADE SIMULATION AND 3D PRINTED PROTOTYPING OF A SCALED NREL PHASE VI WIND TURBINE FOR LABORATORY STUDY

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Abstract
Wind energy plays a central role in the global transition toward renewable energy systems, and the performance of wind turbine blades directly affects efficiency and reliability. Accurate aerodynamic modeling tools are therefore essential for both research and education. QBlade, an open source software, combines the Blade Element Momentum (BEM) method with dynamic simulation capabilities, making it a valuable platform for the analysis of horizontal axis wind turbines (HAWTs). The present work investigates the aerodynamic performance of the NREL Phase VI wind turbine, a widely recognized experimental benchmark, using QBlade. The original blade geometry and S809 airfoil data were implemented in the software, and simulations of the power coefficient (Cp) as a function of tip speed ratio (TSR) were carried out. The results are validated through direct comparison with NREL experimental data, highlighting both the reliability of QBlade in capturing performance trends and its limitations under stall and highly separated flow conditions. Beyond numerical validation, a scaled prototype of the blade was 3D-printed, opening the way for wind tunnel testing and for use as a practical educational tool in laboratory settings. This study demonstrates that QBlade can provide accurate and accessible aerodynamic predictions, while the integration of experimental benchmarking and physical prototyping adds originality by bridging simulation, validation, and teaching applications.

Keywords: Wind Energy, HAWTs, QBlade, NREL Phase VI, Numerical Simulation, 3D printing.

FORCED CONVECTION IMPROVEMENT IN ROTARY CEMENT KILNS: NUMERICAL STUDY OF ZIGZAG WALL EFFECTS ON HEAT TRANSFER CHARACTERISTICS

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Abstract
This investigation evaluates thermal transport enhancement in rotary cement kilns using Zigzag wall configurations. These rotating cylindrical systems are essential in cement production, characterized by elevated temperatures and complex thermal exchange mechanisms, making them suitable for geometric surface modifications. Computational fluid dynamics analysis was performed using ANSYS Fluent 21.0 with k-ε realizable turbulence modeling to examine four distinct corrugated depths (0.5, 1.0, 1.5, 2.0 mm) compared to smooth wall baselines. Numerical validation utilized operational data from Lafarge Cement Oggaz facility in Algeria. Results demonstrate substantial convective enhancement through Zigzag topologies. Progressive Nusselt number augmentation correlates with increasing Zigzag depth, achieving 60-133% improvements relative to smooth surfaces. Optimal configuration (2.0 mm depth) maintains Nusselt values of 1100-1400 in the developed region (15-40 m) versus 500-600 for conventional walls. Thermal analysis reveals Zigzag walls establish uniform temperature distributions at 250-280°C in discharge zones, while smooth walls reach 390°C, creating 110-140°C temperature variance between configurations. Enhancement mechanisms originate from thermal boundary layer disruption, generating transverse circulation patterns and intensifying thermal exchange between primary flows and wall-adjacent regions. Zigzag surfaces create alternating acceleration-deceleration zones with periodic pressure variations amplifying convective processes. Three operational zones were identified: rapid thermal dissipation (0-5 m), thermal recovery (5-15 m), and developed enhancement region (15-40 m). Findings indicate significant potential for energy efficiency improvements in cement manufacturing, suggesting reduced consumption while maintaining thermal processing requirements.

Key words: Heat transfer enhancement, Rotary cement kiln, Zigzag walls, Computational fluid dynamics (CFD), Nusselt number, Forced convection

COMPARATIVE STUDIED BETWEEN $CH_3NH_3PBI_3$ AND $CH_3NH_3SNI_3$ BASED PEROVSKITE SOLAR CELLS

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Abstract
Perovskite materials have attracted great attention in the past few years owing to their excellent optical properties and solution-processable fabrication. However, the further development of these lead-based materials is restricted by the toxic heavy-metal element Pb. The subject of this work was investigation of lead ($CH_3NH_3PbI_3$,MAPI),and lead-free perovskite solar cells ($CH_3NH_3SnI_3$, MASI). Perovskite solar cells are constructed with a thin layer of a material. The resultas of simulation indice that the J_{SC} depends on the optical properties of the solar cell, such as absorption and reflection. The V_{0C} correlates to the quasi-Fermi level of photo-excited perovskite and the electrode work function. The fill factor (FF) is directly affected by the values of the cell's series resistance (RS), The external quantum efficiency (EQE) measurements showed a high conversion rate of photons in the solar cell of 90% compared by about 64% for MASI structure.
However, the development of other types of solar cells can reduce the cost of the devices and make them more environmentally friendly.

Key words: Peroviskite, Materials, $CH_3NH_3SnI_3$, $CH_3NH_3PbI_3$, Frinendly.

ADAPTIVE INTEGRAL BACKSTEPPING MPPT FOR BOOST-CONVERTER PHOTOVOLTAIC SYSTEMS

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Abstract

The volatility of oil prices, rising energy demand, and current apprehensions over global warming have prompted a transition towards renewable and sustainable energy sources. Solar energy is regarded as one of the foremost renewable energy sources for electricity generating. However, it suffers from low efficiency because to fluctuating ambient conditions. An optimal maximum power point tracking (MPPT) method is necessary to maximize power extraction from the photovoltaic (PV) array, hence enhancing its efficiency. This work introduces an Integral Backstepping (IBS) MPPT controller applied to a boost converter, combined with an adaptive reference-voltage generator based on a modified perturb-and-observe (P&O) algorithm. Based on the change of PV power magnitude the adaptive generator adjusts its perturbation step, leading to fast convergence when far from the maximum power point (MPP) and fine tuning near the MPP to minimize oscillations. The IBS controller provides nonlinear stability and integral action to reject disturbances and minimize steady-state error. The efficacy of the suggested controller is evaluated using the MATLAB/Simulink platform. The simulation results confirm that the suggested controller provides rapid and precise tracking. A comparison with the perturb and observe method and a fuzzy logic controller is shown to demonstrate the performance of the suggested controller during sudden changes in environmental circumstances.

Key words: MPPT; Integral Backstepping; Adaptive Perturb-and-Observe; Boost Converter; Photovoltaic Systems; Robust Control.

INVESTIGATION OF DOPING PROFILES ON N-PERT SILICON SOLAR CELL PERFORMANCE

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Abstract
Development of an n-Pert solar cell focuses on designing and optimizing devises based on n-type monocrystalline silicon. This technology aims to improve the efficiency of solar cells by minimizing recombination losses at the emitter and the back of the cell, through a surface passivation treatment. The objective of this sudy is to develop n-type solar cells based on monocrystalline silicon using the n-Pert structure, an advanced approach to improve the efficiency of converting light energy into electricity. The n-Pert structure improves surface passivation, which reduces electron losses and improves solar cell performance. Indeed, better passivation of the electrode and the cell body reduces recombination, which results in an increase in the overall efficiency of the cell.
In this context, our primary objective is to simulate and model the performance of these solar cells. This includes several steps: including modeling the n-Pert structure and simulating performance. Performance enhancement: Analyzing the simulation results allows you to alter certain parameters (such as layer thickness or impurity concentration) to improve the solar cell's energy efficiency.

Key words: n-Pert, solar cell, monocrystalline, silicon, simulate

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RESERVOIR WATER LEVEL CONTROL USING RENOWABLE ENERGY FOR THE SUPPLAY OF A SMALL VILLAGE

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Abstract
The increasing need for sustainable solutions in rural and isolated areas highlights the importance of renewable energy-based water pumping systems. This work presents the modeling and control of water level in a reservoir supplied by wind energy to meet the domestic and agricultural demand of a small village. The proposed system employs an axial-flow pump driven by a submerged asynchronous motor-pump unit operating under rotor flux-oriented vector control to ensure robust and efficient performance. The energy source is a variable-speed wind turbine coupled to a permanent magnet synchronous generator (PMSG). The generated power is processed through a diode rectifier, a DC-link, and a voltage source inverter, which supplies the induction motor. To optimize energy extraction, a Maximum Power Point Tracking (MPPT) strategy based on wind turbine characteristics is implemented, guaranteeing maximum utilization of available wind resources. Simulation results demonstrate that the proposed control strategy maintains the reservoir water level within desired limits despite wind speed fluctuations, while ensuring stable motor operation, smooth torque response, and efficient energy conversion. The originality of this research lies in integrating a wind-driven PMSG with an asynchronous motor-pump group under advanced control, providing a reliable and autonomous water supply solution for remote communities.

Key words: PMSG, MPPT fuzzy logic, Greenhouse, Inverter and rectifier.

INFLUENCE OF SN DOPING ON THE PROPERTIES OF CDO THIN FILMS FOR TRANSPARENT CONDUCTIVE APPLICATIONS

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Abstract
Thin films of cadmium oxide (CdO), both undoped and tin-doped (Sn:CdO), were successfully deposited on glass substrates using the spray pyrolysis technique at 350 °C. The effect of Sn incorporation at 1 and 3 wt.% was systematically studied through structural, morphological, optical, and electrical characterizations. X-ray diffraction confirmed the cubic crystalline structure with a preferred (111) orientation. A slight shift of diffraction peaks toward lower angles, together with the increase in crystallite size, indicated lattice expansion and improved crystallinity upon doping. SEM observations revealed a noticeable grain size growth, while EDS spectra confirmed the presence of cadmium, oxygen, and tin elements. Optical studies showed that transparency improved from about 60% for pure CdO to 79% for 3% Sn-doped films, while the optical band gap increased from 2.41 to 2.49 eV, attributed to the Burstein–Moss effect. Urbach energy values decreased with doping, suggesting reduced structural disorder. Hall effect measurements revealed n-type conductivity with carrier concentrations on the order of 10^{20} cm^{-3}, although mobility decreased, leading to higher resistivity for doped films. These results demonstrate that Sn-doped CdO thin films combine good transparency with electrical conductivity, making them attractive for transparent conducting oxide (TCO) applications in solar cells and optoelectronic devices.

Key words: Spray pyrolysis, Sn-doped CdO, Transparent-conducting oxides, Optical band gap.

ZnSe THIN FILMS SYNTHESIZED VIA ELECTROCHEMICAL DEPOSITION: ELECTROCHEMICAL CHARACTERIZATION BY CV, CA, AND EIS TECHNIQUES

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Abstract
Zinc selenide (ZnSe) semiconducting thin films with a direct bandgap of approximately 2.70 eV, have been extensively studied over the last few years due to their interresting optical and electrical properties, which render them highly suitable for a wide range of optoelectronic applications, including blue-green laser diodes, light-emitting diodes (LEDs), photoconductors, and optically activated switches. Moreover, ZnSe is considered as a viable material for integration into photoluminescent and electroluminescent thin-film devices, in addition to serving as an n-type window (buffer) layer in chalcogenide-based heterojunction solar cells. The present work focuses on the study and synthesis of ZnSe thin films using an electrochemical method and a slightly acidic citrate-based solution containing soluble salts of zinc and selenium. After series of experimental tests, a Zn/Se molar ratio in solution of 500 and a bath temperature of 60 °C were set to carry out various electrochemical techniques such as cyclic voltammetry (CV), chronoamperometry (CA), and electrochemical impedance spectroscopy (EIS). The cyclic voltammetry investigation revealed the electrochemical behavior of Zn-Se-citrate system and helped to determine the optimal deposition potential. Chronoamperometric curves showed good agreement with the Scharifker-Hills model, suggesting a 3D instantaneous nucleation controlled by diffusion. On the other hand, electrochemical impedance spectroscopy (EIS) study revealed an improved stability at the electrode/electrolyte interface. Using the electrochemical technique, high quality ZnSe thin films were successfully synthesized, demonstrating that it is a suitable method for a large-scale semiconducting materials fabrication.

Key words: Thin films; ZnSe, photovoltaic cells, Semiconductor, Electrochemical impedance spectroscopy, Cyclic voltammetry, Chronoamperometry.

HIGH-YIELD BIODIESEL SYNTHESIS FROM WASTE VEGETABLE OIL VIA CAO/ZN/MO CATALYSTS AND RSM OPTIMIZATION

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Abstract
Global interest in renewable and sustainable fuels has intensified efforts to develop biodiesel through the transesterification of vegetable and waste cooking oils. The present work explores the catalytic transesterification of waste fryer vegetable oil as a renewable feedstock for biodiesel production. A heterogeneous bimetallic catalyst consisting of calcium oxide (CaO) supported with zinc and molybdenum was synthesized and systematically evaluated for its activity and stability. Critical process parameters, namely methanol-to-oil molar ratio, catalyst concentration, reaction time, and temperature, were optimized using Response Surface Methodology (RSM). The optimized conditions yielded up to 94% fatty acid methyl esters (FAMEs), demonstrating the high efficiency of the synthesized catalyst. Furthermore, the CaO/Zn/Mo material retained its catalytic activity across six successive reaction cycles, confirming its reusability and long-term applicability. RSM proved to be a reliable and efficient optimization tool, enabling accurate predictions while minimizing experimental runs. The study highlights the dual importance of designing advanced catalytic systems and applying systematic optimization approaches to achieve sustainable, scalable, and eco-friendly biodiesel production.

Key words: Transesterification, Sustainability, Biodiesel, Catalyst

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APPLICATION OF ADAPTIVE PSO FOR COST–EMISSION OPTIMIZATION IN AN INTELLIGENT HYBRID MICROGRID

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Abestract
The energy transition requires the development of intelligent hybrid systems capable of effectively integrating various renewable energy sources while minimizing costs and environmental impacts. In this work, we propose an energy management optimization method for a hybrid microgrid composed of photovoltaic panels, a wind turbine, a battery, the main grid, and Vehicle-to-Grid (V2G) technology. The main objective is to simultaneously reduce energy costs and greenhouse gas emissions by considering multiple operating scenarios. To achieve this goal, an adaptive Particle Swarm Optimization (PSO) algorithm is developed, in which the inertia weight varies dynamically throughout the iterations to improve the balance between exploration and exploitation. The proposed methodology consists of modeling the different energy sources, residential and commercial loads, as well as the storage and grid exchange constraints. The adaptive PSO is then applied to determine the optimal power distribution under different scenarios: grid-only supply, integration of renewable energies, addition of battery storage, and finally the inclusion of V2G. Simulation results demonstrate that the proposed approach significantly reduces both overall cost and CO_2 emissions compared to conventional methods. The originality of this work lies in the use of a variable inertia PSO applied to multi-scenario hybrid systems, providing an effective and flexible strategy for the sustainable energy management of intelligent microgrids.

Key words: Energy management; Microgrid; Adaptive Particle Swarm Optimization (PSO);Battery; Electric vehicle; Renewable Energy

EFFECT OF OPTIMIZED VORTEX GENERATORS ON DARRIEUS TURBINE BLADE PERFORMANCE

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Abstract
Self-start capability is an important feature of wind turbines. The present study aims to improve Darrieus turbine blade performance at startup by using a blade arrangement. Numerical flow analysis yielded the values of the NACA4415 lift and drag coefficients for impacts ranging from incidence -40° to 40° for several azimuth positions. Geometry with vortex generators and continuous blowing jets as passive and active controls has been tested. The Reynolds averaged Navier-Stokes equations were solved Using the ANSYS CFX calculation code and realizable K-Epsilon turbulence model, a tetrahedral mesh was employed to treat the flow character around an asymmetrical profile NACA4415, and the results were validated by wind tunnel measurements. The impact of several parameters (Vortex generator position, span-wise distance for blowing) on the aerodynamic performance of the blade was studied. According to the investigation results, the optimal position for vortex generators was selected upstream of the separation zone at 0.35c. Moreover, the blade performance at start-up was greatly enhanced when lowering the distance between the blowing holes.

Key words: Darrieus Turbine, Vortex Generators, Blowing jet, Self-starting; CFD.

ÉTUDE DE L'EFFET DES FACTEURS CLIMATIQUES SUR LE RENDEMENT DES CELLULES SOLAIRES PHOTOVOLTAÏQUES DANS L'ENVIRONNEMENT DESERTIQUE DU SUD DE L'ALGERIE (REGION D'OUARGLA).

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Abstract
Les panneaux photovoltaïques (PV) actuellement disponibles sur le marché présentent une efficacité maximale de 25 %, malgré un développement continu et des efforts considérables pour améliorer leurs performances. Comme celles-ci sont directement influencées par les conditions environnementales changeantes et les facteurs climatiques incontrôlables, cette étude vise donc à améliorer la fiabilité et l'utilité des systèmes photovoltaïques solaires en examinant l'impact de ces facteurs sur leurs performances. Pour atteindre cet objectif, différentes expériences ont été menées dans des conditions climatiques arides (sud de l'Algérie, région d'Ouargla), où les performances de plusieurs modules PV ont été évaluées sous l'influence de divers facteurs environnementaux tels que l'infiltration d'eau de pluie, l'ombrage partiel réel et les déjections d'oiseaux. Par la suite, l'énergie produite par chaque panneau a été mesurée, enregistrée et comparée afin de déterminer l'impact de chaque facteur sur le rendement de conversion énergétique. L'originalité du présent travail réside dans l'étude combinée de facteurs environnementaux réels et de leur impact sur la production énergétique des panneaux solaires photovoltaïques en région désertique chaude et aride. De plus, l'étude prend en considération la période de formation de certains de ces facteurs, relativement longue (près d'une année dans le cas de l'infiltration d'eau de pluie et de l'accumulation de déjections d'oiseaux). Les résultats obtenus montrent que le pourcentage de perte d'énergie quotidienne a atteint respectivement 63,5 %, 27,6 % et 13,9 % pour l'infiltration d'eau de pluie, l'ombrage partiel réel et les déjections d'oiseaux, par rapport à un panneau conventionnel.

Key words: Panneaux photovoltaïques ; facteurs environnementaux ; rendement de conversion ; perte d'énergie ; climat aride ; sud de l'Algérie.

COMPARATIVE STUDY OF OPTIMIZING COPPER ELECTROPLATING BY PULSED CURRENT AND DIRECT CURRENT DEPOSITION

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Abstract
As the price of silver continues to rise, electroplating technology offers a promising and cost-effective alternative for metallization, although it has not yet fully replaced screen-printing techniques. Copper is increasingly favored over silver due to its excellent electrical conductivity, lower cost, reduced line resistance, decreased shading loss, and compatibility with diverse substrates. Nevertheless, challenges such as thickness uniformity and adhesion stability remain significant barriers to its widespread implementation. The objective of this study is to compare direct current (DC) plating and pulsed current plating (PP) as methods for depositing copper films on silicon substrates with controlled thicknesses in the range of 10–25 µm. The methodology involves electroplating under identical electrolyte compositions, followed by systematic evaluation of growth rates, uniformity, and adhesion strength. Thickness evolution is tracked as a function of deposition time. Preliminary results indicate that DC plating achieves faster deposition rates but induces internal stress, leading to delamination at higher thicknesses and extended deposition times. By contrast, PP improves ion distribution through periodic on–off cycles, resulting in finer grain structures, reduced stress, and enhanced adhesion.

Key words: Copper electroplating, Pulsed current, Direct current, Adhesion, Thickness

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HYDROTHERMAL SYNTHESIS AND ELECTROCHEMICAL PERFORMANECE OF CORE-SHELL SULFIDE ELECTODES FOR SUPERCAPACITORS

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Abstract
Transition metal sulfides have emerged as promising candidates for advanced energy storage due to their high theoretical capacity, multiple oxidation states and rich redox activity. However, their practical application remains limited by poor conductivity and structural instability. Herein, we report the hydrothermal synthesis of a NiS/Co_3S_4@h-Ni nanowire core-shell electrode designed to overcome these challenges. Structured and surface analyses (XRD, XPS and SEM) confirmed the successful formation of the core-shell architecture with a flower like morphology. Electrochemical tests in 4 M LiOH electrolyte revealed an excellent specific capacity of 1893 $C.g^{-1}$ at 1 $A.g^{-1}$, along with remarkable cycling stability, retaining 98.63% of its initial capacity after 10000 charge-discharge cycles at 20 $A.g^{-1}$. These superior electrochemical performances are attributed to the synergistic effects between h-Ni NWs and bimetallic sulfides, which facilitate rapid electron/ion transport and robust structural integrity. This study highlights the potential of core-shell structure sulfide based electrodes for high performance supercapacitor applications.

Key words: Hydrothermal synthesis, electrode material, core shell structure

DESIGN OF MULTI-WALLED CARBON NANOTUBE–ACID FUCHSIN PHOTOCATALYSTS FOR HIGH-PERFORMANCE SOLAR-DRIVEN REGENERATION OF NADH COFACTOR

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Abstract
This study explores the efficient regeneration of the nicotinamide adenine dinucleotide (NADH) cofactor under solar-light irradiation using multi-walled carbon nanotube–acid fuchsin (MWCNT@AF) composites as photocatalysts. The composite was synthesized via covalent functionalization, enhancing visible-light absorption and charge transfer efficiency. Photocatalytic NADH regeneration experiments were conducted using β-NAD+, ascorbic acid as a sacrificial donor, and a rhodium complex as an electron mediator. Under blue LED illumination, MWCNT@AF achieved a regeneration yield of 46.90%, significantly outperforming acid fuchsin alone (17.52%). The mechanism involves photoexcitation of MWCNT@AF, hole scavenging by ascorbic acid, and sequential electron transfer to the rhodium complex and NAD+, yielding enzymatically active 1,4-NADH. Electrochemical and spectroscopic characterization confirmed enhanced conductivity, reduced recombination, and broad visible absorption. The findings highlight the potential of MWCNT@AF composites for cofactor recycling in solar-driven biocatalysis, contributing to sustainable artificial photosynthesis systems.

Keywords: MWCNTs, Photocatalysis, NADH, Photo-reduction, Artificial photosynthesis.

ECO-FRIENDLY MATERIALS FOR LOW-COST SOLAR ENERGY HARVESTING : $RBSNBR_3$ LEAD-FREE PEROVSKITES

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Abstract
Halide perovskite photovoltaics (PVs) have become a critical high-efficiency renewable energy technology in the fight against climate change, offering the potential for a sustainable and environmentally friendly future. This study computationally investigates the electronic and thermoelectrical properties of cubic rubidium tin bromide ($RbSnBr_3$), a lead-free perovskite, to evaluate its solar cell potential.The analysis is conducted using Density Functional Theory (DFT) via the Full-Potential Linearized Augmented Plane Wave (FP-LAPW) method in WIEN2k. Electronic structure calculations employed mBJ-DFT, while thermoelectric properties were evaluated using semi-classical Boltzmann transport theory (BoltzTraP-WIEN2k interface. the modified Becke-Johnson (mBJ) is employed for the incorporation of exchange-correlation energy. Using mBJ-DFT , we predict $RbSnBr_3$'s bandgap at 1.33 eV surpassing prior DFT values and nearing experimental Sn-perovskite ranges (1.4–1.6 eV). This positions $RbSnBr_3$ as a prime candidate for lead-free tandem solar cells.The calculated electronic and thermoelectric properties demonstrate favorable characteristics for photovoltaic applications. These results position $RbSnBr_3$ as a promising candidate for lead-free tandem solar cells and confirm its potential for eco-friendly, cost-effective solar energy harvesting.

Key words: perovskites, renewable energy, simulation, wien2k, bandgap energy, thermo-electrical properties, DFT, $RbSnBr_3$.

ENERGY RECOVERY FROM SUGAR WASTE: BIOETHANOL PRODUCTION

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Abstract−Bioethanol production is an important form of energy recovery from renewable resources. It involves converting biomass, generally composed of agri-food waste or plants rich in fermentable sugars, into bioethanol using controlled biological processes. This process is mainly based on alcoholic fermentation carried out by microorganisms, followed by distillation to isolate the ethanol produced. To optimize production, fermentation conditions are rigorously controlled: a sugar concentration of approximately 150 g/L, a temperature maintained at 35°C, and a slightly acidic pH of around 4 to 5, which are ideal conditions for the fermentation activity of *Saccharomyces cerevisiae* yeast. After a fermentation period of 72 hours, this yeast converts the sugars into ethanol, resulting in a fermented juice rich in bioethanol.
The bioethanol is then recovered by distillation, ensuring the concentration and purification of the final product. At the same time, the solid residues from the treatment, particularly those from beet waste, are recycled through composting. These residues are placed in an aerated bin, promoting controlled biological decomposition, and resulting in the production of stable organic compost, useful as a soil amendment.
This integrated approach not only produces renewable fuel, but also sustainably manages by-products.

Keywords: bioethanol, beet, fermentation, distillation, compost, organic waste, Saccharomyces cerevisiae, properties, valorization, sustainability.

INTEGRATED MATERIAL SOLUTIONS FOR REDUCING HEAT TRANSFER AND ENERGY DEMAND IN BUILDING ENVELOPES

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Abstract
As the demand for indoor comfort and the use of electrical devices rises, reducing energy consumption in buildings becomes increasingly important for ensuring environmental sustainability. Traditional cooling systems are often inefficient and consume large amounts of energy, making passive cooling techniques a promising alternative. This study explores the thermal performance of clay bricks enhanced with a combination of phase change materials (PCMs) and expanded polystyrene (EPS) insulation, using a dynamic heat transfer model. Initially, three PCMs were embedded along the centerline of the brick, while the cavities remained air-filled. In a second phase, the cavities were filled with EPS to evaluate the synergy between both passive strategies. Among the tested PCMs, Capric acid delivered the best performance. Although each method independently improved thermal behavior, their combination resulted in even greater benefits. When Capric acid was positioned at the centerline and EPS filled the cavities, the inner surface temperature dropped by about 3.9°C, and the heat flux was reduced by nearly 35% compared to a traditional brick. Additionally, this setup delayed the peak heat flux by 2h, showcasing its potential to significantly improve energy efficiency in buildings.

Key words: Phase change material; EPS insulation; Building brick; Energy efficiency; computational fluid dynamic

OPTIMIZATION OF THE MELTING PERFORMANCE OF NEPCM/METAL FOAM COMPOSITES IN LATENT HEAT STORAGE SYSTEMS

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Abstract
Although technological advancements have been made, the limited thermal efficiency of energy storage systems continues to hinder their industrial deployment and commercialization. Developing cost-effective solutions remains a key challenge; however, combining phase change materials (PCMs), nanoparticles, and metal foams shows great potential due to the high thermal conductivity of metal foams. This study presents a numerical investigation of the melting process in a thermal storage cavity partially filled with metal foam, nanoparticles and PCM. The enthalpy–porosity method within a finite volume approach is used to simulate phase change and heat transfer. The study evaluates different nanoparticle volume fractions in terms of thermal and economic performance. The investigation indicates that the incorporation of nanoparticles leads to a reduction in stored energy of 3.6% for ϕ = 2% and 7.4% for ϕ = 4%. The results demonstrate that a 2% nanoparticle concentration provides the most effective balance between efficiency and cost.

Key words: Natural Convection, PCM, Nanoparticles, Melting Performance, Metal Foam Numerical simulation.

CRITICAL ROLE OF THERMOPHOTOVOLTAIC CELLS IN ADVANCING RENEWABLE ENERGY SOLUTIONS

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Abstract
Thermophotovoltaic (TPV) cells are an innovative technology poised to significantly enhance the renewable energy sector by converting thermal radiation into electricity from various heat sources, such as concentrated solar power, industrial waste heat, and stored thermal energy. Unlike conventional photovoltaic cells that depend on visible light, TPV cells utilize infrared photons, achieving high efficiencies that rival traditional heat engines. Their ability to enable thermal energy grid storage allows excess renewable energy from solar or wind to be stored as heat and converted back to electricity on demand, addressing the intermittency of renewable sources and ensuring continuous power availability. TPV cells also support waste heat recovery in hybrid systems, reducing energy losses and improving sustainability. With their solid-state design, lack of moving parts, and adaptability for both small-scale and grid-level applications, TPV cells offer a scalable, efficient solution to drive the transition toward a renewable energy future, transforming sectors like solar power and long-duration energy storage.

Key words: Optimal output , Thermophotovoltaic (TPV) system , efficiency , geometry, thermal losses , simulation COMSOL.

NANOSTRUCTURED THIN-FILM COMPOSITES: FROM DYE-SENSITIZED TO PEROVSKITE SOLAR CELLS FOR ADVANCED RENEWABLE ENERGY APPLICATIONS

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Abstract
The advancement of renewable energy technologies, particularly next-generation photovoltaics such as Dye-Sensitized Solar Cells (DSSCs) and Perovskite Solar Cells (PSCs), hinges on the development of high-performance nanostructured thin-film composites. A critical component in these devices is the transparent conducting oxide (TCO) layer, which requires optimized structural and optical properties for efficient device performance. This work investigates the targeted modification of zinc oxide (ZnO), a key TCO material, through rare-earth europium doping to tune its properties for such advanced applications. A series of undoped and europium-doped ZnO thin films were fabricated using a cost-effective, one-step direct electrochemical deposition method on ITO substrates. The resulting films were systematically characterized using X-ray diffraction (XRD), scanning electron microscopy (SEM), and UV-Vis spectroscopy to correlate dopant concentration with material properties. Analyses confirmed the successful formation of well-aligned ZnO nanorods with a hexagonal wurtzite structure. Crucially, the incorporation of europium was found to systematically alter the material's properties; increasing dopant concentrations led to a deterioration in crystallinity and a decrease in average grain size. Optically, while pure ZnO films exhibited high transparency of approximately 80% in the visible spectrum, europium doping resulted in a controlled reduction in transmittance and modified UV-visible emission. This study demonstrates that controlled europium doping is an effective strategy for tuning the fundamental characteristics of ZnO nanostructures. These findings are highly relevant for engineering TCO layers in advanced solar cells, where precise control over crystallinity, morphology, and light transmission is crucial for optimizing charge transport and device efficiency, paving the way for integrating tailored thin-films into more efficient solar cell architectures.

Key words: Zinc Oxide, Europium Doping, Thin-Films, Electrochemical Deposition, Transparent Conducting Oxides, Solar Cells

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PERFORMANCE EVALUATION OF A HYBRID DUAL-AXIS SOLAR TRACKER CONTROLLED BY ARDUINO COUPLED TO AN IMPROVED MPPT MODEL

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Abstract
Photovoltaic panel efficiency depends strongly on its orientation towards sun irradiance and their electrical output adaptation for use. This paper includes the implementation of hybrid dual-axis solar tracker conjugated to simulated MPPT command. The presented Sun tracker tracks, sun on Azimuth angle using geo-solar equation coordinates, and elevation angle using two LDR sensors, to catch direct and diffuse sunlight. The control system is assured by arduino uno microcontroller. To optimize PV output power, we employs an improved variable-step P&O MPPT to accelerate convergence to the MPP, reduces losses and converges during sudden changes in irradiance/temperature. When sudden changes are detected, the system evaluates it by:
- If the MPP has already been reached, the algorithm immediately tracks the new MPP.
- If the MPP has not yet been reached, the current perturbation is canceled, and the algorithm restarts the search process. To eliminate oscillation around MPP, we use FSCC and FOCV methods to calculate the PV maximum power and stop perturbation when MPP is reached. The conjunction of the sun-tracker experimental results and simulated MPPT significantly increased energy yield, boosting output power by 20.86% compared to a fixed panel with MPPT, and by 70.53% compared to a fixed panel directly connected to the load. So, to increase PV efficiency its primordial to use both solar tracker and command MPPT at the same time.

Key words: Sun tracker, MPPT, P&O, FOCV, FSCC, arduino

OPTIMIZATION AND PERFORMANCE ANALYSIS OF AN INVERTED PEROVSKITE SOLAR CELL USING SCAPS-1D

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Abstract
In this work, we analyzed the performance of an inverted P–I–N PSCs including the configuration (FTO)/NiMg(Li)O/MAPbI3/PCBM/Ag, by studying the influence of various parameters layer using the SCAPS-1D which is a free general-purpose tool for simulation. The proposed model was validated by comparing obtained simulated results to experimental model. Once our model was validated, we proceeded to optimize of the MAPbI3 and the PCBM electron transport layer thicknesses, achieving a maximum PCE of 14.10 % at a thickness of 380 nm of MAPbI3 then 14.80 % for 17 nm thickness of PCBM. The obtained values was compared with those reported in the literature. Increasing the absorber layer defect density leads to a reduction in both the PCE and FF from 14.80% to 13.93% and 66.20% to 64.60 % respectively. This behavior can be attributed to the increased non-radiative recombination pathways introduced by defect sites in the absorber layer which reduce the quasi-Fermi level splitting impacting then Voc than diminishing the light absorption. The PSCs PCE and FF decrease with increasing temprerature from 14.80% to 13.63% and 66.20% to 63.88% respectively whichs can be attributed to changes in carrier dynamics, Voc improved but simultaneously increase resistive and non-radiative losses. We conclude that Minimizing the perovskite absorber layer defect density and optimizing the design of PSCs is essential for enhancing charge-carrier dynamics then power conversion efficiency and improving the long-term stability and durability of the device. Its why the use of inverted PSCs is beneficial for achieving enhanced stability.

Key words: PSCs, P-I-N, MAPbI3, PCBM, SCAPS 1D

THE INFLUENCE OF CURING PARAMETERS ON THE ALKALI ACTIVATED MORTAR (LITTERATURE REVIEW)

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Abstract
Alkali activated binder commanly named as gepolymeric binder is considered like a new eco friendly material construction and may remplace the ciment which production is one of the most important source of CO_2, the second most important greenhouse gas, after water vapour, whose concentration has increased by 47% since the 18th century. According to the Global Cement and Concrete Association, cement manufacturing generates 7% of the world's CO_2, In recent years, the environment has become one of the major concerns of our society. In particular the greenhouse gases are at the origin of climate . Today, finding a good alternative becomes crucial. Geopolymers can be obtained by a chemical reaction under highly alkaline conditions between an activating solution of sodium hydroxide and sodium silicate and an aluminosilicate (material with a high SiO2 and Al2O3 content) such as fly ash, blast-furnace slag, metakaolin or other natural minerals Some parameters can influence the geopolymerisation process either the preparation of raw materials or the curing treatment of blends, like the temperature, which affects the reaction rate and also the mechanical properties and the microstructure of the geopolymers, In the literature some studies have been carried out on several types of geopolymer mortar to determine the effect of the cured temperature on the formation of geopolymers..

Key words: geopolymer; Aluminosilicate; alkali-activation; microsturcture ; temperature

MATLAB STUDY OF FACTORS INFLUENCING THE OPERATION OF A PHOTOVOLTAIC CELL

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Abstract

The mathematical equations developed for modeling the performance of PV generators are based on the current-voltage and power characteristics. The literature contains numerous mathematical models to represent the highly nonlinear behavior of a photovoltaic cell. This nonlinearity is primarily due to the semiconductor junctions that are the basis for cell construction. These different models differ in the number of parameters involved in calculating a cell's output voltage and current. Thus, single-diode and dual-diode models are available, depending on the number of junctions considered. Typically, a photovoltaic cell produces less than 2 watts at a voltage approximately equal to 0.5 volts. A series connection of several cells produces a module, and a series and parallel connection of several modules produces a photovoltaic panel. The model establishment has an objective to implement in the MATLAB/SIMULINK software of this source and then to find by simulation the characteristics I-V and P-V of this generator as well as their behaviors according to the solar parameters namely the illumination in the plane of the panels and the junction temperature.

Key words: Photovoltaic cell, Ideal photovoltaic generator, Real photovoltaic generator, Temperature, Matlab.

ENERGY ANALYSIS OF ISCC PLANT AT HASSI R'MEL

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Abstract− The Integrated Solar Combined Cycle (ISCC) plays an important role in modern electricity production by combining renewable solar energy with conventional gas turbines. This study analyzes in detail the performance of the Hassi R'Mel ISCC plant over four representative days of the year (one per season), focusing on natural gas consumption, overall energy balance, and electrical power generation, using Modelica in the OpenModelica simulation environment. The obtained results indicated that the overall thermal efficiency of the power plant could exceed 69% on June 21, while ranging between 56% and 61% on the other selected days. This noticeable improvement in performance is primarily attributed to the significant reduction in fossil fuel consumption, with approximately 1350 tons of natural gas saved during the summer season and about 765 tons in both autumn and spring. Such a remarkable reduction not only enhances the plant's operational efficiency and long-term sustainability but also contributes to protecting the environment by mitigating carbon dioxide emissions and delivering tangible ecological benefits for future generations.

Key words: Parabolic trough concentrators, direct normal irradiation, OpenModelica, efficiency, power, mass flow rate of htf.

STABILIZATION AND NOX EMISSION CHARACTERISTICS OF PREMIXED SWIRLING PROPANE–AIR FLAMES WITH HYDROGEN ENRICHMENT

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Abstract
The optimization of flame stabilization and emissions reduction in modern combustion systems increasingly depends on a combination of advanced techniques and high-fidelity numerical simulations. Two important parameters that significantly influence flame behavior and emissions of NOx and CO are investigated: the equivalence ratio, varied from 0.4 to 0.8, and the hydrogen amount in the mixture, varied from 2% to 10%. This work describes an investigation using a one-dimensional in-house code developed in Python to analyze premixed propane–air flames under atmospheric pressure. The model was validated against experimental data of laminar flame velocity (LFV) for propane–air mixtures, ensuring accuracy before extending the study to hydrogen-enriched cases. The results show that hydrogen enrichment significantly increases the laminar flame velocity, thereby improving the overall reactivity of the mixture and enabling stable combustion under leaner conditions. In addition, hydrogen addition reduces CO emissions by promoting more complete oxidation but increases NOx formation due to higher flame temperatures and enhanced thermal pathways. These findings emphasize the role of hydrogen as an effective additive for improving combustion performance while highlighting the trade-off with NOx emissions.

Keywords: Premixed flame stabilization; Hydrogen enrichment; Propane; Python; NOx emissions

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ENHANCED ACTIVE AND REACTIVE POWER CONTROL IN GRID-FOLLOWING INVERTERS USING OPEN-LOOP SYNCHRONIZATION AND PR REGULATOR FOR RENEWABLE ENERGY INTEGRATION

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Abstract

To ensure stable and high-quality power injection during the integration of renewable energy sources, advanced control of grid-following inverters (GFLIs) is crucial. This study proposes an enhanced active and reactive power control strategy for GFLIs that integrates a proportional-resonant (PR) current regulator with open-loop synchronization to thereby improve stability in weak grids. The open-loop synchronization technique simplifies grid current tracking and removes stability problems in weak grids, in contrast to traditional techniques, and simplifies the system dynamics. Concurrently, the stationary reference frame PR regulator provides precise power reference tracking with zero steady-state error and inherent harmonic compensation capabilities. The proposed control scheme is rigorously validated through MATLAB/Simulink simulations under various grid disturbances, including voltage sags and harmonic distortion. The results demonstrate superior transient performance, enhanced robustness, and excellent power quality. The method's ability to maintain stable operation and grid compliance confirms its significant potential for ensuring the reliable and high-performance integration of renewable energy systems.

Key words: Grid-Following Inverter, Renewable Energy Integration, Open-Loop Synchronization, Proportional-Resonant (PR) Controller, Active and Reactive Power Control, Power Quality.

THERMAL INSULATION AND ENERGY DEMAND IN MEDITERRANEAN CLIMATE ZONES

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Abstract

This study evaluates the impact of thermal insulation on the energy consumption of buildings located in Mediterranean climate zones. Experimental tests were conducted on the solar house installed at the Solar Equipment Development Unit (UDES) in Bou Ismail during both winter and summer seasons. Air temperatures recorded in various zones of the house were compared with results obtained through numerical simulations using TRNSYS software, allowing for the calibration of a reliable thermal model. This model was then used to simulate the addition of thermal insulation to the exterior walls and roof. As part of this study, the city of Algiers was selected as a reference site representative of the Mediterranean climate in northern Algeria. The results show that in winter, roof insulation leads to a 17% reduction in energy demand, more than twice the savings achieved by wall insulation (7%). In summer, wall insulation has a negligible effect (1%), while roof insulation results in a significant energy saving of 57%. These findings highlight the strategic importance of roof insulation in Mediterranean regions for improving the energy performance of buildings.

Keywords: Building – Energy efficiency – Simulations – Thermal insulation - Roof.

MODELING THE IMPACT OF ELECTRON TRANSPORT LAYER PROPERTIES AND ABSORBER DENSITY OF STATES ON PEROVSKITE SOLAR CELLS EFFICIENCY

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Abstract

In this study, a perovskite solar cell was simulated using SILVACO software to analyze the impact of the type and thickness of the electron transport layer (ETL) on the cell's performance. C60 and SnO_2 were used as ETL materials. The results showed that increasing the thickness of the C60 layer led to a noticeable decrease in cell efficiency, highlighting the importance of precise thickness control to reduce recombination and improve charge transport. In contrast, varying the thickness of the SnO_2 layer had no significant effect on performance, indicating the stability and effectiveness of this material over a wide range of thicknesses. The study also examined the effect of the density of states (DOS) in the valence band of the p-type absorber layer (perovskite solar cells) on the device performance. It was found that increasing the valence band density of states (N_v) from 1×10^{17} cm^{-3} to 1×10^{19} cm^{-3} results in a decrease in efficiency due to the rise in reverse saturation current and the reduction of open-circuit voltage, which ultimately lowers the power conversion efficiency.

Key words: Perovskite, density of states N_v, ETL, efficiency.

ENHANCED MAXIMUM POWER POINT TRACKING IN PV SYSTEMS USING PSO AND DANDELION OPTIMIZATION

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Abstract

Solar energy has emerged as a sustainable and eco-friendly alternative to conventional energy sources, with photovoltaic (PV) systems playing a critical role in harnessing this renewable resource. However, maximizing power extraction from PV arrays remains a significant challenge, particularly under partial shading conditions (PSCs), which introduce multiple local maxima in the power-voltage (P–V) curve. To overcome this, intelligent Maximum Power Point Tracking (MPPT) techniques have been developed. This paper presents a comparative analysis between two metaheuristic-based MPPT methods: Particle Swarm Optimization (PSO) and Dandelion Optimization Algorithm (DO). The performance of both algorithms is evaluated based on key metrics including convergence speed, tracking accuracy, and robustness in dynamic environmental conditions. MATLAB/SIMULINK simulations are conducted to validate the tracking capabilities of each method under various shading patterns. The results demonstrate that while both algorithms are effective in locating the Global Maximum Power Point (GMPP), the DO-based MPPT exhibits superior dynamic response, reduced steady-state oscillation, and higher tracking efficiency compared to the conventional PSO approach. These findings suggest that the dandelion-inspired optimization method holds significant promise for improving the performance and reliability of PV systems under real-world operating conditions.

Key words: Dandelion Optimization, Particle Swarm Optimization, Partial shading conditions, Photovoltaic (PV) systems, Global Maximum Power Point.

NUMERICAL ANALYSIS OF THE HIGH EFFICIENCY OF INGAN-BASED PHOTOVOLTAIC CELLS

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Abstract

The ternary alloy $In_xGa_{1-x}N$ is a promising candidate for modern electronics. Due to it modulation of energy band gap from UV to visible spectrum (0.7 eV - 3.4 eV) and its interesting absorption coefficient, it can be considered as a potential candidate for high efficiency solar cells.$In_xGa_{1-x}N$-based solar cell was studied and simulated by SCAPS-1D simulator using 1-sun AM1.5 illumination. This new cell structure consists mainly of indium gallium nitride in buffer layer and active layer, the window layer is formed by zinc oxide $In_xGa_{1-x}N$(P)/ $In_xGa_{1-x}N$(i)/ZnO (N). According to the numerical simulations carried out, we have optimized different optoelectronic parameters to improve the performance of the solar cell; we obtained the best results for a thickness of 1450 nm of active layer, n-doping $3*10^{18}$ cm^{-3} and 30% of indium concentration; we have reached an energy efficiency of 26,11%. The numerical simulations in this paper may be helpful for experimental studies of solar cell and the improvement of cell performance.So, this study investigates the great potential of InGaN solar cells and can be used for the design and manufacture of high efficiency III-nitride based solar cells.

Key words: $In_xGa_{1-x}N$, band gap, efficiency, simulations, solar cells

OPTIMIZING PHOTOVOLTAIC SYSTEMS: INTEGRATING ARTIFICIAL INTELLIGENCE AND THERMAL ANALYSIS

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Abstract
The global transition to renewable energy is vital for mitigating climate change and enhancing energy security. Among renewable sources, solar energy stands out due to its abundance and capacity to reduce reliance on fossil fuels. However, photovoltaic modules are frequently exposed to harsh environmental conditions. These stresses, along with the natural aging of components, can lead to decreased performance, accelerated degradation, and unexpected failures. This underscores the importance of efficient monitoring and maintenance strategies for PV systems. To address these challenges, integrating photovoltaic modeling with artificial intelligence techniques has gained considerable attention in recent scientific studies. AI-driven approaches offer enhanced capabilities for fault detection, anomaly identification, and predictive performance analysis, thereby extending the lifespan and reliability of PV installations. One particularly promising technique involves the use of infrared imaging based on thermal data. This method leverages the strengths of deep neural networks such as the DenseNet-121 architecture to process and analyze complex visual data. These networks can detect fine thermal anomalies, including hotspots and defective PV cells, that might not be apparent through conventional monitoring methods. The application of IR imaging, combined with AI models, allows for more precise, early-stage fault detection and proactive system maintenance. Such integration minimizes operational disruptions and reduces the risk of costly system failures. In conclusion, the synergy between renewable energy technologies and artificial intelligence presents a forward-looking approach to optimizing PV systems. This not only boosts energy efficiency but also ensures a more resilient and sustainable contribution to the global energy transition

Key words: Renewable energies, Photovoltaic (PV) systems, solar illumination, Artificial intelligence.

GASIFICATION BASED POWER GENERATION OF COMBINED EFGT-ORC SYSTEM FROM OLIVE POMACE IN TIZI OUZOU REGION : THERMODYNMIC AND ECONOMIC ANLYSIS

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Abstract
Each year, the olive oil industry generates a significant quantity of olive pomace, a solid residue resulting from olive trituration. This biomass, characterized by a high calorific value, is often either burned or discarded directly in the fields, leading to serious environmental concerns. In this study a theoretical modelling and simulation study of a small-scale CHP plant fuelled with olive pomace is conducted. The system comprises a 500 kW downdraft gasifier, a 100 kWe externally fired gas turbine (EFGT), and an Organic Rankine Cycle (ORC) as the bottoming unit. The produced syngas presents the following composition: CO=20%, H_2=16%, CO_2=11.98%, CH_4=2.98%, and N_2=48%, reaching a lower heating value (LHV) of 4.72 MJ/kg and a gasification efficiency of 73%. To maximize the electricity production, six ORC working fluids are analysed: cyclohexane, R113, R245fa, benzene, isopentane, and pentane. The results indicate that isopentane yields the highest power output with 35.4 kWe, increasing electricity generation from 75.8 kWe to 111.2 kWe and improving the overall plant efficiency from 16.41% to 23.48%. Additionally, an economic analysis is conducted, evaluating the project's profitability using four key parameters: net present value (NPV), profitability index (PI), internal rate of return (IRR), and payback period. The findings demonstrate favourable economic outcomes, primarily due to the low cost of the biomass fuel. Such systems represent an excellent solution to promote distributed power generation in rural areas.

Key words: Biomass, gasification, distributed power-generation, ORC, olive wastes, rural areas.

ASSESSMENT OF LOST ENERGY RECOVERY FROM METHANE EMISSIONS DUE TO ORGANIC WASTE BIODEGRADATION IN ORAN'S MUNICIPAL LANDFILLS (WEST ALGERIA)

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Abstract

This study focuses on the energy recovery potential lost due to the lack of organic waste valorization through anaerobic digestion in landfills. Specifically, it aims to estimate the quantity of methane that could be generated by the biodegradation of municipal solid waste (MSW) in three controlled landfills and one open dump in the Oran department (Western Algeria). Using four models—IPCC 1996, IPCC 2006 (FOD and DM), LandGem, and MTM—the study quantifies landfill gas (LFG) emissions and highlights the magnitude of untapped energy resources. Reliable estimations depend on the quality of model parameters and field data, which are critical for validating model outputs and selecting the most suitable approach.

From 1986 to 2018, the total methane emissions from the four sites were estimated at 904.81 Gg (IPCC-DM), 472.85 Gg (IPCC-FOD), 474.91 Gg (LandGem), and 289.93 Gg (MTM). These emissions represent a significant lost opportunity for energy generation. The corresponding electricity potential from the emitted methane was evaluated at 214.81 GWh (IPCC-FOD), 1921.98 GWh (LandGem), and 1111.64 GWh (MTM). These findings demonstrate the critical need to implement waste-to-energy strategies to capture and utilize methane, thereby transforming environmental liabilities into valuable energy resources and contributing to greenhouse gas mitigation.

Key words: methane emission, landfills, energy potentiel, municipal solide waste

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ENHANCED NONLINEAR SYSTEM CONTROL USING WCMFO-TUNED FUZZY LOGIC

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Abstract

In this paper, we propose using the Hybrid Water cycle moth-flame optimization (WCMFO) algorithm for optimal tuning of the membership function parameters of a Fuzzy Logic Controller (FLC) designed for a nonlinear system. Additionally, a performance comparison is made between the WCMFO-tuned FLC and a Particle Swarm Optimization (PSO)-tuned FLC. Analyses are based on three performance indices: the integral of square of errors (ISE), the integral of the absolute errors (IAE), and rise time (Tr). Simulation results demonstrate that the FLC tuned with the WCMFO algorithm achieves better performance, including faster response times and lower ISE and IAE values, compared to the PSO algorithm. In summary, the WCMFO algorithm shows effective capability for optimally tuning the membership function parameters of an FLC applied to nonlinear systems

Key words: WCMFO, PSO, Fuzzy Logic Controller (FLC), Nonlinear System, Optimization algorithms

IMPROVED CONTROL PERFORMANCE OF A DOUBLY FED INDUCTION GENERATOR IN WIND TURBINE SYSTEM BY COMPARISON BETWEEN THE SYNERGETIC AND BACKSTEPPING METHODS CONTROL

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Abstract:
In the last years, many generators are employed in wind turbine system to transform the mecanical energy resulting from the wind to electrical power. To control this generators, many linear and noninear control methods are proposed. However, this systems still incompleted stability through the effects of parametric variations, and wind speed variation. To solve this problem and ensure the robustness in the control power production, the comparison between deference control methods are used.
So our wind energy conversion system is based on a doubly fed induction generator (DFIG) with rotor fed by the electrical network through two converters. Firstly, we present the dynamic model of wind turbine connected to DFIG and grid system. Secondly, we used the synergetic control and the backstepping method to control the active and reactive power generated by DFIG. The comparison between this tow methods is proposed to proof and choose the best strategy of control. The simulation was done to confirm the reliability and effectiveness of the proposed strategies and methods for production power control.
Key words: Wind turbine, DFIG, backstepping, synergetic control, active and reactive power

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HYDROGEN GENERATION ON p-TYPE $CuCrO_2$ PHOTOCATALYST

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Abstract:
Herein, p-Type delafossite $CuCrO_2$ calcined at 1100 °C (CC1100) was synthesized through a coprecipitation route and investigated as a photocatalyst for hydrogen generation under visible-light irradiation. Its structural and textural properties were examined by XRD, BET, and SEM-EDS, while its optical and electrochemical behaviors were studied using UV-Vis spectroscopy, cyclic voltammetry, electrochemical impedance spectroscopy, and Mott-Schottky analysis. These comprehensive characterizations confirmed the p-type semiconducting nature of CC1100, together with an optimal crystallite size and a suitable band gap that ensure efficient absorption and conversion of visible photons. When tested in a basic NaOH medium, CC1100 displayed remarkable photocatalytic hydrogen production, demonstrating a clear relationship between its physicochemical features and catalytic efficiency. Furthermore, the material exhibited excellent stability and reproducibility, confirming its durability under irradiation. Overall, delafossite $CuCrO_2$ synthesized by coprecipitation and calcined at 1100 °C emerges as a promising, stable, and efficient photocatalyst for sustainable hydrogen production under visible-light conditions.

Key words: Delafossite $CuCrO_2$, Photocatalysis, Hydrogen production

ENERGY HARVESTING IN SWIPT-ENABLED UAV COMMUNICATIONS

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Abstract:
Unmanned Aerial Vehicles (UAVs) are increasingly integrated into the Internet of Things (IoT) due to their autonomy and mobility, enabling applications such as data collection, delivery, remote monitoring, and rescue operations. These tasks require reliable wireless connectivity, positioning UAVs as aerial users (AUes) within cellular networks, thus forming cellular-connected UAV systems. However, UAVs face stringent energy constraints owing to limited battery capacity. To address this challenge, radio frequency (RF) energy harvesting has emerged as a promising solution. In particular, simultaneous wireless information and power transfer (SWIPT) allows UAVs to receive both energy and information over the same wireless link, offering an efficient approach to enhance their operational sustainability.
This work investigates a downlink cellular-connected UAV network where AUes, uniformly distributed at a fixed altitude, are served by up-tilted ground base station (BS) antennas using SWIPT. A power splitting (PS) architecture is adopted, enabling AUes to decode information and harvest energy simultaneously, with a fraction $\tau \in (0,1)$ allocated to information and $1-\tau$ to energy harvesting. We derive analytical expressions for both the energy coverage probability (ECP) and the signal-to-interference-plus-noise ratio (SINR) coverage probability (SCP), assuming the typical AUe associates with the nearest BS while interference originates from all other BSs.
The analytical results validated by Monte Carlo simulations showed that ECP can be improved with a high density of BS. In addition, both of ECP and SCP can be improved by carefully adjusting the AUe altitude, positioning the SWIPT approach as a promising technology for greener and more sustainable UAV communication networks
Key words: Energy coverage, Energy harvesting, SWIPT, UAV

INNOVATIVE LEAD-FREE PEROVSKITE SOLAR CELL STRUCTURE WITH TWO ABSORBER LAYERS FOR NEXT-GENERATION RENEWABLE ENERGY APPLICATIONS

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Abstract:

This work presents an innovative lead-free perovskite solar cell structure designed to meet the growing demand for clean and sustainable renewable energy technologies. The proposed device integrates two perovskite absorber layers, selected for their non-toxic composition and photovoltaic potential. Comprehensive optimization of physical and structural parameters was performed using the SCAPS-1D simulation software, including absorber thickness, doping levels, defect densities, and interface quality.

The final architecture (FTO/HTL/perovskite1/perovskite2/ETL/Au) demonstrates excellent performance under standard test conditions (AM1.5G, 300 K), with an open-circuit voltage of 1.437 V, a short-circuit current density of 34.76 mA.cm^{-2}, a fill factor of 91.11%, and a power conversion efficiency of 45.51%. This study highlights the potential of lead-free perovskite solar cells as a promising new technology for renewable energy generation, combining environmental safety with high efficiency.

Key words: Renewable energy; Lead-free perovskite; High efficiency; Two absorber layers; SCAPS-1D simulation.

FPGA-BASED REAL TIME IMPLEMENTATION OF LYAPUNOV-BASED MODEL PREDICTIVE CONTROL FOR LCL FILTERED GRID-TIED INVERTER

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Abstract:
In recent years, the finite control set predictive control (FCS-MPC) has been widely adopted as an alternative strategy to handle the non-linearity of controlled system. Thus, the FCS-MPC suffers from the computational burden, which causes delay. This paper presents a Lyapunov-based MPC (LMPC) technique for an LCL-filtered grid connected inverter. The proposed control strategy addresses key limitations of the conventional FCS-MPC, including computational delay and stability guarantee. The incorporation of Lyapunov stability criterion on the multi-objective cost function ensures system stability while providing a precise control of the injected grid current. Additionally, a two-step prediction is applied to compensate for the inherent delay caused by computational operations, further improve the dynamic performance in real time. The proposed control algorithm is implemented and tested for real-time hardware-in-the-loop (HIL) co-simulation using two software environments (MATLAB/Simulink®) and Xilinx System Generator. The hardware tool used for real-time controller is Virtex-6 FPGA, interfacing the host PC and the FPGA kit through JTAG cable. Therefore, the LMPC control strategy is evaluated under different scenarios of studies covering steady-state performance, dynamic response, weak grid conditions (unbalanced and distorted grid voltage). Moreover, the control technique is verified for robustness under LCL filter parameters mismatching. The Simulation results demonstrate that the proposed LMPC delivered a high quality injected current and fast dynamic response with good robustness against stiff grid conditions and parameter variations. Alongside the improved performance of the suggested algorithm, the LMPC offers a significant reduction in computational time compared to classical FCS-MPC.

Key words: LMPC; LCL-filter inverter; grid-connected systems; HIL; Real-time control implementation.

EFFECT OF SOLAR RADIATION ON THE FLOW BEHAVIOR IN A SOLAR CHIMNEY POWER PLANT

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Abstract:
This study analysis the thermo-hydrodynamic behavior of a solar chimney power plant (SCPP), accentuating the effect of solar radiation on system performance. Based on the Manzanares prototype, a two-dimensional axisymmetric numerical model was performed using ANSYS Fluent. The Navier–Stokes equations were solved using the finite volume method, with turbulence effects represented by the standard k–ε model. A structured, non-uniform mesh was applied, and a mesh independence test confirmed the adequacy of a 48×400 grid. Validation of our results to the study of Pastohr et al. (2004) presents a good agreement, confirming the reliability of the computational study.The numerical investigation highlights solar radiation as the leading parameter driving the system's efficiency. As radiation augmented, the temperature gradient between the collector inlet and tower-chimney base rises, thus strengthening buoyancy forces and the stack effect. This system directly enhances airflow velocity at the chimney outlet, which is critical for turbine performance and electricity generation. furthermore, the mass flow rate through the system reveales a strong positive correlation with solar radiation intensity. The reaserches further illustrate that geometric factors, principally the chimney's height and radius, exert an important impact on flow distribution, pressure variation, and overall efficiency. Through a comprehensive parametric evaluation, the study provides practical insights into the optimization of SCPPs. The findings underline the significance of considering both environmental conditions and structural concept in order to maximize power output and operational reliability, offering guidance for future advances in the solar chimney technology.

Key words: Solar chimney, solar radiation, thermo-hydrodynamic behavior, CFD.

PHOTOELECTROCHEMICAL CONVERSION OF CO_2 INTO VALUE-ADDED CHEMICALS: ADVANCES AND PERSPECTIVES USING A Cu_2S@Sn CATALYST FOR IMPROVED SELECTIVITY

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Abstract:
The conversion of carbon dioxide (CO_2) into valuable chemicals using photoelectrochemical (PEC) processes is a promising strategy for combating climate change. This study focuses on recent advancements, particularly the development of a Cu_2S@Sn catalyst that enhances the selectivity of photoelectrochemical CO_2 reduction.
Our research demonstrates that this catalyst significantly improves the efficiency and selectivity of CO_2 reduction, facilitating the production of high-value-added chemicals such as formate and formic acid. We will present the synthesis and characterization of this catalyst using simple and cost-effective chemical methods such as chemical bath deposition (CBD) and hydrothermal synthesis, highlighting the synergistic effects between the Cu_2S core and the Sn outer layer, which optimize electron transfer and catalytic activity.We will also provide an overview of current photoelectrochemical CO_2 conversion technologies, highlighting the challenges and future research directions. By integrating our research findings with those of recent studies, we offer a forward-looking perspective on the crucial role that advanced catalysts can play in the sustainable utilization of CO_2.
This presentation will be of interest to students, researchers and professionals in chemistry, materials science, and renewable energy, and will foster discussions on the future of PEC technology for combating climate change.

Key words: CO_2 conversion, photoelectrochimical, value addeds chimicals, selectivity

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INFLUENCE OF CALCINATION ON STRUCTURAL AND ELECTROKINETIC PROPERTIES OF GREEN SYNTHESIZED NiO-ZnO NANCOMPOSITE

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Abstract:
We have studied the effect of calcination on the formation, structural and electrokinetic properties of NiO-ZnO naocomposite fabricated via green synthesis method using allium cepa and allium sativium extract as an eco-friendly and cost effective approach. The structural characterization of as synthesized samples was carried out using X-ray diffraction (XRD). From XRD spectra we revealed that the as-prepared sample is poorly crystalline, exhibiting broad peaks characteristic of hydrozincite and NiOxalate hydrate phases. **Moreover, a**fter calcination at 500 C° for 2 h, the XRD pattern of the sample is mainly composed of a sharp and intense diffraction peaks confirm the formation of a well-crystallized oxide phases within the NiO-ZnOnanocopmosite (NiO phase crystallizes in a cubic structure, while the ZnO phase exhibits a hexagonal Wurtzite structure). Also, the xrd spectrum presented an unaffected peak attributed to Ni phase observed at $2\theta = 44.63°$ in both samples. Surface electrokinetic properties were further investigated using zeta potential and electrophoretic mobility. Prior to calcination, the sample displayed a positive zeta potential of +5.2 mV and a mobility of +0.411 μm·cm/V·s, indicating a weakly stable colloidal suspension dominated by positively charged surface groups. Following calcination, the zeta potential shifted to –2.2 mV with a mobility of –0.175 μm·cm/V·s, suggesting charge inversion and reduction of colloidal stability due to the removal of hydroxyl and organic residues and exposure of oxygen-rich surfaces. These findings demonstrate that calcination not only enhances crystallinity but also significantly alters the surface chemistry and interfacial behavior of the material, with direct implications for its use in catalysis, electronic devices.

Key words: Green synthesis, allium cepa, allium sativium, NiO-ZnO, potentielzeta, calcinations.

HIGH-PERFORMANCE NICOP/GRAPHENE ELECTRODES FOR SUSTAINABLE HYDROGEN PRODUCTION VIA ALKALINE ELECTROLYSIS

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Abstract:
This work focuses on the development of high-efficiency NiCoP/graphene composite electrodes for sustainable hydrogen generation through alkaline water electrolysis. The electrodes were synthesized via a controlled electrochemical deposition technique and subjected to a comprehensive set of characterization methods, including SEM, XRD, Raman spectroscopy, and XPS, to confirm their morphological, structural, and compositional features. The introduction of graphene provided a highly conductive support with a large surface area, ensuring uniform deposition of NiCoP and enhancing electron transport. Electrochemical performance was systematically evaluated under different operational conditions using cyclic voltammetry, linear sweep voltammetry, Tafel slope analysis, and electrochemical impedance spectroscopy. The results revealed excellent charge transfer kinetics, high catalytic activity, and remarkable stability, even during prolonged operation.
A detailed investigation of the relationship between material composition, deposition parameters, and catalytic performance demonstrated the synergistic role of graphene in improving electrode conductivity, durability, and resistance to degradation. Furthermore, the optimized NiCoP/graphene electrodes exhibited lower overpotentials and reduced charge-transfer resistance compared to pristine NiCoP, confirming the beneficial effect of the hybrid structure. The study also highlights the scalability of the deposition process, making it suitable for cost-effective fabrication of large-area electrodes.
These findings demonstrate the promising potential of NiCoP/graphene composites as efficient, durable, and low-cost electrocatalysts for alkaline hydrogen evolution. The results provide valuable insights into the rational design of advanced transition metal phosphide–based electrodes, paving the way toward their integration into practical, scalable, and sustainable hydrogen production technologies for future clean energy systems.

Key words: Green hydrogen, Alkaline electrolysis, NiCoP/graphene composite, Electrode materials, Renewable energy technology.

STUDY ON A PILOT PROJECT OF A SOLAR PLANT IN SOUTH ALGERIA

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Abstract

We particularly focused in this work on the understanding of the effects that temperature variations can have on the efficiency and energy production of photovoltaic systems. This research examines how high and very high ambient temperatures reduce the open-circuit voltage and the overall efficiency of photovoltaic panels of different technologies using two methods: a simulation method and a real-data-based method. The objective is to provide practical recommendations to optimize the performance of photovoltaic panels in different climatic environments and to address global and sustainable environmental issues like air pollution and the greenhouse effect, which are known to be mitigated by using renewable energy sources. We particularly focused our work on southern Algeria regions, which are characterized by high temperatures and high temperature gradients, two distinct photovoltaic technologies—nanotechnology-based panels made of CIGS thin films in addition to conventional crystalline-based panel such as polycrystalline and monocrystalline PV panels are examined and contrasted.

Key words: Pilot plant, solar energy, photovoltaic, thin films

PREDICTIVE GAUSSIAN–POLYNOMIAL MODELING OF TJ DISCHARGES IN HV INSULATORS: FROM PHYSICAL INTERPRETATION TO DESIGN INSIGHTS

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Abstract:
This paper presents a predictive modeling framework for electric discharges at triple junctions (TJs) in high-voltage (HV) insulators composed of silicone, hear tempered glass, and porcelain. A hybrid Gaussian–polynomial regression approach is employed to simulate the maximum discharge current (Imax) as a function of voltage application time, surface condition, and electrode diameter. The Gaussian model captures transient discharge behavior related to surface degradation and moisture absorption, while the polynomial model quantifies geometric effects on electric field distribution and intensity. The models, validated through RMSE, MAPE, and adjusted R^2, demonstrate high accuracy, robustness, and physical consistency. The simulation results provide valuable insight into electro-thermal aging mechanisms, field mitigation strategies, and optimal insulation geometry. This methodology supports design improvements aimed at reducing discharge activity and extending the service life of HV insulation systems. Furthermore, the proposed approach facilitates predictive diagnostics and enhances the reliability of insulation in harsh environmental and high-voltage operating conditions.

Key words: Triple junction discharges; High-voltage insulators; Gaussian regression; Polynomial regression; Electro-thermal aging; Design optimization.

INTELLIGENT CONTROL AND OPTIMIZATION OF BIDIRECTIONAL POWER CONVERTERS IN ISOLATED HYBRID RENEWABLE ENERGY SYSTEM

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Abstract:

This research introduces an advanced control paradigm for bidirectional power converter within autonomous hybrid renewable energy systems, leveraging the capabilities of Artificial Intelligence (AI) to optimize DC bus voltage stability. The system architecture integrates a Photovoltaic Generation Unit (PVS), a Wind Energy Conversion Module (WECS), a Battery Energy Storage System (BESS), and multiple power electronic stages to ensure maximum energy capture from the available resources. The control strategy employs an Adaptive Network-based Fuzzy Inference System (ANFIS) to enhance the dynamic and steady-state performance of the DC bus. Comprehensive comparative assessments against conventional Proportional–Integral (PI) and Fuzzy Logic Control (FLC) schemes reveal that the proposed method significantly suppresses voltage ripple, accelerates transient response, and mitigates overshoot phenomena. The effectiveness of the control framework has been substantiated through detailed numerical modeling and simulation using the MATLAB/Simulink environment.

Key words: Bidirectional converter,Wind system, Storage system, PV, ANFIS, Performance.

FPGA-BASED REAL TIME IMPLEMENTATION OF LYAPUNOV-BASED MODEL PREDICTIVE CONTROL FOR LCL FILTERED GRID-TIED INVERTER

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Abstract:
In recent years, the finite control set predictive control (FCS-MPC) has been widely adopted as an alternative strategy to handle the non-linearity of controlled system. Thus, the FCS-MPC suffers from the computational burden, which causes delay. This paper presents a Lyapunov-based MPC (LMPC) technique for an LCL-filtered grid connected inverter. The proposed control strategy addresses key limitations of the conventional FCS-MPC, including computational delay and stability guarantee. The incorporation of Lyapunov stability criterion on the multi-objective cost function ensures system stability while providing a precise control of the injected grid current. Additionally, a two-step prediction is applied to compensate for the inherent delay caused by computational operations, further improve the dynamic performance in real time. The proposed control algorithm is implemented and tested for real-time hardware-in-the-loop (HIL) co-simulation using two software environments (MATLAB/Simulink®) and Xilinx System Generator. The hardware tool used for real-time controller is Virtex-6 FPGA, interfacing the host PC and the FPGA kit through JTAG cable. Therefore, the LMPC control strategy is evaluated under different scenarios of studies covering steady-state performance, dynamic response, weak grid conditions (unbalanced and distorted grid voltage). Moreover, the control technique is verified for robustness under LCL filter parameters mismatching. The Simulation results demonstrate that the proposed LMPC delivered a high quality injected current and fast dynamic response with good robustness against stiff grid conditions and parameter variations. Alongside the improved performance of the suggested algorithm, the LMPC offers a significant reduction in computational time compared to classical FCS-MPC.
Key words: LMPC; LCL-filter inverter; grid-connected systems; HIL; Real-time control implementation

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TECHNICAL AND ECONOMIC COMPARISON OF PHOTOVOLTAIC PUMPING AND LOW-VOLTAGE GRID-POWERED PUMPING IN SEMI-ARID AREAS

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Abstract:
In semi-arid areas, the water requirements of agricultural farms necessitate reliable pumping systems despite low rainfall, strong summer demand, and prolonged droughts. The choice between a photovoltaic system and a low-voltage grid-powered pumping system cannot be limited to technical considerations alone. The economic assessment, based on Life Cycle Cost, compares investment, operation, maintenance, and end-of-life costs in order to identify the most cost-effective and sustainable solution. In Batna (eastern Algeria), a pumping system is designed for 46 m³/h and 154 m of HMT. It uses a 30 kW motor pump with a 37 kW VFD. Hydraulic energy reaches 73.44 kWh/day, or 119 kWh/day of electricity (62% efficiency), representing 43,435 kWh/year. In economic terms, the initial investment amounts to 6,180,100 DA for the grid, compared to 3,222,500 DA for PV. The implementation cost is estimated at 2,472,040 DA for the grid and 966,750 DA for PV. The grid adds an annual energy cost of 92,038.77 DA, absent in the PV system. Annual maintenance costs amount to 309,005 DA for the grid, compared to only 96,675 DA for the PV system. Over a 25-year analysis period, the total discounted cost amounts to 24,205,528 DA for the grid and 15,723,005 DA for PV, representing a saving of more than 8 million DA. The cost per cubic meter of pumped water is 6.89 DA/m³ for PV compared to 10.61 DA/m³ for the grid, representing a saving of 35%. Photovoltaic pumping is therefore a reliable, sustainable, and economically advantageous solution for farms in semi-arid areas.
Key words: Solar photovoltaic, PV pumping sizing, low-voltage network, life cycle cost

IMPACT OF INSERTING A BUFFER LAYER BETWEEN THE β-Ga_2O_3: Si DRIFT REGION AND THE 4H-SIC SUBSTRATE IN A SOLAR-BLIND SCHOTTKY BARRIER ULTRAVIOLET PHOTODETECTOR

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Abstract:
An IZTO/β-Ga_2O_3 solar-blind Schottky barrier diode photodetector was exposed to a wavelength of 255 nm, and the dark case was simulated. Numerical simulations have successfully reproduced the measured photocurrent at reverse bias by considering several factors such as conduction mechanisms and material parameters. This study investigated the effect of inserting a buffer layer between the β-Ga_2O_3:Si drift layer and the 4H-SiC substrate for J-V characteristics, responsivity, and IQE. Additionally, the study extracted other pertinent metrics such as time-dependent photo response (T-D PhR) and relationships between current density responsivity, IQE, and light power density. These simulations were crucial in understanding the fundamental factors influencing the device's operational performance.Recent research has shown that buffer layers are employed to reduce the mismatch between the substrate and the active layer, thereby improving the quality of film crystallization and enhancing device performance. Therefore, it was proposed to incorporate an intrinsic thin buffer layer from the same 4H-SiC substrate material. This buffer layer would be strategically placed between the β-Ga_2O_3:Si drift layer and the 4H-SiC substrate. The J-V characteristic shows a significant four-fold increase in photocurrent when adding a buffer layer. We found that the phenomenon of saturation is detected more slowly in the device equipped with a buffer layer. This indicates that the carrier recombination rate is higher, delaying the onset of saturation. A decrease in the electronic affinity of the buffer layer results in a gradual increase in ϕ_B. Consequently, the photocurrent density decreases in reverse bias.

Key words: Solar-blind,Numerical simulations,reverse bias,buffer layer,β-Ga_2O_3:Si drift layer,4H-SiC substrate.

Exploring R1234yf–Al2O3 Nanorefrigerants as a Low-GWP Alternative to R134a in VCRS

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Abstract:
This study examines the performance of a vapour compression refrigeration system (VCRS) using R134a and R1234yf refrigerants enhanced with Al2O3 nanoparticles at a concentration of 5 wt%. Within the objective of evaluating the influence of higher nanoparticle concentration on the system behaviour, at the same time to examine whether R1234yf can serve as a promising replacement for R134a. A MATLAB code linked with the REFPROP database was used to simulate thermodynamic performance, while compressor power, coefficient of performance (COP), and evaporator heat absorption were analyzed together with an economic assessment. The obtained results demonstrated that incorporating 5 wt% of Al2O3 nanoparticle improved the COP by about 4% for both refrigerants compared to their pure forms, while compressor power consumption decreased from 7.05 kW to 6.31 kW for R134a and from 7.40 kW to 6.74 kW for R1234yf. In contrast, the absorbed heat by the evaporator remained constant at around 30.2 kW, which confirm that cooling capacity was preserved even at higher nanoparticle loading. Overall, the incorporation of 5 wt% Al2O3 led to significant improvements in terms of system's efficiency and compressor power consumtion. On the other hand, R1234yf–Al2O3 nanorefrigerants showed similar performance as the one showed by the refrigerant R134a, but at the same time ensuring a nearly zero global warming potential, which make it a promising replacement for next generation refrigeration systems.

Key words: VCRS, Nanorefrigerants, R1234yf, R134a, Al2O3, COP.

NUMERICAL STUDY OF Cs_2TiBr_6 -based solar cell.

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Abstract:
Herein, we propose a numerical study of a lead-free and eco-friendly perovskite-based solar cell, which architecture design is as follow: FTO/ZnO/Cs_2TiBr_6/$MoSe_2$/Go. The photovoltaic characteristic of the device was simulated utilizing the solar cell capacitance simulating software (SCAPS 1D). The effect of varying several parameters was studied in order to enhance the performance of this model, such as the absorber (Cesium Titanium Halide), electron transport material and hole transport material thickness, the defect density of the absorber, back metal work function and the operating temperature. The results showed that the performance of the device enhanced by optimizing the absorber thickness and defect density. A higher density represents a poorer performance of the device. The cell showed good photovoltaic properties at low temperatures. It was also noticed that metallic work function contacts made with gold (Au) and carbon (C) showed higher PCE. After all simulations were done, and with the optimum values of each parameter, we obtained the following photovoltaic properties: an open circuit voltage of 0.81V, a fill factor of 84.66 %, the short circuit current density was 23.48 mA/cm² and the power conversion efficiency was 16.16 %. This device represented a higher power conversion efficiency compared to other simular solar cells that have been investigated in other papers.

Keywords: Perovskite; solar cells; Cesium Titanium Halide; SCAPS, numerical simulation; hole transport layer.

OMPARATIVE PERFORMANCE ANALYSIS OF NATURE-INSPIRED MPPT ALGORITHMS FOR STANDALONE PV SYSTEMS

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Abstract:

The photovoltaic (PV) system plays a crucial role in the power system by offering clean and sustainable energy, thereby reducing environmental pollution associated with conventional energy sources. However, the performance of such nonlinear systems is highly sensitive to changes in solar radiation and temperature, making it difficult to extract maximum power. To overcome these limitations, maximum power point tracking (MPPT) algorithms are employed to optimize maximum power extraction of a PV system. This paper presents a comparative study of four metaheuristic optimisation algorithms: particle swarm optimization (PSO), genetic algorithm (GA), cuckoo search (CS), and dandelion optimiser (DO), applied to track the maximum power point (MPP) of a standalone PV array. The tracking performance of these techniques is evaluated based on the convergence time, tracking accuracy, and steady-state stability under both standard test conditions (STC) and dynamic irradiation conditions. This study is conducted using MATLAB/Simulink 2021a, and the simulation results demonstrate that all algorithms effectively track the global maximum power point (GMPP), while the DO exhibits better performance in terms of convergence speed, tracking efficiency, and stability.

Key words: MPPT, Photovoltaic, PSO, DO, CS,GA.

ADAPTIVE BACKSTEBBING CONTROL OF DOUBLY FED INDUCTION GENERATOR (DFIG) IN WIND ENERGY BASED ON LYAPUNOV THEORY STABILITY

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Abstract
The growth of electrical energy consumption and high power electrical applications imposed researchers to find alternative ways to create energy as wind, who is one of the most important and promising source of renewable energy all over the world, but it is perturbed. The control of wind energy conversion system (WECS) constitutes a vast subject and is more complex than those of DC drives. Furthermore; traditional control techniques can be advantageous in one direction and disadvantageous in another, because the dynamic (DFIG-Wind Turbine) is more complex and praticly the DFIG parameters to be controlled are difficult to determine or vary over time. Which affect the control, at present adaptive control is of great importance in the control domain, this control is dominant in systems with uncertainties, structural disturbances and environmental variations. The main object of adaptive control is the synthesis of adaptation law, in order to automatically adjust loop controllers in real time. This is to achieve or maintain a certain level of performance.
In order to improve the performance and control of the active and reactive powers generated by the DFIG, a robust hybrid Adaptive backstepping controller was proposed. The objective is to show that the proposed technique can improve performances of DFIG in terms of reference tracking, and adaptive estimation of the internal parameters generator, sensibility to perturbations and robustness against machine parameters variations. The results obtained by simulation prove the effectiveness of the control strategies in terms of decoupling, robustness and dynamic performance for different operating conditions.

Key words: Double Feed Induction Generator, Nonlinear Control, Adaptive Backstepping control.

ARTIFICIAL BEE COLONY-OPTIMIZED CONTROL FOR PERFORMANCE IMPROVEMENT OF A MULTICELL INVERTER IN A FUEL CELL SYSTEM

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Abstract:
The performance of power electronic interfaces, especially multi-cell inverters, is crucial for the stability and efficiency of contemporary renewable-energy microgrids. A significant challenge lies in the complex tuning of their control systems to ensure high performance. This paper addresses this challenge by exploring the use of advanced metaheuristic optimization, specifically the Artificial Bee Colony (ABC) algorithm, for the optimal parameter tuning of a novel adaptive controller designed for a multi-cell inverter integrated with a fuel cell source. The primary goals of this optimization are to minimize the output voltage's total harmonic distortion (THD) and to significantly enhance the system's dynamic response to sudden changes in load and generation. The proposed approach enables the ABC algorithm to autonomously identify the ideal controller parameters, thereby ensuring robust and superior performance across a wide spectrum of operating conditions, including both grid-connected and islanded modes. Consequently, this research establishes a practical framework for applying artificial intelligence-driven tuning methodologies to advance the capabilities of power converters, ultimately contributing to more reliable and high-quality power delivery in modern microgrid systems.

Key words: Metaheuristic Optimization, Fuel Cell System, Multicell Inverter, Adaptive Control, Microgrid, Artificial Bee Colony.

PREPARATION AND CHARACTERIZATION OF $CoAl_2O_4$ AS AN EFFICIENT PHOTOCATALYST FOR HYDROGEN GENERATION THROUGH THE WATER-SPLITTING PROCESS

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Abstract:
In In this study, $CoAl_2O_4$ nanoparticles were synthesized via the sol-gel method, using propionic acid as a chelating agent. The structural, morphological, compositional, and optical properties of the material were analyzed using X-ray diffraction (XRD), Fourier-transform infrared (FT-IR) spectroscopy, UV-visible diffuse reflectance spectroscopy (DRS), and scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy (SEM-EDX). XRD analysis confirmed the formation of a pure spinel phase with a particle size estimated to be 35 nm, while SEM images revealed a sheet-like morphology with low porosity. EDX confirmed the expected elemental composition of cobalt (Co), aluminium (Al), and oxygen (O). Additionally, X-ray photoelectron spectroscopy (XPS) analysis suggested the presence of Co (II), Al (III), and O, consistent with the expected spinel structure and its chemical environment. The photocatalytic activity of $CoAl_2O_4$ was assessed through hydrogen evolution experiments. The highest hydrogen production was achieved at pH ~12, yielding 182 µmol, whereas in a neutral medium (pH ~7), the release was 127 µmol. These experiments were conducted under visible light irradiation at an optimal temperature of 50°C.

Key words: $CoAl_2O_4$; Sol-gel; Spinel; Photocatalytic activity; Hydrogen evolution.

THERMAL PERFORMANCE EVALUATION OF CONCENTRIC, ECCENTRIC, AND SINUSOIDAL TUBES IN PCM-INTEGRATED PTCS"

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Abstract
This study investigates parabolic trough collectors (PTCs) using phase change materials (PCMs) with concentric, eccentric, and sinusoidal receiver tubes, showing that the sinusoidal configuration achieved the highest HTF outlet temperature (144.19°C), surpassing the concentric and eccentric designs by 54.8% and 106.1%, respectively. It also attained the highest PCM liquid fraction (90.25%), exceeding the concentric by 5.96% and the eccentric by 8.75%, while the concentric outperformed the eccentric by 2.62%. In terms of thermal efficiency, the sinusoidal tube led with 70.65%, improving over the concentric and eccentric by 7.7% and 6.7%, respectively. These results confirm that pipe geometry significantly influences heat absorption, PCM activation, and thermal performance. The eccentric tube showed a slight improvement over the concentric tube in efficiency by 0.91%, indicating modest gains. Overall, the sinusoidal tube provided the most balanced and efficient performance. These findings reinforce the value of geometric optimization in enhancing the durability and effectiveness of solar thermal systems.

Keywords: parabolic trough collector ; Thermal energy storage ; Phase change materials; Heat Transfer Fluid; Receiver Tubes (Concentric,Sinusoidal and Eccentric); Thermal efficiency.

APPLICATION D'UN PLAN D'EXPERIENCES DE TYPE BOX-BEHNKEN POUR OPTIMISER LES CONDITIONS DE PRODUCTION DU BIODIESEL

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Résumé:
La diminution des réserves de combustibles fossiles et une sensibilisation accrue aux conséquences des émissions de gaz à effet de serre sur l'environnement ont engendré un besoin urgent de découvrir des sources d'énergie autres, renouvelables et non polluantes. Parmi ces choix, le biodiesel apparaît comme une alternative de carburant propre.
Cette étude vise à optimiser les conditions de production de biodiesel à partir d'huiles de cuisson usagées grâce à un catalyseur hétérogène à base d'oxyde de calcium (CaO) dérivé de coquilles de moules. Pour ce faire, nous avons appliqué la méthodologie du plan d'expérience Box-Behnken, qui permet d'évaluer l'influence de plusieurs facteurs tout en minimisant le nombre d'expériences nécessaires.
L'optimisation a révélé que les conditions idéales pour maximiser le rendement en biodiesel étaient : une masse de catalyseur de 1,13 g, un rapport éthanol/huile de 4:1, une température de 63 °C et un temps de réaction de 62 minutes. Ces conditions ont permis d'atteindre un rendement maximal de 95,05 %.
L'analyse de variance (ANOVA) a été utilisée pour valider le modèle et a montré que les interactions entre les paramètres étaient significatives, soulignant l'importance d'une approche systématique pour l'optimisation des processus de production de biodiesel. Cette recherche démontre l'efficacité du plan Box-Behnken dans l'optimisation des paramètres de réaction, contribuant ainsi à des méthodes de production de biodiesel plus durables et efficaces.

Mots clés: Biodiesel, Optimisation, plan Box-Behnken, Transestérification, Huiles de cuisson usagées, CaO, Coquilles de moules.

DATA-DRIVEN POROSITY ESTIMATION USING ANN BASED ON WELL LOGS FROM HASSI MESSAOUD

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Abstract:
The Hassi Messaoud Basin, located in southeastern Algeria, is among the most prominent hydrocarbon-rich regions in North Africa. Due to its complex lithological and structural settings, accurate reservoir characterization remains a critical challenge. This study investigates the application of Artificial Neural Networks (ANN) for predicting porosity using well log data obtained from a single exploratory well within the basin. A dataset consisting of 300 samples was extracted from four conventional well log measurements: Gamma Ray (GR), Bulk Density (RHOB), Neutron Porosity (NPHI), and Sonic Transit Time (DT). The data were divided into two subsets: 80% for training the ANN model and 20% for testing its predictive capability. The network architecture comprises one input layer with four neurons, a single hidden layer with ten neurons, and one output layer corresponding to the target porosity values. The model demonstrated strong predictive performance, achieving a coefficient of determination (R^2) of 0.89, a Mean Absolute Error (MAE) of 0.014, and a Root Mean Squared Error (RMSE) of 0.019 on the test dataset. These results highlight the potential of ANN-based approaches in enhancing reservoir property estimation when traditional petrophysical analysis is limited. This work underscores the viability of machine learning techniques in subsurface characterization and encourages further exploration using larger datasets and multiple wells to improve generalization and robustness.

Keywords: Porosity, Artificial Neural Networks (ANN) ,Well Logs ,Hassi Messaoud Field ,Machine Learning.

IMPROVING TOTAL SUGARS RECOVERY FROM LIGNOCELLULOSIC BIOMASS THROUGH INNOVATIVE PRETREATMENT METHOD

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Abstract:

Lignocellulosic biomass is considered as a promising raw material for biofuel and bioproducts, but its complex structure limits the direct release of sugars. Pretreatment is therefore an essential step to make cellulose and hemicellulose more accessible for further conversion. This work investigates the potential of carob biomass as a source of fermentable sugars for biofuel production using microwave-assisted pretreatment. Two power levels were tested, 450 W and 600 W, with a biomass loading of 10%. The raw material was first characterized, showing 10.6 ± 0.4% moisture, 89.4 ± 0.4% dry matter, 2.79 ± 0.2% ash, 97.20 ± 0.2% organic matter, 40.78 ± 0.04% total sugars, and 4.98 ± 0.4% proteins. Microwave treatment significantly enhanced sugar release, with the highest concentration obtained at 600W from te finest carob powder (250µm), reaching 78.25 g/L of total sugars. These findings highlight the efficiency of microwave irradiation in weakening the rigid structure of biomass and facilitating the release of fermentable sugars. The approach accelerates hydrolysis while lowering chemical demand compared with conventional pretreatment strategies.

Key words: Biomass, Bioethanol, Pretreatment, Microwave.

PV PLANT POWER QUALITY IMPROUVEMENT USING FLC APPLIED ON DRILLING SYSTEM

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Abstract:
This work focus on regulation of the parallel active power filter (APF) Dc Voltage bus by judicious choice of rule bases and intervals for each selected fuzzy variable of suitable fuzzy logic controller. A direct application to the APF capacitor voltage regulation with their simulation, by MATLAB, applied to PV power conversion chain network in the case of a non-linear load, to show the effectiveness of this kind of regulators on electrical power quality and improve the reliability of the APF on PV power system harmonic minimization on Drilling systeme electrical part.
Pv system is Modeled then simuled under MATLAB/Simulink with the control systeme based on fuzzy logic controller designed after analyse of each part of the drilling systeme top drive and the well choose of member sheep function of each linguistigues input and output.
Simulation results are analysed and discussed to improove the effictifnes off the fuzzy logic controller on power quality improuvement of the top drive machine.

Key words: Power quality, FLC, Top Drive, Regulation, Drilling.

EVALUATION OF THE TREATMENT EFFICIENCY OF AN EXTENSIVE WASTEWATER SYSTEM: CASE STUDY OF THE AERATED LAGOON PLANT IN REGUIBA (EL OUEDREGION)

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Abstract

Amid growing water scarcity and tightening environmental regulations, wastewater treatment has become a critical challenge in arid regions. This study evaluates the operational performance of the Reguiba wastewater treatment plant in El Oued, Algeria, which employs an aerated lagoon system an extensive, energy-efficient technology particularly suited to regions with high solar radiation and low precipitation. A multi-week monitoring campaign was conducted to assess key physico-chemical indicators at both influent and effluent points, including biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), suspended solids (SS), pH, and electrical conductivity. The results demonstrate high treatment efficiency, with average removal rates of 80% for SS, 81% for BOD_5, and 85% for COD. pH values remained stable, indicating effective process control, while electrical conductivity exhibited minimal variation, reflecting the system's limited capacity for dissolved salt removal. The plant generally complies with Algerian discharge standards, though episodic exceedances may occur under hydraulic overload or operational disturbances. The findings confirm the relevance of aerated lagoon systems in arid environments, emphasizing their low energy requirements, operational simplicity, and adaptability to high ambient temperatures. However, limitations were noted in nutrient and micropollutant removal, as well as sensitivity to climatic fluctuations. Continuous monitoring and optimized design are essential to ensure reliable long-term performance.

Key words: Aerated lagoons, Wastewater treatment, arid regions, Treatment efficiency.

APPLICATION OF A NOVEL SCHIFF BASE LIGAND FOR THE REMOVAL OF TOXIC METALS FROM CONTAMINATED WATER SOURCES

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Abstract

The increasing presence of heavy metals in water sources represents a growing threat to both ecosystems and human health. These metals are not only toxic and resistant to natural degradation but also have the ability to bioaccumulate, making their removal both urgent and challenging. Their persistence in aquatic environments makes them a significant concern from both analytical and environmental standpoints. Conventional methods for heavy metal removal often suffer from low selectivity or require complex procedures, complicating their large-scale implementation. As a result, developing more efficient and selective approaches is crucial to addressing this pressing environmental and public health issue. In this work, we report the synthesis and application of a thiosemicarbazone-based Schiff base ligand (DHCT) for the selective complexation of metal ions in aqueous solutions. The ligand was synthesized through standard condensation methods and characterized using IR, ^{1}H NMR spectroscopy, and single-crystal X-ray diffraction (XRD). Structural confirmation supports the intended molecular design and coordination capabilities. The ligand exhibited strong chelating behavior toward divalent metal ions such as Cu (II), Pb(II), and Cd(II), suggesting potential utility in trace metal detection and remediation. This study underlines the efficiency of Schiff base ligands in analytical and environmental applications, particularly for the selective removal of hazardous metals from water.

Key words: Heavy metals, Complexation, Thiosemicarbazone, DHCT, Spectroscopy, Water remediation.

EVALUATING THE EFFECTIVENESS OF DIFFERENT ADVANCED OXIDATION PROCESSES (AOPS) FOR TREATING REAL REFINERY WASTEWATER

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Abstract
This study aims to explore the viability of implementing Advanced Oxidation Processes (AOPs) for the treatment of Algiers refinery effluent, given their emerging reputation as highly efficient methods for removing contaminants from effluents, attracting substantial global attention in recent years. The study investigated the oxidative degradation of refinery wastewater through four processes: direct UV, UV/H_2O_2, UV/persulfate (UV/PS), and the photo-Fenton process. The results indicate that UV/H_2O_2 and UV/PS treatments significantly enhanced COD, turbidity, and TSS removal compared to UV treatment alone, while the photo-Fenton process demonstrated satisfactory performance in reducing COD, TOC, and BOD by 95%, 98%, and 95%, respectively. Moreover, it demonstrated a higher efficiency in removing TSS and turbidity. Notably, the results from the photo-Fenton process in the presence of H_2O_2 not only met but exceeded rejection standards, opening the possibility for the potential reuse of the treated water.

Keywords: Petroleum refinery, Advanced Oxidation Processes, UV/H_2O_2, UV/persulfate (UV/PS), and the photo-Fenton

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REVIEX ON THE APPLICATION OF LAMELLAR DOUBLE HYDROXYDE MATERIALS IN PHOTOCATALYSIS

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Abstract

Nowadays, humanity is faced with severe pollution caused by uncontrolled urban, agricultural, or industrial wastewater, which requires the continuous development of effective and inexpensive remediation methods. Advanced oxidation processes are therefore emerging in purification technology, involving several oxidation techniques and processes. Heterogeneous photocatalysis is an advanced oxidation process that has gained considerable attention in recent years. It offers the advantage of using clean and free energy (sunlight) to degrade pollutants into non-toxic or less toxic products. Several articles report the degradation of various pollutants using this technique, suggesting a wide range of photocatalysts. The materials used are characterized by their high stability, variable structure, non-toxicity, and low cost. Lamellar double hydroxides (LDHs) have gained considerable importance in photocatalysis in recent years, and their photocatalytic activity is widely covered in the literature. This work presents a literature review that summarizes some articles reporting HDLs in photocatalytic applications.

Key words: Photocatalysis, Advanced Oxidation Process, Lamellar Double Hydroxydes, Conductive Materials.

POLLUTANT LOADS RETENTION BY A TUBULAR MEMBRANE BASED ON KAOLIN CLAY

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Abstract
This work is based to the development of a tubular membrane based on natural clay wich is kaolin. The first part of this work is devoted to the development of tubular support by mixing the kaolin powder, organic additives with water and extruding ceramic paste. The support is sintered at different temperatures using a themal program. The membrane is developed by deposition inside of tubular support. The results of mechanical resistance and the permeability test study as a function of sintering temperatures shows that the tubular support obtained by kaolin is consolited at the optimal temperature (1000 °). The tubular support has the maximum water permeability (1420.12 L/m^2.h.bar), the permeability test performed on the membrane deposited on kaolin indicate that this latter is a microfiltration membrane. We demonstrated that the membrane shows high efficiency for the clarification and retention of several pollutant loads of a cheese effluent.

Key words: Clay, Membrane, Microfiltration, Retention, Effluent.

ELABORATION ET CARACTERISATION DE LA BENTONITE MODIFIEE PAR CHLORURE D'ALUMINIUM : ETUDE DE LA RÉTENTION DU BIS-PHENOL A

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Abstract
Les activités industrielles présentent une problématique très importante et contribuent d'une façon générale à la pollution de l'environnement par les rejets industriels tels que les hydrocarbures, phénols et leur dérivés, colorants..., ou agricole (pesticides, engrais...). Son impact négatif sur les écosystèmes et sur la santé publique est devenu une grande inquiétude à l'échelle mondiale. Le bisphénol A (BPA) est un composé organique. La molécule contient deux groupements fonctionnels alcooliques (phénol) et fait partie des composés organiques aromatiques. Actuellement, on compte un nombre important d'adsorbants d'élimination de ces composés organique aromatique tels que les zéolites naturelles ou synthétique, charbon actif, bioadsorbants, les résines et aussi les argiles. En effet, ces derniers sont matériaux connus par leur abondance, leurs propriétés d'échange ionique et leur capacité d'absorption élevée. Cette étude a pour l'objectif d'améliorer le pouvoir d'élimination de BPA en solution aqueuse par adsorption sur l'argile modifiée par chlorure d'aluminium selon le rapport molaire ($\frac{OH}{AL} = 2.5$). Concernant notre travail, nous avons réalisé tout d'abord les cinétiques d'adsorption afin de déterminer le temps de contact entre adsorbant et adsorbat à l'équilibre. L'étude de l'adsorption BPA présente la courbe cinétique qui montre une adsorption plutôt rapide avec ces matériaux argileux. La capacité de fixation de ce polluant est d'ordre 60 mg/g. L'analyse de cinétique de processus d'adsorption indique une réaction rapide avec un pseudo second ordre et une étape limitante de type diffusionnelle.

Key words: Adsorption, Argile, BPA, Chlorure d'aluminium, Cinétique, Environnement.

MODIFIED SILICON NANOPARTICLES WITH CEO_2/NIO AS A PHOTOCATALYST FOR THE DEGRADATION OF TETRACYCLINE

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Abstract
The purification of wastewater polluted with antibiotics using photocatalysis techniques has been the subject of much recent research. Numerous kinds of photocatalysts have been investigated in this context. In this study, silicon nanowires (SiNWs) were created using a hydrothermal process, coated with nickel oxide (NiO) and cerium oxide (CeO_2), and employed as novel photocatalysts to break down tetracycline (TC), a stubborn antibiotic, when exposed to visible light. The prepared samples were characterized by scanning electron microscopy (SEM) coupled with energy dispersive X-ray spectroscopy (EDS), X-ray diffraction, X-ray photoelectron spectroscopy and UV–Vis spectrophotometry. According to these characterizations, SiNWs have a good coating of NiO and CeO2 along their whole length. After being exposed to visible light for 120 minutes, TC degraded at a rate of 96%. Radical scavenging assays identified (e−), •OH, O2•−, and (h+) as the main species involved in TC degradation. Lastly, this work suggests a novel method for creating a potent photocatalyst that can remove newly discovered pollutants from the aquatic environment.

Key words: SiNWs, CeO_2/NiO, Photocatalysis, TC, Degradation.

ÉTUDE DE L'ADSORPTION D'UN COLORANT ANIONIQUE SUR BENTONITE NATURELLE MODIFIEE PAR SDBS

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.**Abstract**
Les colorants synthétiques, provenant principalement des industries textile, papier, cuir et agroalimentaire, constituent une source majeure de pollution des eaux. Parmi eux, le méthylorange (MO), utilisé comme pigment et indicateur, est particulièrement préoccupant en raison de sa faible biodégradabilité et de ses effets cancérigènes et génotoxiques. Ce colorant empêche la lumière de pénétrer dans les plans d'eau, perturbant ainsi la photosynthèse et menaçant la vie aquatique. Pour traiter ce problème, diverses méthodes efficaces et économiques ont été explorées, y compris les approches physiques, chimiques et biologiques, telles que la solubilisation micellaire et l'adsorption. Cette dernière est privilégiée en raison de sa simplicité, de son faible coût et de son efficacité, contrairement à des méthodes comme la coagulation ou l'électrolyse qui entraînent la production de boues toxiques et des coûts élevés. Cependant, l'adsorption présente également des limitations, comme la toxicité des adsorbants usés et la nécessité d'utilisation de substances chimiques pour la régénération, ce qui n'élimine pas totalement la contamination. Parmi les matériaux étudiés pour l'adsorption des colorants, la bentonite se distingue grâce à son efficacité, sa disponibilité et son faible coût. Cette étude se concentre sur l'optimisation de l'adsorption du méthylorange sur la bentonite modifiée au SDBS. Les résultats montrent que l'adsorption est favorisée en milieu acide et atteint l'équilibre rapidement, en 10 minutes. Le modèle de pseudo-deuxième ordre caractérise bien la cinétique d'adsorption, tandis que l'isotherme suit un modèle de type C avec une capacité maximale de 37,5 mg/g, bien décrit par le modèle de Freundlich (R^2 = 0,99). Enfin, l'analyse thermique indique que le processus est exothermique, mettant en évidence l'efficacité de la bentonite modifiée pour traiter les eaux contaminées par le méthylorange.

Key words : Colorant, méthylorange, Adsorption, Bentonite-SDBS.

SYNTHESE ET CARACTERISATION DU MCM-41 POUR L'ADSORPTION DU BLEU DE METHYLENE

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Abstract

La préservation des milieux naturels constitue aujourd'hui une préoccupation majeure tant pour les décideurs que pour l'opinion publique. À long terme, il est désormais établi que tout rejet de substances polluantes en particulier celles présentant une faible biodégradabilité ou une toxicité élevée - représente une menace sérieuse pour l'environnement. Il apparaît donc essentiel de limiter au maximum ces émissions afin d'en atténuer les impacts. Face à ces problématiques persistantes, de nombreuses recherches ont été menées dans le but de limiter l'impact des micropolluants et de développer des procédés de traitement efficaces des eaux contaminées. Plusieurs technologies ont ainsi vu le jour pour la dépollution des eaux fortement chargées en micropolluants organiques et inorganiques. Parmi elles, l'adsorption demeure la méthode la plus couramment utilisée, en particulier avec des matériaux mésoporeux tels que MCM-41. La présente étude s'inscrit dans cette dynamique en évaluant l'efficacité du matériaux MCM-41 pour l'élimination des colorants basiques présents dans les eaux usées. Le matériau obtenu a été caractérisé par diffraction des rayons X (DRX), fluorescence des rayons X (FRX), ainsi que par spectroscopie infrarouge à transformée de Fourier (FTIR). Les résultats ont démontré que le MCM-41 présente un bon potentiel en tant qu'adsorbant pour l'élimination des polluants de type colorants. Par ailleurs, l'étude des isothermes d'adsorption a révélé que le modèle de Langmuir offrait une meilleure description du processus d'adsorption sur MCM-41 que le modèle de Freundlich.

Key words : Silice, MCM-41, Colorant, Adsorption.

STUDY AND CHARACTERIZATION OF ACTIVATED SLUDGE FROM AN URBAN WASTEWATER TREATMENT PLANT

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Abstract

Wastewater treatment leads to the production of sludge, which contains inert and organic compounds, pollutants and pathogens. Its composition depends on the type of wastewater treatment. The main objective of our work is to characterize activated sludge from an urban wastewater treatment plant. This characterization was carried out using official methods dedicated to sludge analysis. The sludge resulting from wastewater treatment contains elements of agronomic value (OM, MS, P, K, Mg, Ca, S, Na) that justify its use as soil fertilizer. This study was carried out on sludge from the Boumerdes wastewater treatment plant. It presents a global analysis (physico-chemical and microbiological) to give an identity card or a more or less global idea of the sludge.

Key words: Activated sludge, Wastewater treatment, Wastewater treatment plant, Methylene blue dye; Box-Behnken design; Adsorption; Langmuir isotherm.

TREATMENT OF GROUNDWATER IN THE NORTHERN SAHARA (EL OUED – ALGERIA)

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Abstract
This study aims to assess the efficiency of the demineralization plant in the El Oued region, using reverse osmosis technology. The objective of this study is to evaluate the physico-chemical quality of both raw water and treated water at the demineralization station. Two samples of raw water and treated water were collected from the station over a period of three months, with an average of four sub-samples taken for each sample. In general, the quality of water at the outlet of the demineralization station was evaluated through the analysis of several physico-chemical parameters: temperature, pH, electrical conductivity, chlorides, sulfates, nitrites, nitrates, calcium, sodium, potassium, etc. The results of the various physico-chemical analyses showed that the raw water is highly mineralized, due to its high content of calcium, bicarbonates, sulfates, and chlorides. The mineral profile of the raw water indicates that the concentrations of calcium, sodium, potassium, chlorides, and sulfates exceed WHO standards, while the levels of magnesium, iron, and manganese remain low compared to the recommended limits. The results of the treated water analyses revealed a significant decrease in all values: a pH close to neutrality, low electrical conductivity (1.09 mS/cm), greatly reduced mineralization, and a decrease in hardness. A reduction in calcium, sodium, potassium, chlorides, sulfates, magnesium, iron, and manganese levels was also observed, in accordance with WHO standards. At the conclusion of this study, the effectiveness of the reverse osmosis technique in the demineralization of groundwater was confirmed, as evidenced by the notable reduction in salinity and lower mineralization levels that meet WHO standards. It is therefore necessary to implement this type of plant in regions suffering from water salinity problems. One of the main advantages of such demineralization plants lies in the possibility of producing non-conventional potable water, meeting the drinking water needs of local populations and contributing to the economic revival of the Northern Sahara region.

Key words: Groundwater, the demineralization station; El Oued, Raw water,Treated water, Physico-chemical.

A BOX-BEHNKEN DESIGN FOR OPTIMIZING CONGO RED DYE ADSORPTION ON CTAB-ACTIVATED ILLITE-KAOLINITE CLAY: MECHANISTIC, EQUILIBRIUM, AND KINETIC ANALYSIS.

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Abstract
This study created a stable multilayered composite by combining illite kaolinite (IKaol) clay with cetyltrimethylammonium bromide (CTAB) surfactant through electrostatic self-assembly. The researchers investigated how well this IKaol/CTAB composite could adsorb congo rad (CR) dye from water, analyzing its properties using various characterization techniques. They optimized five key factors affecting CR adsorption using the Box-Behnken design method. The highest removal efficiency (86.24%) was achieved under specific conditions (0% CTAB loading, 0.06g adsorbent dose, pH 7, 45°C, and 17.5 minutes), with an adsorption capacity of 114.94 mg/g. The adsorption process followed the Freundlich isotherm and pseudo-second-order kinetic models, with the mechanism involving electrostatic attractions, n-π interactions, and hydrogen bonding. This study demonstrates that IKaol can serve as an effective adsorbent for removing cationic dyes from aqueous environments

Keywords: Illite Kaolinite, CTAB; Removal congo red dye, Box-Behnken design, Adsorption, Langmuir

isotherm.

HYDRO-GEOTECHNICAL ANALYSIS AND ENVIRONMENTAL IMPACTS OF SUBMERGED WEIRS

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Abstract
Submerged weirs are key hydro-geotechnical structures used in water management and treatment, especially in industrial and urban settings. Unlike free-flow weirs, submerged weirs occur when the downstream water level exceeds the crest, altering flow conditions, reducing effective discharge, and causing complex phenomena such as increased head losses and turbulence. These effects impact the hydraulic performance of the structures and the quality of water treatment. Environmentally, submerged weirs can release polluted water rich in organic matter and nutrients, causing rapid drops in dissolved oxygen in receiving waters, harming aquatic life and potentially creating temporary dead zones. These discharges also promote eutrophication, disrupting aquatic ecosystems and biodiversity. Furthermore, turbulence and flow variations linked to submersion fragment habitats and alter ecological connectivity of watercourses, affecting species migration and reproduction. Finally, these structures can facilitate the transport of pollutants and contaminated sediments downstream, degrading water quality. A precise understanding of the hydraulic effects of submersion is essential to optimize the design of hydro-geotechnical weirs, limit their environmental impacts, and ensure sustainable water resource management. Analytical modeling validated by experimental tests allows evaluation of head losses, discharge variations, and critical flow conditions, contributing to better control of

Key words: Submerged weir, submerged flow, Hydraulic performance, Discharge coefficient, Experimental modeling, and Environmental impacts.

IRON OXIDE NANOPARTICLES: A SUSTAINABLE PATHWAY FOR ADVANCED TREATMENT OF INDUSTRIAL EFFLUENTS

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Abstract
the sustainable management of water resources is a pressing challenge as industrial activities expand and environmental constraints intensify. Innovative approaches are needed to ensure efficient treatment of wastewater while reducing environmental impact. In this context, iron oxide nanoparticles represent a promising technology for advanced water treatment. Their high surface area and strong adsorption capacity make them particularly effective for removing hydrocarbons from industrial effluents, especially those produced by oil and gas operations. The integration of such nanomaterials into remediation processes enhances overall treatment performance while reducing chemical consumption and promoting the reuse of treated water, thus aligning with sustainability objectives. However, practical challenges remain, including nanoparticle stability, recovery after use, and potential ecological risks. This study contributes to ongoing research efforts that aim to valorize nanotechnology in environmental applications. By advancing the use of iron oxide nanoparticles, it seeks to support the development of efficient, eco-friendly strategies for water treatment and sustainable resource management.

Keywords: nanoparticles, iron oxide nanoparticles, hydrocarbons, adsorption, industrial wastewater treatment

OPTIMIZATION OF A MICRO-SENSOR FOR THE SIMULTANEOUS DETECTION OF CIPROFLOXACIN AND PARACETAMOL IN ENVIRONMENTAL WATER

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Abstract

Ciprofloxacin (CIP) and paracetamol (PAR) are drugs, which are widely prescribed and administered in daily life. In one hand, the CIP is a fluoroquinolone antibiotic, used for treating several infections such as urinary, skin, digestive and respiratory infections. In another hand, the PAR is an anti-inflammatory, used to treat headache, fever and postoperative pain. However, an overdose of each one of them can cause in addition to theirs common side effects, serious problems to the human health such as digestive system bleeding, hepatic toxicity, kidney and liver damages. As these antibiotics are also prescribed for animals, they can be transferred into the food chain and generated antibiotic-resistant bacteria in human body. Moreover, these two widely used drugs are considered as pollutants mostly founded in waters in relatively high concentrations ranging. Therefore, the monitoring of their levels is necessary to ensure the food safety and the protection of the human health. In this context, we have developed and optimized a simple, economical, selective and sensitive electrochemical sensor for the simultaneous determination of CIP and PAR. The developed device consists of a micro-cavity electrode integrated nanostructured material. After optimization of operating conditions, the nanostructured sensor showed a wide linear response in the range of 0.05 to 3 µM and 0.025 to 3 µM for CIP and PAR, and low detection limits of 39 and 23 nM, respectively.Therefore, the proposed electrochemical sensor is a potential candidate for the monitoring of ciprofloxacin and paracetamol in water matrices, contributing to water quality and safety.

Key words: ciprofloxacin, paracetamol, micro-sensor, water, environmental monitoring

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LA CONSERVATION DES EAUX A PARTIR DU LEUR TRAITEMENT

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Abstract

Le rejet des eaux résiduaires dans l'écosystème est une source dramatique de pollution, d'eutrophisation et de perturbation non esthétique dans la vie aquatique et par conséquent présente un danger potentiel de bioaccumulation qui peut affecter l'homme par transport à travers la chaine alimentaire.

On trouve celle du textile qui génère une pollution importante ; mais cette pollution à plusieurs méthodes de traitement parmi eux on trouve le procédé de Fenton (H_2O_2/Fe^{2+}). Ce procédé est basé sur la formation des radicaux hydroxyles OH et HO_2 qui sont capable d'oxyder les molécules organiques. L'efficacité du réactif de Fenton dépend de plusieurs facteurs. Ces paramètres ont été étudiés par divers groupes de recherche, dont les principaux sont : le pH, la concentration de Fe^{2+}, la concentration de H_2O_2, la concentration initiale des polluants et la température. Dans ce travail on a montré que le réactif Fenton dégrade totalement le colorant textile au bout 180 min avec un taux de dégradation égal à 98 % dans des conditions optimisées, ces valeurs sont comme suit pH=3, $[H_2O_2]$=0.05M, $[Fe^{2+}]$=0.00001M, $[colorant]_0$ =50mg/L, T=40-60 °C . Les résultats de dégradation du colorant textile par le procédé Fenton que ce soit sur les deux plans rendement et cinétique sont satisfaisants.

Key words : Procédé de Fenton, procédé d'oxydation avancée, radicaux hydroxyles, minéralisation, colorant, traitement des eaux de rejet.

DEVELOPMENT OF A MAGNETIC ADSORBENT FOR EFFICIENT RECOVERY AND REUSABILITY IN WASTEWATER TREATMENT.

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Abstract
Adsorption is widely recognized as an efficient, simple, and cost-effective technique for removing both organic and inorganic contaminants from water, with notable success in eliminating heavy metals from industrial effluents. However, the rising demand for conventional adsorbents such as activated carbon has increased costs, prompting the development of alternative low-cost and sustainable materials derived from biomass or advanced functionalized supports. Among these innovations, magnetic adsorbents have gained significant attention due to their unique properties, including high surface area, tunable surface chemistry, and, most importantly, easy separation from aqueous media using external magnetic fields. Unlike traditional adsorbents, which require filtration or sedimentation, magnetic materials can be rapidly recovered in seconds, reducing both energy consumption and operational costs. This advantage makes them particularly suitable for large-scale wastewater treatment applications. In the present study, a magnetic adsorbent was synthesized by incorporating Fe_3O_4 nanoparticles onto a porous support. Structural and magnetic analyses, such as vibrating sample magnetometry (VSM), confirmed the successful integration of magnetic particles and their strong responsiveness. Furthermore, regeneration experiments demonstrated that the material maintained high adsorption efficiency over several cycles, underlining its reusability and economic viability. Overall, this work highlights the potential of magnetic adsorbents as scalable, high-performance, and sustainable solutions for water purification, offering an eco-friendly alternative to conventional methods.

Key words: Adsorption, biomass, magnetic adsorbent, Wastewater treatment, Regeneration

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ASSESSMENT OF THE LEVEL OF POLLUTION OF METALLIC ELEMENTS IN SEDIMENTS.

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Abstract
The contamination of sediments in the Seybouse River and its tributary, Meboudja, by heavy metals (Fe, Co, Zn, Pb, Cd, Cu) was investigated using UV/Visible spectrophotometry. Physicochemical parameters such as pH, electrical conductivity, moisture content, and organic matter were also analyzed in samples collected from three sites downstream of industrial discharge points in the Annaba region. Results showed that the finest sediment particles (<63 µm) contained the highest concentrations of metals, particularly at site S3, where iron reached approximately 17,000 mg/kg and zinc about 13,000 mg/kg, both exceeding acceptable environmental limits. This indicates a significant impact of industrial pollution on the river system. In contrast, copper levels were relatively low, possibly due to its higher mobility or dispersion in the environment. This study highlights the severity of heavy metal contamination resulting from industrial activities and emphasizes the importance of monitoring sediment quality to assess environmental risks in aquatic ecosystems.

Key words: Sediments, granulometry, mineralization, heavy metals, pollution.

EFFICIENCY OF GREEN SCALE INHIBITORS ON CALCIUM CARBONATE PRECIPITATION FROM HARD WATER: EFFECT OF TEMPERATURE AND CONCENTRATION

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Abstract
The scaling phenomenon is a major concern in various industrial sectors such as wastewater treatment, desalination, oil and gas, petrochemicals, etc. Indeed, scale deposits often cause numerous problems, leading to untimely shutdowns, reduced flow, reduced heat transfer, sticking of valves, and clogging of filters. Non-productive expenses related to scaling have been estimated at billions of dollars per year. Calcium carbonate $CaCO_3$ depots are the most widespread on the tops of production tubes and in surface production facilities. Scale inhibitors are widely used and highly effective in preventing salt precipitation. Plant extracts have recently been used as anti-green scale inhibitors. Indeed, they are easily extracted and environmentally friendly and represent an interesting alternative source of "natural" organic molecules. The objective of this study is to develop eco-friendly scale inhibitors based on aqueous extracts of Spergularia rubra (SRE) and Paronychia argentea (PAE), aimed at reducing calcium carbonate ($CaCO_3$) scale formation on copper surfaces. The anti-scaling properties were evaluated using chronoamperometry, and calcium deposits were characterized using optical microscopy. The results showed that, in the presence of the inhibitors, a change in the residual current was observed with increasing inhibitor concentrations, indicating a decrease in the rate of $CaCO_3$ electrodeposition. The highest inhibition efficiency was achieved with 150 ppm of Spergularia rubra extract and 300 ppm of Paronychia argentea extract. Furthermore, the results confirmed that temperature positively influences the electrodeposition of calcium carbonate, and aqueous extracts of SRE and PAE were found to be less effective at elevated temperatures.

Keywords: Hard water, Scale Inhibitor, plant extracts, Chronoamperometry

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ETUDE DE LA POLLUTION DE LA NAPPE ALLUVIALE DANS LES ZONES SEMI-ARRIDES : CAS DE LA PLAINE DE HAUT CHELIFF

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Abstract
Nous avons étudié dans ce travail la pollution des eaux souterraines de la nappe alluviale du Haut Cheliff par les nitrates ,en procédant à l'utilisation d'une méthode analytique permettant l'étude de l'évolution des teneurs maximums des nitrates depuis l'année 2010 et par conséquent le calcul du bilan azoté de la campagne 2016/2017 après avoir déterminé ses origines et les avoir classé selon leur danger sur l'environnement .Nous sommes enfin arrivé a étudier le mécanisme de transfert des nitrates dans le système sol –zone non saturée en nous basant sur une étude géotechnique élaborée dans la zone d'étude durant la même campagne . Le niveau actuel de la pollution nitrique des eaux souterraines dans le périmètre irrigué du Haut Cheliff commence à devenir critique. Les zones dont les teneurs en nitrates des eaux souterraines dépassent 100 mg NO_3^-/l sont localisées à l'Est et à l'Ouest de la région d'étude (Djendel Ain Soltane, Bir Ouled Khelifa et Djelida). La partie Nord de la région (entre Khemis Miliana et Arib) reste en général moins polluée. La pollution des eaux souterraines par les nitrates dans la plaine du Haut Cheliff est donc une réalité de puis la campagne 2010.

Key words: Eaux souterraine, Pollution nitrique, Bilan azoté, Nitrate, Haut Cheliff

CONTRIBUTION A L'ETUDE DU TRAITEMENT DES EAUX USEES PAR LA STATION D'EPURATION DE BOUZADJER D'AIN TEMOUCHENT

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Abstract
La présente contribution consiste à l'évaluation de la qualité physico-chimique des eaux usées brutes et épurées au niveau de la station d'épuration de bouzedjar (système à boues activées) a été mise en évidence. Les paramètres physico-chimiques suivis sont la température, le Ph, la conductivité électrique, l'oxygène dissous, les MES, la siccité de boue en MS, volume de décantation V_{30}, MVS, Métaux lourds. Les résultats obtenus nous ont permis de dire que le rabattement des paramètres de pollution tels que la DBO5, DCO et les MES indique que le traitement par bassin aérobie est très efficace. La comparaison des résultats d'analyses des eaux épurées avec les normes a révélé que les valeurs physico-chimiques sont acceptables. Ceci indique que ces eaux peuvent être utilisées à des fins d'irrigation. A la lumière de ces résultats, ces processus d'épuration des eaux usées peuvent éliminer au maximum la pollution de l'eau notamment la pollution bactériologique et chimique, afin de diminuer l'impact de ces nuisances sur l'environnement.

Mots clés : eaux usées, station d'épuration de bouzedjar, eaux épurées, qualité physicochimique.

INFLUENCE OF SOLUTION PH ON THE ADSORPTION OF CEFIXIME BY $CUCR_2O_4$-POLYSTYRENE AND POLYSTYRENE BEADS.

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Abstract
Antibiotic residues, such as cefixime, in wastewater are a growing environmental threat. Adsorption on polymers (polystyrene, composite polymer) is emerging as a simple, effective and sustainable solution. Pure polystyrene (PS) and the $Cucr_2O_4$-polystyrene composite. The aim was to compare their adsorption efficiency at different pH levels. The results show that pure polystyrene has a limited adsorption capacity, mainly based on hydrophobic and electrostatic interactions, and sensitive to pH. In contrast, the $Cucr_2O_4$-polystyrene composite has a much higher adsorption capacity due to the additional chemical interactions offered by Cur_2O_4. This composite is also more stable and regenerable, making it more suitable for practical applications. The best performance was observed at pH (3.5) for both materials, but the composite shows better tolerance to pH variations. This study highlights the effectiveness of composite materials for treating water contaminated with antibiotics.

Key words: Polystyrene, pH solution, antibiotic, water traitement, adsorption, Composite.

PERFORMANCE EVALUATION OF COAGULATION AND FLOCCULATION PROCESSES IN TREATING INDUSTRIAL EFFLUENTS FROM THE PAPER INDUSTRY

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Abstract
Despite the advent of digital technology, the paper industry still plays a dominant role in the global economy. Although some predicted its decline with the advent of digital technology (computers, smartphones, e-books), demand for paper persists and is even growing, with annual consumption approaching 400 million tonnes. However, this industry faces major environmental challenges, particularly due to its high water consumption. Producing a single sheet of paper requires between 2 and 13 liters of water, generating liquid effluents loaded with pollutants. Therefore, the implementation of effective treatment processes, such as dissolved air flotation (DAF), coagulation-flocculation, or adsorption, are therefore becoming an absolute necessity. Today, FADERCO is the Algerian leader in paper products, also standing out for its environmental responsibility. The objective of this work is to evaluate the efficiency of coagulation-flocculation treatment in reducing the pollutant load of effluents while minimizing their environmental impact. The application of the coagulation-flocculation process significantly reduced concentrations of TSS, COD, BOD_5, and turbidity. The use of the coagulant (aluminum chlorohydroxysulfate), combined with the chemical flocculant (polyacrylamide), achieved high physico-chemical treatment performance, with a 98.55% reduction in COD, demonstrating excellent ability to remove dissolved organic matter. Similary, a 99.91% reduction in turbidity confirmed high efficiency in water clarification

Key words: Paper industry, coagulation, floculation, COD, turbidity.

USE OF OXIDANTS TO ENHANCE ELECTROREMEDIATION OF SIMULATED CONTAMINATED SOIL FROM DIESEL

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Abstract
In this work electrokinetic remediations of Diesel spiked sand or kaolinite samples have been tested. Knowing that hydrocarbons are hydrophobic, facilitated agents are added i.e. oxidants: permanganate potassium. Electrokinetic tests were carried out in a cylindrical cell in Glass where the central compartment dimensions are 200 mm length and 50 mm inner diameter containing 300-350 grams of a contaminated soil (kaolinte or sand). The circulation of the catholyte and the anolyte is continually under agitation in a graduated reservoirs (300 ml each), placed at each end of the sample compartment, which allows the escape of generated gas near the electrodes. In the two extremities there are two Graphite electrodes with an immersed area of 36 cm^2. The two electrode chambers are isolated from this one by paper filter (Whatman N°5), and porous stones. The variation of the composition of the sample is followed by analyses using total organic carbon analyzer. The applied voltage is delivered by a power supply and maintained constant in all the runs. A constant potential difference of 2 DCV cm^{-1} was applied in all experiments for a treatment time of 10 days. The current intensity and the pH in the electrode compartments were taken periodically. The role of oxidizing agent is also shown and the various results obtained are discussed

Key words: soil, diesel contamination, electrokinetic remediation, organic pollutants, electromigration.

SYNERGISTIC ELIMINATION OF AZO DYE: CRITICAL CONTRIBUTIONS OF BOTH ADSORPTION AND PHOTOCATALYSIS USING POLYANILINE/CO-BURIFIED BENTONITE CLAY

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Abstract
Methyl orange (MO), a typical azo dye, was removed by a two-step process. In situ polymerisation technique was used to synthesize a hybrid material of cobalt-exchanged purified bentonite clay charge reinforced polyaniline matrix. The synthesized material has shown immense promise in environmental remediation by a synergistic combination of adsorption and photocatalysis under natural sunlight. Thanks to abundant active sites and enhanced structural, textural and optical properties, which were proved in this work by XRD, FTIR, BET and UV-Vis this material has emerged as one of the most thrilling study objects for adsorbents and photocatalysts. The hybrid system involved here, with the integration of adsorption and photocatalysis processes, was 67.50% effective in the degradation of methyl orange. According to the experimental test, at an initial MO concentration of 30 mg/L and natural pH 6.5, the capacity of adsorption under dark conditions for 90 min reached 79.18 mg/g, which led to 39.59 % of molecules adsorbed on the surface. The subsequent photodegradation process, which was accountable for the degradation of over 27.91 % of MO in 240 min under cost-efficient and ambient conditions, was ascribed to improve the removal of the hazardous azo dye. By the modified Freundlich model, the kinetic system's second phase was established through analysis to exhibit a pseudo-first-order kinetics pattern with surface heterogeneity. These results encourage effective use of the synthesized nanomaterial as adsorbent and as photocatalyst in the elimination of different type of dyes and other contaminants.

Key words: Enironmental remediation; Adsorption-Photocatalysis; Azo dye; Polyaniline; Bentonite; Kinetics.

ADSORPTION AND DIFFUSION BEHAVIOR OF CADMIUM IONS IN ZEOLITIC IMIDAZOLATE FRAMEWORKS FOR WATER PURIFICATION

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Abstract
Cadmium (Cd^{2+}) contamination in water is a severe environmental concern due to its toxicity and persistence. Zeolitic Imidazolate Frameworks (ZIFs), a subclass of Metal–Organic Frameworks, offer high surface areas (>1500 $m^2\ g^{-1}$) and tunable pore structures suitable for heavy-metal removal. In this study, the adsorption and diffusion of Cd^{2+} ions into ZIF-8 were investigated under batch conditions. Adsorption equilibrium was reached within 90 min, with a maximum uptake capacity (q_m) of 182.4 mg g^{-1} at pH 5.0. Kinetic data fitted the pseudo-second-order model (R^2 = 0.997), indicating chemisorption dominance, while intraparticle diffusion analysis revealed a multi-stage process involving rapid surface binding followed by slower pore diffusion. Diffusion coefficients ranged from 1.2×10^{-11} to 4.5×10^{-12} $cm^2\ s^{-1}$ depending on initial concentration (50–200 mg L^{-1}). These findings demonstrate the strong potential of ZIF-based materials for efficient Cd^{2+} removal, highlighting their applicability in advanced water treatment systems.

Keywords: ZIF-8, cadmium adsorption, diffusion coefficient, pseudo-second-order kinetics, water treatment.

GREEN TECHNOLOGY FOR WATER QUALITY IMPROVEMENT

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Abstract
Urbanization, industrialization, and population growth have led to the release of various contaminants into water resources, highlighting the limitations of conventional mechanical wastewater treatment plants, which require significant energy and produce substantial sludge while often failing to eliminate all pollutants. Azolla pinnata, a fast-growing aquatic fern from the Azollaceae family, is known for its symbiotic relationship with nitrogen-fixing cyanobacteria, enhancing its effectiveness as both a biofertilizer and a water purifier. This study investigates Azolla as a natural tool for controlling water pollution, particularly in reducing contaminants in sewage water. Experimental setups involved introducing Azolla into contaminated water and monitoring changes in key water quality parameters, including pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), and salinity. The results indicated significant improvements in water quality, with pH levels decreasing toward neutrality and reductions in EC, TDS, and salinity, demonstrating Azolla's capacity to absorb and remove dissolved solids and salts. Additionally, the increase in Azolla biomass during treatment suggests that the plant thrives in polluted environments, enhancing its pollutant-removal capabilities. Beyond water treatment, the high biomass production of Azolla opens up a range of applications, including its use as an agricultural fertilizer, biogas production, animal feed, and medicine. These findings underscore Azolla pinnata's potential as a cost-effective, eco-friendly solution for managing water quality, particularly in regions grappling with sewage water management, making Azolla phytoremediation a highly recommended advanced treatment option.

Key words: Phytoremediation, Azolla pinnata, Wastewater treatment, Water quality

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STUDY OF NI(II) AND MN(II) ADSORPTION ON A CAROB-BASED COMPOSITE

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Abstract
This study explores the potential of carob (Ceratonia siliqua), a natural, abundant, and low-cost biomaterial, for the removal of heavy metals such as nickel (Ni) and manganese (Mn) from aqueous solutions. The carob was utilized in its raw form and characterized using Fourier-transform infrared spectroscopy (FTIR). Batch adsorption experiments were conducted to investigate the influence of several key physicochemical parameters on the adsorption efficiency and capacity of carob for Ni and Mn. These parameters included the biosorbent dose, the initial concentration of metal ions (Ci), pH, and contact time. Residual concentrations of metal ions in the aqueous phase after adsorption were measured using UV-visible spectroscopy. The experimental data were analyzed through adsorption isotherm models (Langmuir and Freundlich) and kinetic models (pseudo-first-order and pseudo-second-order) to elucidate the mechanisms and rate- limiting steps of the process. The results confirm that carob is an effective, sustainable, and ecological solution for the removal of Ni and Mn from contaminated water resources, contributing to the development of economical and environmentally friendly water treatment technologies.

Key words: Biomaterials; Adsorption; Ni(II); Mn (II); Kinetics, Modeling ; Isotherms.

INNOVATIVE BIOPROCESSES FOR ENVIRONMENTAL SUSTAINABILITY: THE CASE OF *AZOLLA PINNATA*

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Abstract

Water quality degradation and the need for sustainable industrial processes remain critical challenges. Conventional treatment methods are often costly, energy-intensive, and generate secondary waste. This study investigates the use of *Azolla pinnata*, a fast-growing aquatic fern, within engineered bioprocess frameworks for environmental applications. Controlled trials were conducted using sewage water with initial *Azolla* biomass loads of 50 g and 100 g. Water quality parameters (pH, electrical conductivity, total dissolved solids, and salinity) were monitored over 30 days. Results demonstrated significant improvements: pH decreased from 8.1 to 7.2, EC from 2.1 to 1.43 mS/cm, TDS from 1.15 to 0.78 ppt, and salinity from 1.34 to 0.91 ppt. Simultaneously, *Azolla* biomass increased, offering renewable material for downstream applications. This dual role highlights *Azolla pinnata* as both a biofilter and a biomass resource. The findings suggest that *Azolla*-based systems can be developed as innovative, low-cost bioprocesses, aligning with circular economy principles and contributing to sustainable industrial development.

Key words: Azolla pinnata, Water quality, Bioprocess, Circular economy, Sustainable development.

ASSESSMENT OF ENVIRONMENTAL CHANGES ON THE QUALITY OF CULTIVATED SOIL IN IRRIGATED PERIMETER (CASE STUDY: THE ABADLA PLAIN, SW ALGERIA)

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Abstract

Increased GHG emissions are causing a rise in Earth's temperature, which is resulting in changes in climate, land use patterns, and access to water. Climate change can impact the ecosystem in various ways through impacts on environmental sustainability and natural resources, including water, land use, and the environment. The present study aims to assess the quality of cultivated soils in the irrigated areas of the Abadla plain, as well as evaluated the spatial variability of soil salinity. This variability was used in the frame of a non-parametric geostatistical interpolation method in order to assess the risk of the soil salinity. A study on a 580 ha field located in the eastern region of Abadla, Sud-West of lgeria,238 soil samples were taken from irrigated field sat depth of 0.60 cm (the root layer). The statistical analysis showed a high spatial variability with significant differences throughout the experimental field on the parameters, EC, ESP and PH. The EC variogram increased up to distance of 1.22 km or reaches a plateau of 1395 ms /cm, the nugget effect of the order of 120 ms /cm, is small that it represents 8.5%. The pH increased up to a distance of 0.448 km corresponding to a plateau of 1.952. The effect of nugget of 0.256 represented 13.11%. The ESP at a range of 0.42 km, a nugget of 83.3 and a nugget effect of 0.3, weak as compared 0.36% of the landing. The structure and the permeability caused a reduction of the speed of infiltration of waters.

Key words: Climate change; Soil; salinity; Irrigated; Algeria.

PH AND SURFACE CHARGE EFFECTS ON THE INTERACTION OF FUNCTIONAL MATERIALS WITH ORGANIC POLLUTANTS

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Abstract
The efficiency of functional materials in environmental applications is largely governed by their surface properties and interactions with pollutants. Among these factors, the solution pH and the point of zero charge (pHpzc) are crucial, as they determine the surface charge of materials and directly affect adsorption, degradation, and overall reactivity. The objective of this study is to evaluate the role of pH and pHpzc in controlling the interfacial behavior of functional materials in aqueous systems. Physicochemical characterization, combined with surface analyses, was carried out to determine charge distribution under different pH conditions. The results show that the material acquires a positive surface charge below its pHpzc, favoring the adsorption of negatively charged contaminants, whereas above the pHpzc, electrostatic repulsion reduces interaction efficiency. This clear dependence between surface charge and pollutant uptake demonstrates the fundamental role of pHpzc in adsorption mechanisms. Overall, the findings highlight the originality of linking surface charge properties to environmental performance, providing useful insights for the design of advanced materials for water treatment and monitoring applications.

Key words: pH, pHpzc, Surface Charge, Organic Pollutants, Functional Materials, Water Treatment.

RECOVERY OF ETHANOL FROM AQUEOUS SOLUTIONS USING SALTING EFFECT: APPLICATION OF DISSOLVED SODIUM CHLORIDE SALT

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Abstract
It is well documented that alternative energy resources can significantly reduce demand and consumption of global oil reserves. Ethanol offers several advantages, as it uses a renewable source, provides an additional economic use for existing agricultural products, and can be used directly in existing internal combustion engines. It should be noted that ethanol exposure amplifies the toxicity of other solvents in the acute setting. This interaction is especially dangerous in the setting of recreational solvent inhalation. Recently some researchers have reported on the use of liquid-liquid extraction to selectively remove ethanol from water. The effect of NaCl at different mass ratios (5%, 10%, 15%) on the liquid-liquid extraction of ethanol with cyclohexanone as solvent, at room temperature and atmospheric pressure, was experimentally tested in this work using the cloud point method. The results show that the addition of salt caused the immiscibility zone to widen and the mutual solubility of water and ethanol to decrease. It also promoted the transfer of ethanol from the aqueous phase to the solvent phase, a process known as "salting out," which has been explained by the hydration theory. Increasing the mass ratio of salt promotes the transfer of ethanol from the aqueous phase to the organic phase; it promotes the salting-out of ethanol and improves extraction. This is clearly confirmed by the tie lines and distribution curves. The reliability of experimental equilibrium data, tie lines, has been successfully verified by the application of Eisen Joffe correlations.

Key words: Liquid-liquid extraction, salting effect, salting out, distribution coefficient, ethanol, Esisen –Joffe equation.

NATURAL AND MODIFIED ALGERIAN CLAYS FOR THE REMOVAL OF CATIONIC DYE FROM WATER UNDER SUNLIGHT IRRADIATION.

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Abstract

A Cr_2O_3-supported natural volcanic Algerian clay (Cr_2O_3/CCA) was synthesized through an impregnation method to prepare a photocatalytic adsorbent integrated. The discoloration of crystal violet dye (CV) from an aqueous solution using natural and modified clays via Chromium (III) oxide by photocatalytic degradation. The materials were characterized by different analysis techniques using X-RF, FT-IR, XRD, and SEM. The Cr_2O_3/CCA material is considered to be an effective adsorbent and photocatalyst in the decolorization of the CV dye solution. The photocatalysis process of CV was executed by the Cr_2O_3/CCA material under sunlight irradiation. The characterization results obtained show that the natural clay contains two phases, sericite and clinochlore, with the existence of the Cr_2O_3 phases for the modified clay. The experimental results show that the pseudo-second and pseudo-1st order models describe the kinetics of adsorption and degradation, respectively. The discoloration efficiency with the Cr_2O_3/CCA (~ 92%) is higher compared to the CCA (46%), clearly indicating to promoting effect of Cr_2O_3.

Key words: Clay; Cr_2O_3; Crystal violet dye; Impregnation; Photocatalysis; Sunlight irradiation

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ASSESSMENT OF HEXAVALENT CHROMIUM IN SOLVENT-BASED PAINT SLUDGE FROM THE PAINT INDUSTRY

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Abstract

Hexavalent chromium is the most common form of chromium in the environment, showing high solubility and extreme toxicity that causes serious problems for ecosystem and human health**.** The solvent-based paint manufacturing plant is one of the industries that generates amount of toxic waste such as paint sludge, which contains a lot of heavy metals include hexavalent chromium. The aim of this study is to estimate the content of hexavalent chromium present in the paint sludge. Therefore, experiments of digestion were carried out to study the effect of temperature and digestion medium on hexavalent chromium extraction. Its quantification was achieved using colorimetric method and Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES). The most influential factor and suitable metal extraction method was studied by software (SPSS 25). The results obtained show that temperature and type of digestion medium affected the extraction of chromium. its concentrations range from 1.90 to 209 mg/kg. This means that land-filling of this sludge is prohibited; its treatment is therefore required.

Key words: Hexavalent chromium, environment, solvent based paint sludge, digestion

TREATMENT OF LEAD-CONTAMINATED WATER USING POLY (2-HYDROXY 4-METHACRYLOYLOXYBENZOPHENONE)

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Abstract
Lead (Pb^{+2}) is a pervasive and highly toxic pollutant that adversely affects human health and contaminates aquatic ecosystems, through industrial discharges. This study evaluates the effectiveness of a novel material, poly(2-hydroxy4-methacryloyloxybenzophenone)(PHMB), for the removal of Pb^{+2} from water. The monomer 2-hydroxy4-methacryloyloxybenzophenone (HMB) was synthesized and polymerized via free-radical polymerization to obtain the adsorbent PHMB. PHMB and HMB were characterized by spectroscopic techniques (FTIR, 1H and 13C NMR). Removal efficiency of Pb^{2+} from water samples was examined using UV-Visible spectroscopy. Results showed that the optimal Pb^{2+} removal was achieved at pH 6 with PHMB dosage of 0.75 g/L, equilibrium attained within 180min. Isotherms analysis showed that the Freundlich model provided the best fit, implying favorable multilayer adsorption of Pb^{2+} onto PHMB with a maximum adsorption capacity of 142.68 mg/g. Furthermore, PHMB retained about 80% of its efficiency over multiple regeneration cycles; its reusability and high affinity for Pb^{2+} make it a strong candidate for sustainable and practical water purification.

Keywords: Lead ions; Monomer synthesis; Radical Polymerization; Poly (2-hydroxy-4- hydroxy4-methacryloyloxybenzophenone)

EVALUATION OF CADMIUM POLLUTION LEVELS IN PAINT INDUSTRY SLUDGE

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Abstract
Solvent-based paint manufacturing plants generate a significant amount of toxic waste, such as paint sludge, which is considered as a highly complex material containing numerous heavy metals include lead, chromium, copper, iron and cadmium; this waste is used as pigments and additives in paint production. The objective of this study was to estimate the cadmium content in this type of sludge. To this end, acid digestion experiments were conducted, examining the effect of certain parameters, such as temperature, acid type, and its concentration, on cadmium extraction. Quantification was performed using inductively coupled plasma optical emission spectroscopy (ICP-OES). The most influential factor and the most suitable metal extraction method were studied using software (SPSS 25), applying linear regression after the two-factor ANOVA test. The results obtained show that the above-mentioned parameters affected cadmium digestion. Its concentrations range from 1.6 to 106 mg/kg, exceeding the regulatory standard according to europeen legislation (10 mg/kg of sludge). Therefore, landfilling of this sludge is prohibited; and its treatment is required which is currently the subject of an investigation.

Key words: Cadmium, environment, solvent based paint sludge, digestion.

ARTIFICIAL RECHARGE EFFECTIVENESS OF THE WATER TABLE BY PURIFIED WASTEWATER: CASE STUDY OF EL OUED, ALGERIA

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Abstract:
Artificial water table recharge in El Oued, Algeria, using treated wastewater has become essential due to the decline in the static level of the water table in Mih Ouenza, Oued Alenda, Nakhla, Ogla, and Robbah localities. For this reason, the combined influence of geomorphology and human activities must be considered to ensure effective artificial recharge.
At the Kouinine wastewater treatment plant, the effluent quantity exceeds the treatment capacity, and leads to a rise in the static level of the water table in the Kouinine locality. This causes flooding of the low-lying areas and the Ghout hydroagrarian alarm system. Chemical analysis has been done in the inlet and the outlet of the wastewater treatment plant, notably chemical oxygen demand, biochemical oxygen demand, dissolved oxygen, and suspended solids. Correlation between these parameters indicates that the collected wastewater in Kouinine wastewater treatment plant has several sources, including domestic, agricultural, and industrial waste, and the organic matter has different types, notably easily biodegradable, slowly biodegradable, soluble non-biodegradable, and particulate non-biodegradable organic matter.
To ensure good water quality during natural and/or artificial recharge, the Kouinine wastewater treatment plant should be extended to handle the increasing quantities of wastewater, and additional tertiary treatment is necessary. Meanwhile, transferring the purified water to the affected areas by the drawdown of the water table's static level is necessary to meet the population's water needs.

Key words: Kouinine, El Oued, purified wastewater, water table, artificial recharge.

SUSTAINABLE WATER TREATMENT THROUGH FOREST WASTE-DERIVED ADSORBENT

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Abstract
The Valorisation of bio-resources involves optimizing the use of materials to create value-added products, reduce waste, and promote sustainability. In this content Bio-resources, derived from plants, are renewable, biodegradable, and abundant, making them key components in addressing global challenges such as environmental degradation and the need for sustainable economic growth. In the present, the environmental problem is a serious problem due to the industrialization and urbanization development results; and the Water is the main consuming sources in the many of the industries and results in waste industrial effluents discharge into the environment specially the textile ones. In this case, Adsorption technique is an effective method for the removal of dye due to its eco-friendly and economically advantages. Recently, many of the scientists working on natural adsorbents, since the removal efficiency is significant in case of natural adsorbents compared with synthetic ones. In This work, cedar cone forest waste-biomass, an abundant agricultural waste in north Algeria, was used as an adsorbent in batch mode for elimination of an organic dye Methylene blue (MB) from aqueous solution. The best experimental condition was stimulated; the functional groups were determined by Fourier transform infrared spectroscopy (FTIR). The adsorption process was examined as the functions of adsorbent dose, contact time, initial CV concentration and solution Ph. The isotherms adsorption were studied at different temperatures (289–318) K, Maximum amount of dye were determined at 99.93% from aqueous dye solution at concentration of 60 mg/L.

Key words: Bio-resources; cedar cone; biomass; Adsorption; isotherm

EFFICACY OF LOCAL CLAYS IN REMOVING BASIC DYES FROM TEXTILE INDUSTRY WASTEWATER

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Abstract
The presence of organic dyes in water sources creates a pressing environmental issue, contributing to serious health risks that can adversely affect communities and ecosystems. Using local and natural materials for water treatment is essential for developing sustainable and environmentally friendly solutions. Among these materials, local clays offer significant advantages due to their abundance, low cost, and effective adsorption properties. This study investigates the effectiveness of three natural inorganic clays bentonite, sepiolite, and zeolite in removing basic dyes from aqueous solutions commonly utilized in the textile industry. A variety of analytical techniques, including X-ray diffractometry (XRD), Fourier-transform infrared spectroscopy (FTIR), and scanning electron microscopy (SEM), were employed to characterize the distinct properties of each clay. The results indicated that sepiolite exhibited the highest adsorption capacity, primarily due to its enhanced porosity. Both sepiolite and zeolite achieved impressive adsorption efficiencies, with over 90% dye removal within just four hours. In contrast, bentonite, while effective, required a longer contact time to achieve comparable results. Furthermore, the efficiency of dye adsorption varied depending on the chemical structure of the dyes. These findings highlight the strong potential of natural local clays as effective adsorbents for dye-contaminated wastewater, offering viable solutions for sustainable and low-cost industrial water treatment.

Key words: adsorption, bentonite, sepiolite and zeolite

THE IMPACT OF ORGANIC ADDITIVES ON THE PHOTOACTIVATED PERSULFATE DEGRADATION OF CHLORAZOL BLACK IN SEAWATER

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Abstract
Many organic compounds widely used by industry are discharged into seawater. These compounds must therefore be taken into consideration in every treatment process. In the present work, we studied the effect of several surfactants and formic and acetic acid on the degradation kinetics of Chlorazol Black (CB) in seawater ($[S_2O_8^{2-}]_0$ = 0.5 mM, C_0 = 20 mg/L, and pH = 3). The study found that the addition of persulfate to UV irradiation significantly enhanced the removal of CB, achieving 77% within 45 minutes compared to only 40% with UV irradiation alone. This improvement is attributed to the involvement of radicals in the degradation process. Acetic acid (1-50 mM) and the surfactants DSS, Tween 20, and Tween 80 were found to have no significant impact on the removal rate of the dye. In contrast, formic acid exhibited a strong inhibitory effect, reducing the degradation efficiency from 76% to 23% as its concentration increased from 1 to 100 mM. Similarly, the surfactant Triton X-100 caused a 40% decrease in the degradation rate. These results suggest that the chloride-derived radical ($Cl_2^{\bullet-}$), a key reactive species in saline matrices, displays high reactivity towards formic acid and Triton X-100. This study demonstrates the critical influence of specific organic additives on the efficacy of advanced oxidation processes in marine environments.

Key words: Advanced oxidation processes, UV/ persulfate, water treatment, organic compounds, seawater.

TANSFERT DES METAUX LOURD VERS LA FEVE EN TRIOS TYPES DE SOLS AGRICOLE IRRIGUENT PAR LES EAUX USEE

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Abstract

La croissance démographique et la consommation des denrées alimentaires sont de plus en plus en augmentation, nécessitant des apports plus croissants en eau potable. La réutilisation des eaux usées en agriculture, peut avoir des impacts défavorables sur la santé publique et l'environnement, le problème c'est la toxicité due à une concentration élevée de certains métaux lourds. Dans cette étude, nous nous sommes intéressés à étudier le transfert de Cd, Cr et Fe dans trois sols différents irrigués dans des zones arides (région de M'sila avec des eaux usées urbaines traitées) vers les racines et les parties aérées de fève ("racine", "feuilles", "fleur", "fruit") et déterminer les propriétés des sols et des plantes qui influencent ce transfert. Les résultats révélés pour les sols des valeurs en métaux lourds allant de 0 jusqu'au 400 mg/kg. Par contre dans les différents organes de la fève on a obtenu des valeurs allant de 0 à 9,75 mg/kg. Ces valeurs augmentent progressivement en fonction de temps, pendent le développement de la fève, mais Ces teneurs restent en dessous du seuil de toxicité dans les différents organes de la fève (Fageria et al. 2002). Pour la bioaccumulation dans les racines on peut les classer Sol**3** > Sol**2** > Sol**1**, ces valeurs sont plus élevées que celles détectées dans la partie aérienne on peut conclure que les sols sableux moins riches en MO et pauvre en argile permettent donc un transfert des éléments-traces vers les plantes plus élevé que les sols plus lourds (plus argileux).

Key words: métaux lourd, eaux usées urbaines, sol, fève, transfert.

OILY WATER TREATMENT IN THE OIL INDUSTRY AT THE HASSI MESSAOUD OIL FIELD (BRN)

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Abstract

The oil industry can pollute groundwater through oil spills, pipeline leaks, or the infiltration of toxic waste and sludge into the soil. A single liter of hydrocarbons can contaminate large quantities of groundwater, posing a serious danger to living beings due to the toxicity and persistence of these substances. This study focuses on the treatment of oily water from the oil industry at the BRN field in the eastern zone of Hassi Messaoud in the Berkine Basin using the coagulation-flocculation technique. Initial analysis revealed that this highly polluted raw water contained pollutants such as hydrocarbons, heavy metals, pollution indicators, and suspended matter exceeding permitted environmental standards. After applying five types of flocculated coagulants at different concentrations, a significant improvement in water quality was observed, with a reduction of pollutants to levels consistent with international standards. The study focused particularly on optimal treatment conditions, including pH and concentrations of the products used, to achieve maximum contaminant removal. The results demonstrate that coagulation-flocculation is an effective and economical method for treating oily waters. Coagulant-flocculants 2 and 5 showed better performance. This can be explained by the chemical composition of these two coagulant-flocculants and their ability to react effectively at a specific pH.

Key words: oily water, petroleum industry, coagulation-flocculation, pH, concentration**.**

CONTRIBUTION A LA CARACTERISATION DES PARAMETRES PHYSICO-CHIMIQUES DES EAUX D'OUED M'ZI (LAGHOUAT) : APPROCHE ANALYTIQUE ET RECOMMANDATIONS POUR UNE GESTION DURABLE.

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Abstract
Cette étude vise à évaluer la qualité physico-chimique des eaux d'oued M'Zi, un cours d'eau important traversant la région semi-aride de Laghouat, en Algérie. Des échantillons d'eau ont été prélevés d'amont, du centre et en aval d'oued. Les analyses ont porté sur plusieurs paramètres physico-chimiques, notamment le pH, la Dureté, la conductivité électrique,…etc. Les résultats obtenus sont comme suit : L'Alcalinité de 179 mg/L à 180,66 mg/L ; la Dureté totale est de 74,46 mg/L à 75 mg/L ; le pH de 7,55 à 7,89 ; les Matériaux de dépôt de 82,93 mg/L à 178,79 mg/L. La Salinité est de 0,43 mg/L à 0,6 mg/L, les Résidus secs sont de 768,33 mg/L à 784 mg/L, la Conductivité électrique : de 1458,66 uS/cm à 1630 uS/cm. Pour les Carbonates : Ses résultats étaient de 300 mg/L. Alors -que les Nitrates et les nitrites : le résultat est nul. Les résultats montrent une dégradation progressive de la qualité des eaux le long de l'oued, particulièrement en aval de la ville de Laghouat, en lien avec les rejets domestiques et agricoles. Plusieurs paramètres dépassent les normes de potabilité et de qualité pour les eaux de surface, indiquant une pollution modérée à élever, surtout en période d'étiage. Cette étude souligne l'importance de la mise en place d'un système de surveillance régulier de la qualité des eaux de l'oued M'Zi, ainsi que l'adoption de mesures de gestion durable pour préserver cette ressource vitale dans une région à forte vulnérabilité hydrique.
Key words: Oued M'Zi, Analyses physico-chimiques, Qualité de l'eau, Laghouat, surveillance environnementale**.**

MAGNETIZED FRUIT-BASED BIOSORBENT FOR DYSPROSIUM IONS RECOVERY FROM AQUEOUS SOLUTIONS

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Abstract
The recovery of rare earth elements (REEs) from water is of growing interest due to their economic value and environmental impact. In this study, a sustainable magnetic biosorbent derived from fruit waste was prepared and applied for the recovery of dysprosium ions from aqueous solutions. Batch adsorption experiments were carried out under various conditions, including initial pH of solution, contact time, initial Dy (III) ions concentration, biosorbent dosage, and temperature. The results revealed that the optimum pH for dysprosium recovery was 5.6, and adsorption equilibrium was reached within 60 minutes. The maximum adsorption capacity was found to be 17 mg/g, demonstrating the efficiency of the biosorbent. Kinetic studies indicated that the process followed the pseudo-second-order model, suggesting chemisorption as the dominant mechanism. Among the tested isotherm models, the Dubinin–Radushkevich (D–R) isotherm provided the best fit, confirming the heterogeneous nature of the adsorption sites. Thermodynamic analysis further highlighted the endothermic, spontaneous and favorable character of the recovery process. The magnetic property of the material ensured easy separation and reusability, confirming its potential as a green and cost-effective solution for rare earth recovery from contaminated waters.

Key words: Magnetic biosorbent, Fruit-based material, Dysprosium (II I), Adsorption, Water treatment.

ASSESSMENT OF THE ENVIRONMENTAL IMPACT OF BRINES DISCHARGED FROM DESALINATION PLANTS: CASE OF CHATT EL HILLAL DESALINATION PLANT (AIN TEMOUCHENT CITY).

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Abstract

After desalinating seawater, desalination plants generate brine containing significant amounts of salts, heavy metals and organic pollutants. This brine is twice as salty as standard seawater. Currently, the discharge of large quantities of brine may alter the chemical composition of seawater in the future and harm biodiversity and marine ecosystems, including underwater fauna and flora. However, the specific impact of these brines on marine ecosystems remains poorly documented. This study aimed to assess the chemical loads of desalination brines discharged into the sea by the Chatt el Hillal desalination plant and to evaluate the impact of these brines on the receiving environment. Several seawater samples were taken at different times of the day at three different points along the desalination plant's discharge pipe into the deep sea. The physicochemical parameters were analysed, including temperature, pH, conductivity, BOD_5, TSS, heavy metals, ammonium, nitrates, nitrites, phosphorus, etc. The levels of the parameters measured were compared with the Algerian regulatory standards. Analysis of the results revealed a sharp increase in pollution levels at the outlet of the discharge pipe, followed by a gradual decrease at the other two locations. The high brine loads significantly degraded the quality of the seawater. The organic pollution index classified these discharges as hypersaline water (higher than seawater), which translates into excessive levels of chlorides, potassium, calcium, phosphorus, sodium and TSS, leading to disruption of the local aquatic ecosystem.

Key words: Impact, seawater, brine, desalination plant, discharge, assessment**.**

COMPARISON OF FENTON AND SOLAR PHOTO-FENTON PROCESSES FOR THE DEGRADATION OF P-NITROPHENOL

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Abstract

Advanced oxidation processes (AOPs) are considered promising technologies for the treatment of water contaminated with recalcitrant organic compounds. These processes generate highly reactive oxidizing species, such as hydroxyl radicals ($^{\bullet}OH$), which enable the efficient degradation of toxic pollutants resistant to conventional treatment methods. As a result, they help reduce associated environmental and public health risks. This study compares the Fenton and solar photo-Fenton processes to evaluate their efficiency in degrading p-nitrophenol (PNP)**,** a model persistent organic pollutant. The evolution of PNP concentration over time was monitored using UV-Visible spectroscopy. Under optimal conditions (pH ≈ 3, $[Fe^{2+}]$ = 0.5 mM, $[H_2O_2]$ = 7 mM), the solar photo-Fenton process achieved 78.6% degradation of PNP within 90 minutes, whereas the classical Fenton process reached only 45% under the same conditions. The pseudo-first-order rate constant for the photo-Fenton process was 0.05622 min^{-1}**,** compared to 0.04642 min^{-1} for the Fenton process, confirming the enhanced kinetics of the photo-assisted system. These results highlight the improved performance of the solar photo-Fenton process and its potential as an efficient and sustainable technology for wastewater treatment.

Key words: Advanced oxidation processes, Fenton, solar photo-Fenton, p-nitrophenol, hydroxyl radicals, degradation kinetics.

ELECTROLEACHING-BASED REMOVAL OF CADMIUM FROM NATURAL PHOSPHATES FOR SUSTAINABLE WATER AND ENVIRONMENTAL PROTECTION

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Abstract

Demographic expansion, together with the industrial revolution, has resulted in widespread contamination of water, soil, and air by heavy metals and other hazardous pollutants. Among them, cadmium is of particular concern due to its high toxicity, bioaccumulation, and long-term environmental persistence. The presence of cadmium in soils and waters poses a serious threat to both human health and ecosystems, making the search for efficient, economical, and sustainable removal methods a global priority. Recently, the European Union has proposed new regulations aiming to reduce cadmium concentrations in phosphate fertilizers. This measure pursues two major objectives: the harmonization of the fertilizer market and the prevention of the gradual accumulation of cadmium in agricultural soils, which could otherwise compromise soil fertility and food safety. In this framework, our experimental study investigates the removal of cadmium from Djebel El Onk phosphate ore (Tébessa, Algeria) using an electroleaching process under the influence of an electric field. The obtained results demonstrate that the cadmium concentration in the untreated ore ranges between 15 and 16 $mg \cdot kg^{-1}$. After treatment, electroleaching was able to significantly decrease cadmium levels from 15.85 to 7.66 $mg \cdot kg^{-1}$, highlighting its potential as an effective and promising approach for producing cleaner phosphate resources and supporting sustainable agricultural practices.

Key words: Natural phosphates, Cadmium, Electroextraction, Environment, Heavy metals

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BIO-FUNCTIONALIZATION OF A SENSOR FOR THE DETECTION OF PESTICIDES

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Abstract

During the last decades, the considerable progress of the techniques brought into play in fields as varied as medicine and clinical biology, the food industry or the control of the quality of our environment (monitoring of industrial or domestic discharges) have required the development of increasingly precise and selective analytical methods. Electrochemical sensors and biosensors are arguably the most attractive alternative for providing simple and reliable, rapid and selective detection systems. Within the framework of this work, we are mainly interested in the development of a biosensor with impedance technology. To detect pesticides, which are toxic elements in water contaminated with industrial waste, vegetables and fruits treated with pesticides, and agricultural soils.

The predominant step in this study is the selection of the sensitive membrane to be deposited on the chosen transducer. For our case, we chose to use (the enzyme) which will act as a discriminating molecule for the species to be detected (pesticides). In addition, these measurements were made by modifying a number of characteristic parameters of the system studied in order to determine the role of various elements involved in the development of the receptor part of the sensor (Enzyme (CRL), Bovine serum albumin (BSA) , glutaraldehyde (GA), glycerol).

The work is carried out with the technique of electrochemical impedance spectroscopy in a frequency range going from 100 KHz to 100 mHz.

Key words: biosensor, electrochemical impedance, enzyme, Bovine serum albumin, glutaraldehyde.

OPTIMIZATION OF THE PHOTO-FENTON PROCESS FOR CRYSTAL VIOLET DEGRADATION

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Abstract

Human activities, particularly industrial discharges, release large quantities of persistent organic pollutants into aquatic environments, leading to severe ecological and health concerns. Synthetic dyes such as Crystal Violet are of particular interest because of their intense color, chemical stability, and potential toxicity, including mutagenic and carcinogenic effects. Conventional treatment methods, whether biological or physico-chemical, often fail to completely remove these contaminants, highlighting the need for alternative approaches.

Advanced oxidation processes (AOPs) have emerged as powerful methods for degrading recalcitrant organic molecules through the in-situ generation of highly reactive hydroxyl radicals. Among these, the Photo-Fenton process—combining ferrous ions, hydrogen peroxide, and UV/visible irradiation—offers enhanced mineralization rates under mild conditions. In this study, the Photo-Fenton process was applied to the degradation of Crystal Violet dye. A systematic experimental design was implemented to evaluate and optimize key operational parameters such as pH, Fe^{2+} and H_2O_2 concentrations, irradiation time, and initial dye concentration. The degradation kinetics and mineralization efficiency were monitored by UV–Vis spectrophotometry. Preliminary results showed up to 90 % removal of Crystal Violet within 60 minutes under optimal conditions, demonstrating a significant improvement in color removal and mineralization compared with the classical Fenton reaction. These findings confirm the potential of the optimized Photo-Fenton process as a cost-effective and environmentally friendly treatment for dye-contaminated effluent.

Key words: Photo-Fenton, Crystal Violet, Advanced Oxidation, Dye Degradation, Water treatment, Pollution.

ELIMINATION OF METHYLENE BLUE FROM AQUEOUS SOLUTIONS USING MIXED OXIDE PHOTOCATALYSTS UNDER VISIBLE LIGHT IRRADIATION

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Abstract

The persistent presence of organic pollutants in water represents a critical environmental challenge, driving the need for efficient and sustainable remediation strategies. In this study, mixed oxide materials of perovskite and spinel structures were synthesized and evaluated as visible-light-driven photocatalysts for the elimination of methylene blue, a model organic pollutant. The objective was to investigate the influence of crystal structure and composition on photocatalytic efficiency and to elucidate the underlying degradation mechanisms. Materials were systematically characterized using X-ray diffraction (XRD), UV–Vis diffuse reflectance spectroscopy (DRS), Fourier-transform infrared spectroscopy (FTIR), and electron microscopy (SEM/TEM) to correlate structural and optical properties with activity. Photocatalytic experiments under visible-light irradiation revealed that perovskite and spinel mixed oxides exhibit distinct degradation kinetics, highlighting the role of crystal structure in facilitating charge separation and reactive species generation. Mechanistic studies using selective scavengers demonstrated that both hydroxyl radicals and photogenerated holes significantly contribute to pollutant degradation. This work provides a novel insight into structure-activity relationships for mixed oxide photocatalysts and demonstrates their potential as versatile materials for sustainable water treatment applications. The findings offer guidance for the rational design of high-performance photocatalytic systems targeting organic contaminant removal.

Keywords: mixed oxides, perovskite, photocatalysis, visible light, methylene blue, pollutant degradation

CONTINUOUS COLUMN ADSORPTION OF TOXIC HEXAVALENT CHROMIUM ONTO RAW PEACH STONES: EXPERIMENTAL AND BREAKTHROUGH CURVES ANALYSIS

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Abstract

Chromium is a toxic and carcinogenic heavy metal often found at high concentrations in industrial wastewater. Therefore, its removal before discharge into aquatic environments is of prime importance, which constitutes the main objective of this study. Raw biosorbent waste is a low-cost and environmentally friendly material that offers a good cost–benefit ratio for industrial applications. In this work, raw local peach stones (RPS) were used as an adsorbent to remove hexavalent chromium from contaminated water using a fixed-bed column system. The effects of operational parameters such as flow rate (1.5, 3 and 5ml/min) and bed height (1, 2 and 3cm) on Cr(VI) adsorption onto RPS were investigated. Experimental results showed higher adsorption efficiency at the lowest flow rate (1.5ml/min) and the greatest bed height (3cm). The breakthrough curves were successfully fitted by the Thomas and Yoon-Nelson models. These findings highlight the high potential of raw peach stones as an effective biosorbent for the removal of Cr(VI) ions from aqueous solutions.

Keywords: Hexavalent chromium; Raw peach stones; Adsorption; Breakthrough curves; Flow rate; Bed height.

$NI_XCU_{1-X}FE_2O_4$ SPINEL SOLID SOLUTIONS AS EFFICIENT ELECTROCATALYSTS FOR GLUCOSE SENSING

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Abstract

The solid solution $Ni_xCu_{1-x}Fe_2O_4$ (NFCO, x= 0, x=0. 2,….x=1) prepared by sol-gel method after annealing at 800 °C crystallizes in a normal spinel structure. The structural, magnetic, optical, electrochemical and electrical properties were investigated. The formation of the tetragonal phase with a good crystallization quality and stoichiometric content were confirmed by X-ray diffraction (XRD) (x = 0 and 0.2) while a transition to cubic symmetry is observed for the other compositions. Magnetic measurements reveal that saturation magnetization value (Ms) increases as the amount of Ni in the structure increases whereas the coercivity decreased. The transport properties are characteristic of *n*-type behavior where the electrical conductivity decreases up to x = 0.4 and then increases above this value, and is governed by the thermal emission over the inter-crystalline. The electrode $\boldsymbol{Ni_{0.2}Cu_{0.8}Fe_2O_4}$ showed excellent electrocatalytical response to the oxidation, which was studied by cyclic voltammetry (CV). The synthesized nanoparticles exhibited rapid response, low detection limit, good reproducibility and selectivity.

Key words: Sol-Gel; Semiconductors; Glucose; Voltammetric detection; Transport properties.

ENHANCED PHOTOCATALYTIC ACTIVITY OF CO-DOPED $BiMnO_3$ NANOPARTICLES UNDER SUNLIGHT IRRADIATION

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Abstract
In this work, $BiMnO_3$ nanoparticles doped with cobalt at various concentrations (0%, 0.1%, 0.3%, and 0.5%) were successfully synthesized using the hydrothermal method. The structural and physicochemical properties of the obtained samples were investigated using X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), Raman spectroscopy, and zeta potential analysis. Cobalt doping was found to influence the structural, colloidal, and photocatalytic properties of the material. XRD analyses revealed two crystalline phases, namely monoclinic and cubic with crystallite sizes ranging from 30.16 to 92.88 nm, confirming the nanostructured nature of the material. Fourier-transform infrared spectroscopy in ATR mode (FTIR-ATR) further identified the vibrational modes associated with the Bi–O and Mn–O bonds, consistent with the perovskite framework of $BiMnO_3$. Raman spectroscopy confirmed these findings, highlighting the structural distortions induced by cobalt incorporation, while zeta potential measurements provided insights into the colloidal stability of the nanoparticles.The **0.3% Co-doped sample** exhibited **complete degradation of Congo red in just 5 minutes** and **85% degradation of methylene blue within 60 minutes**.These findings highlight the critical role of cobalt concentration in tuning the multifunctional performance of $BiMnO_3$-based materials for potential environmental and biomedical applications.

Key words: $BiMnO_3$ Cobalt doping, photocatalysis, MB,CR

ENVIRONMENTAL IMPACT AND TREATMENT STRATEGIES FOR PHOSPHATE SLUDGE FROM BENEFICIATION PROCESSES

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Abstract
Phosphate ore beneficiation produces large volumes of fine-grained residues known as phosphate sludge, which pose environmental risks due to their potential to contaminate water sources and degrade land quality. This study investigates the physicochemical properties of phosphate sludge and evaluates its impact on surrounding water systems. Laboratory analyses were conducted to determine particle size distribution, pH, conductivity, and the presence of heavy metals and nutrients. The sludge's mobility in aqueous environments was assessed, as well as its contribution to turbidity and sedimentation in nearby bodies of water. Several treatment approaches, including gravitational settling, chemical flocculation, and filtration, were tested to evaluate their efficiency in removing pollutants and reducing the sludge's environmental footprint. Preliminary results indicate that untreated phosphate sludge significantly increases water turbidity and may facilitate the transport of hazardous substances. Chemical treatment methods demonstrated high removal efficiency for suspended solids. The findings highlight the urgent need for proper waste handling practices in phosphate mining operations. Moreover, integrating low-cost treatment technologies into current waste management systems could help mitigate the environmental impacts of phosphate tailings and contribute to more sustainable mining practices.

Key words: Phosphate sludge; Water pollution; Waste treatment; Environmental impact; Sustainable mining

PHYTOCHEMICAL COMPOSITION AND BIOEFFICACY OF *RUTA* SPECIES OILS AND THEIR MIXTURE AGAINST A MOSQUITO VECTOR

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Abstract
In recent years, plant-derived insecticides have gained attention as sustainable and eco-friendly alternatives for mosquito control. Essential oils, with their chemical diversity, multiple modes of action, and biodegradability, represent promising candidates to overcome the limitations of synthetic insecticides. In this study, we evaluated the larvicidal efficacy of essential oils extracted from *Ruta graveolens* and *Ruta montana*, tested individually and as a 1:1 blend, against *Culiseta longiareolata* larvae. Gas chromatography–mass spectrometry (GC–MS) analysis identified eight compounds in *R. graveolens*, six in *R. montana*, and ten in the mixture. Bioassay experiments demonstrated strong larvicidal activity, with LC_{50} values confirming the high toxicity of both individual oils and, more notably, their combination. In addition to mortality, exposure to these essential oils caused marked physiological disruptions in the larvae, reflected by significant reductions in protein, lipid, and carbohydrate reserves. Such depletion of essential biomolecules indicates a severe impairment of larval metabolism, contributing to the overall toxic action of the oils. By combining direct toxicity with metabolic disruption, these essential oils exert multi-target effects that not only enhance larvicidal efficacy but also reduce the likelihood of resistance development. Overall, the findings highlight the potential of Ruta-based essential oils, particularly in binary mixtures, as promising and environmentally safe tools for sustainable mosquito management.
Key words: GC–MS analysis, Synergistic effect, Larval metabolism, Botanical insecticides.

EXPLORING THE PRODUCTION OF THERMOTOLERANT EXTRACELLULAR AMYLASES BY THERMOPHILIC BACTERIA ISOLATED FROM A HOT SPRING IN ALGERIA

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Abstract
The unique ability of extremophiles and their extremozymes to withstand extreme environmental conditions underpins their industrial value. Thermozymes from thermophilic bacteria, such as proteases, lipases, cellulases, chitinases, and amylases, have garnered significant research interest due to their beneficial thermostable properties. Thermally stable amylases alone constitute nearly 25% of the enzyme market. Consequently, amylases from thermophilic bacteria, which remain stable under poly-extremophilic conditions, are advantageous for various industries, including food, paper, textile, and detergent sectors. This study aims to isolate thermophilic bacteria from a hot spring in Algeria, evaluate their amylase production, and assess their thermotolerance at different temperatures to identify the most efficient strain. A collection of thermophilic isolates was obtained from water and sediment samples collected from the Hammam Ibainan hot spring in northeastern Algeria. Screening on solid media revealed that 22 strains exhibited amylase activity. The amylase activity, measured using the Miller method, ranged from 3 ± 0.17 U to 17.1 ± 0.72 U across temperatures from 60 °C to 100 °C. A two-way ANOVA coupled with Tukey's test revealed that strain Sd15 exhibited significantly higher activity compared to the other strains ($p < 0.001$). This strain underwent further phenotypic characterization using 64 tests and molecular identification via 16S rDNA gene sequencing, confirming its affiliation with the species *Geobacillus thermoleovorans*. Further evaluation of the amylases produced by strain Sd15 will enable their industrial application, particularly for the valorization of agro-food by-products.
Key words: amylases, hot spring, thermophilic bacteria, thermotolerant.

CARACTERISATION DE LA POLLUTION ET DU DEGRE D'EUTROPHISATION DES EAUX DU BARRAGE CHEURFA II, NORD OUEST ALGERIEN.

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Résumé

Cette étude s'inscrit dans le cadre du développement durable et de la gestion des ressources en eau dans l'ouest algérien (wilayas de Mascara et Sidi Bel Abbès). L'objectif était de caractériser le degré de pollution et d'eutrophisation du barrage Cheurfas II, dont l'eau est destinée à l'alimentation et à l'irrigation.L'eutrophisation est la prolifération d'algues due à un excès de nutriments (azote et phosphore) dans les lacs, entraînant une baisse de l'oxygène dissous, une dégradation du milieu aquatique et donc un risque sanitaire. Les indices calculés à partir des résultats d'analyses d'échantillons d'eau prélevés révèlent une forte dégradation de la qualité de l'eau du barrage:

- Indice de Qualité de l'Eau (IQE / WQI) : Une valeur de 181,353 indique que l'eau est non potable.
- Indice de Pollution Organique (IPO) : Les valeurs, situées entre 2,5 et 2,75, traduisent une forte pollution organique.
- Indice de l'État Trophique (TSI) : Les valeurs élevées (57,19 à 71,99) confirment un milieu eutrophe (dégradé et riche en nutriments).
- Classification de l'OCDE : Basée sur les concentrations de phosphore total (*90 a` 190 µg/L*), classe le barrage dans la catégorie eutrophe à hyper-eutrophe, signalant une très forte disponibilité en nutriments propice à la prolifération algale.

Les résultats démontrent une forte menace pour la faune aquatique et les usagers due à une pollution organique et une eutrophisation, sévères du réservoir.

Mots clés : développement durable, pollution, eutrophisation, indices de qualité de l'eau, indice de l'état trophique, barrage CheurffasII.

EFFET DES CONDITIONS DE TRAITEMENT SUR LA DEGRADATION DE POLLUANTS ORGANIQUES REFRACTAIRES PAR LE SYSTEME UV/CHLORE D'OXYDATION AVANCEE

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Abstract

L'élimination des contaminants émergents dans les eaux usées est essentielle pour réduire les risques sanitaires et environnementaux. Les procédés d'oxydation avancée (POA), qui génèrent des espèces réactives telles que les radicaux hydroxyles et chloré, sont prometteurs pour traiter les polluants organiques persistants et toxiques. L'association de l'ultraviolet (UV) et du chlore constitue une méthode écologique de désinfection, offrant une protection résiduelle tout en permettant à la fois l'inactivation des pathogènes et la dégradation des micropolluants. Cependant, l'application de cette méthode aux effluents de l'industrie textile reste limitée, en raison de la décoloration rapide des colorants par le chlore seul, ce qui masque l'effet synergique de l'UV/chlore. Ce travail se concentre sur l'étude de l'élimination de bleu de toluidine, un colorant textile réfractaire, en étudiant l'impact du pH, de la concentration initiale de chlore, de la concentration du colorant et de la longueur d'onde du rayonnement UV.

Les résultats montrent que l'optimisation du pH à des valeurs neutres et l'utilisation de faibles doses de chlore favorisent significativement l'effet synergique, améliorant ainsi la dégradation photochimique de bleu de toluidine. Ces conditions permettent de limiter la décoloration rapide causée par le chlore seul et optimisent l'efficacité du procédé UV/chlore dans le traitement des eaux usées textiles, constituant ainsi une avancée importante pour cette application.

Key words: procédés d'oxydation avancée, réfractaires, UV/chlore, synergique, toluidine bleu

DEVELOPMENT OF A BIO-ADSORBENTS AND A BIOPOLYMERS FROM WASTE MATERIALS FOR THE TREATMENT OF TOXIC INDUSTRIAL EFFLUENTS

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Abstract
Waste recovery can be regarded as a strategic approach to reducing environmental impact and developing local wastewater treatment solutions. In this study, abundant and inexpensive natural resources were transformed into functional materials by preparing chitosans from chitin purified by basic deacetylation carried out at room temperature and with a low NaOH content (40%), yielding a biopolymer of interest for pollution control. These conditions are entirely distinct from those previously documented in the extant literature, namely elevated temperature (100 to 110°C), NaOH concentrations ranging from 40 to 60%, and a duration of several hours under agitation. Concurrently, a bioadsorbent derived from shellfish was prepared without undergoing chemical modification and employed for the removal of an anionic azo dye present in textile effluents. The findings indicate the considerable promise of these materials in terms of their application in the sustainable treatment of industrial water.

Key words: Chitin, Chitosan, Bioadsorbent, Azo dye, Deacetylation.

ASSESSMENT OF NON-STATIONARY HYDROLOGICAL EXTREMES: CHANGES IN FLOOD AND DROUGHT REGIMES IN THE MAZAFRAN WATERSHED, NORTHERN ALGERIA

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Abstract

This study examines how the hydrological regime and sediment transport dynamics in the Mazafran watershed (1,912 km^2), which is situated in North of Algiera, are affected by intensified hydrological extremes, including floods and low-flow events. The Thiessen polygon and isohyetal methods were used to spatially analyse precipitation data from 1972 to 2013, these methods allowing for the physical understanding of the watershed (orographic effect) showed that Oued Chiffa had the highest mean annual precipitation (649 mm), the average rainfall recorded at the Oued DjerBouroumi and Oued Mazafran stations is 539 mm and 571 mm, respectively. Gumbel and log-normal distributions were used to derive Intensity–Duration–Frequency (IDF) curves; chi-square goodness-of-fit tests indicated that the two-parameter exponential distribution was the most appropriate. Correlation analysis, cross-correlation functions, and hydrological model were used to investigate the rainfall–runoff relationship. Although seasonal variability and antecedent soil moisture conditions affect its predictive power, the results demonstrate that precipitated water depth is a valid indicator of discharge. In terms of strategic change, especially counters such as brush layering (fascines) for bank stabilisation, which these works recommend for the riverbed management and mitigation of impacts, are of primary relevance.

Key words: Extreme events, IDF curves, rainfall-runoff modeling, sediment transport, Mazafran watershed, hydrological management.

ENHANCING LIQUID-LIQUID EXTRACTION OF PROPIONIC ACID WITH CACL

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Abstract
Carboxylic acids, such as propionic acid, are important industrial compounds, but their presence in industrial effluents raises significant environmental concerns. Their occurrence in wastewater from the agro-food and paper industries poses a major problem., emphasizing the need to optimize their extraction from aqueous solutions. This study investigates the effect of calcium chloride ($CaCl_2$) on the liquid-liquid extraction of propionic acid, utilizing hexane as solvent. The addition of $CaCl_2$ introduces ionic forces that alter the immiscibility curve, affecting the distribution of the solute, propionic acid, between the extract and raffinate phases. This process promotes phenomena such as salting-out and salting-in, which can enhance extraction efficiency.Experimental data on liquid-liquid equilibrium for the ternary system Water/Propionic Acid/Hexane were collected at $CaCl_2$ concentrations of 5%, 10%, and 15% under ambient temperature and atmospheric pressure, using the cloud point method. The reliability of these experimental results was verified through the application of Othmer-Tobias, Hand, and Eisen-Joff correlations, which demonstrated excellent consistency. In the absence of salt, all three correlations exhibited very high R^2 values, particularly for the Hand and Eisen-Joffe equations, confirming that the equilibrium data accurately represent the studied system. With the addition of $CaCl_2$, an improvement in the R^2 coefficient was observed for the Othmer-Tobias and Eisen-Joffe equations at 5%, indicating a high degree of uniformity in the data. The best fit for Othmer-Tobias occurred at 10%, though coefficients decreased slightly at 15%.
Overall, the results indicate that $CaCl_2$ significantly influences the equilibrium of this system, enhancing the extraction of the desired compound and highlighting the crucial role of salts in improving extraction efficiency.
Key words: Cloud point method, calcium chloride effect, experimental data, extraction efficiency, liquid-liquid extraction, immiscibility curve.

GROUNDWATER QUALITY FOR IRRIGATION IN THE KEBIR AMONT SUB-BASIN OF THE KEBIR RHUMEL BASIN, ALGERIA

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Abstract
The assessment of the Irrigation Water Quality Index (IWQI) for 24 wells in the Kebir Amont sub-basin area (Constantine Province), based on EC, Na, Cl, HCO_3, and SAR, revealed that the vast majority of samples (91.97%) fall within the High Restriction (HR) category, while limited proportions were classified under Severe Restriction (SR) (4.16%) and the Moderate Restriction (MR) class (4.16%). This situation highlights a critical constraint on the use of these waters for irrigation. Correlation analysis (r, p value) showed a perfect relationship between Na and Cl ($r=1.00$, $p<0.001$), along with significant positive correlations between EC and both Na ($r=0.44$, $p=0.033$) and Cl ($r=0.44$, $p=0.033$). In contrast, a significant negative correlation was recorded between SAR and HCO_3 ($r=-0.41$, $p=0.046$), in addition to a weak and non-significant negative relationship between SAR and both Na and Cl ($r=-0.39$, $p=0.060$). Hierarchical classification (CHA) further indicated that SAR behaves independently from the other parameters (EC, Na, Cl, HCO_3), and the wells were separated into two distinct groups, reflecting heterogeneity in their hydrochemical signature. Regarding the drivers of IWQI, linear regression ($R^2=0.905$) confirmed that EC is the most influential parameter, followed by HCO_3 and SAR, while Na and Cl played a secondary role. Random forest analysis supported these findings, ranking EC as the most important variable, followed by Na, Cl, and HCO_3, whereas SAR had only a marginal effect. Overall, the results demonstrate that salinity (EC) is the principal determinant of irrigation water quality in the study area, with varying contributions from the other parameters.

Key words: Irrigation Water Quality Index (IWQI), Salinity, Correlation analysis, Hierarchical classification (CHA).

EXTRACTION OF LEAD FROM AQUEOUS NITRATE MEDIA USING THE EMULSION LIQUID MEMBRANE (ELM) TECHNIQUE

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Abstract
Environmental pollution by heavy metals is one of the major issues of our time. These metals are found in both soil and water, and their often mixed presence complicates recovery efforts, requiring selective and environmentally friendly extraction techniques. Lead, a heavy metal extensively used since antiquity and rediscovered during the Industrial Revolution, is still widely exploited today, particularly from used vehicle batteries. This work explores a novel approach for lead recovery: the use of emulsion liquid membrane (ELM) extraction, which presents a promising alternative to the widely adopted liquid-liquid extraction (LLE) process at the industrial scale. ELM enables simultaneous extraction and pre-concentration of metals in one step. It minimizes the use of organic solvents due to regeneration, improves mass transfer thanks to the high surface area of emulsion globules, and requires moderate energy input with little sludge generation. In this process, emulsion globules are formed from dichloromethane containing di(2-ethylhexyl)phosphoric acid (D2EHPA) as extractant and Triton X-100 as surfactant. The results demonstrate complete (100%) lead extraction under the following conditions: D2EHPA/Triton ratio: 0.5% (w/w); Emulsification time: 20 Minutes; Emulsification speed: 1000 rpm; Stripping solution: 1 M H_2SO_4; Equilibrium time: 40 minutes; Extraction stirring speed: 230 rpm; Initial Pb(II) concentration: 500 ppm. These results confirm the potential of ELM as a highly effective and sustainable method for selective lead recovery from contaminated water.
Key words: Water Treatment; Liquid membrane emulsion; Lead (II); D2EHPA; Triton X-100

WATER TREATMENT AND METHYLENE BLUE ADSORPTION ONTO ACTIVATED CARBON: KINETIC AND ISOTHERM

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Abstract
The contamination of aquatic environments by synthetic dyes, particularly methylene blue, poses a major environmental concern due to their toxicity, chemical stability, and low biodegradability. Among the available treatment techniques, adsorption onto commercial activated carbon is considered one of the most efficient, cost-effective, and straightforward methods for removing organic dyes from wastewater. This study investigates the adsorption performance of commercial activated carbon for methylene blue removal from aqueous solutions. The effects of key operational parameters were examined, including initial dye concentration, adsorbent dosage, contact time, solution pH. Experimental results indicate that adsorption occurs rapidly in the initial stages before reaching equilibrium. The results of this study demonstrate that activated carbon has a high adsorption capacity, making it an adsorbent of choice for methylene blue. Operational parameters, such as the initial dye concentration, pH, temperature, and contact time, play a crucial role in the adsorption efficiency.In conclusion, this study confirms that the use of activated carbon is a promising and effective solution for the removal of methylene blue from wastewater. Optimization of adsorption conditions can lead to a significant improvement in treatment performance, which is crucial for industrial applications. However, further research is necessary to explore the effectiveness of this method on a larger scale and for different types of contaminants, in order to develop more sustainable and efficient water treatment solutions.
Keywords: Water Treatment, Adsorption, Methylene Blue, Activated Carbon

EXPLORING ARTIFICIAL INTELLIGENCE SIMULATIONS FOR OPTIMIZING WASTEWATER TREATMENT AT AIN EL HOUTZ PLANT (TLEMCEN)

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Abstract
Wastewater process optimisation has now become a priority in Algeria, a country where water is scarce and there is demand for efficient and sustainable management. The potential of Artificial Intelligence (AI) to enhance the performance and efficiency at the AIN El Houtz Wastewater Treatment Plant (WWTP) in Tlemcen, Algeria is discussed. The WWTP was commissioned in 2005 with a capacity of 30,000 m³/d (low-load activated sludge technology), obtaining removal rates for organic pollutants (BOD_5: 92%, COD: 90%, TSS: 91%) and low achievements for nutrients ($NH_4^+ \approx 60\%$; TP < 50%). To further optimise biological effluent removal, a Random Forest Regression (RFR) model was developed and trained on monitoring data from 2020–2022 to estimate effluent quality and assist decision-making. This study gives evidence for acceptable prediction (R^2 = 0.81) of nitrogen compounds, and moderate for BOD_5 and COD. Suspended solids and phosphorus were more difficult to predict because of variability and limited dataset. However, the investigation into the use of AI-based simulations for real-time monitoring, predictive maintenance, and operations optimisation of WWTPs is promising and can be applied across much of the developing world. This study highlights the potential of AI predictive modelling as an embedded system in smart and sustainable water management for Algeria.
Key words: Wastewater Treatment Plant (WWTP), Artificial Intelligence (AI), Random Forest Regression (RFR), Process Optimisation, Effluent Quality Prediction, Sustainable Water Management.

ADVANCED PHOTOCATALYSIS FOR WATER TREATMENT: A SUSTAINABLE STRATEGY FOR THE DEGRADATION OF CONGO RED AND INDUSTRIAL EFFLUENTS

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Abstract
Dyes are extensively used in the textile, food, cosmetic, and pharmaceutical industries, but many of them are toxic and environmentally persistent, leading to severe risks for aquatic ecosystems and human health. Developing efficient and sustainable methods for their removal from wastewater is therefore of great importance. In this study, a nanoparticles $FeMn_2O_4$ spinel oxide was synthesized via sol–gel combustion and characterized using XRD, SEM–EDS, FTIR, and UV–Vis spectroscopy. The material exhibited a crystalline spinel phase with fine particles and a strong visible-light response. The photocatalytic activity was investigated using Congo Red (CR), a common azo dye, under visible LED irradiation. The effects of pH, initial dye concentration, catalyst loading, and irradiation time were systematically studied. Under optimized conditions $FeMn_2O_4$ achieved nearly complete degradation of the dye (≈98%). Kinetic modeling confirmed a high rate constant, and radical-trapping experiments indicated that hydroxyl (•OH) and superoxide ($\bullet O_2^-$) species were the key oxidizing agents driving the degradation process. These findings highlight $FeMn_2O_4$ as a promising visible-light-driven photocatalyst for the efficient and sustainable removal of toxic dyes, with strong potential for application in industrial wastewater treatment and water resource protection.
Key words: $FeMn_2O_4$, photocatalysis, Congo red, wastewater treatment, azo dyes

PHOTOCATALYTIC PERFORMANCE OF 2% MN- AND 2% FE-DOPED ZNO NANOPARTICLES: A COMPARATIVE STUDY.

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Abstract
Water contamination by persistent organic pollutants such as 2-mercaptobenzothiazole (MBT), widely used in rubber and industrial processes, represents a major environmental challenge due to its resistance to natural degradation. Semiconductor photocatalysis has emerged as an effective and sustainable method for pollutant removal, with zinc oxide (ZnO) being one of the most promising photocatalysts. However, the rapid recombination of charge carriers limits its efficiency, and metal ion doping is often employed to enhance its photocatalytic properties. The objective of this work is to perform a comparative study between 2% Mn-doped ZnO nanoparticles and 2% Fe-doped ZnO nanoparticles in the degradation of MB from water. Both materials were prepared using the sol–gel method and characterized by X-ray diffraction (XRD). The analysis confirmed a hexagonal wurtzite structure with crystallite sizes of approximately 22-25 nm for Mn-doped ZnO and 16-19 nm for Fe-doped ZnO. The photocatalytic efficiency was evaluated under UV irradiation. The results revealed that Fe-doped ZnO exhibited superior activity, achieving a degradation efficiency of 95% after 180 minutes, compared to 92% for Mn-doped ZnO. The superior activity of Fe-doped ZnO can be attributed to its smaller particle size, which increases surface area and active sites for photocatalysis. These findings highlight the importance of particle size in enhancing ZnO-based photocatalysts for water treatment applications.

Key words: Photocatalysis, ZnO nanoparticles, Metal doping, Particle size, Sol–gel, Water treatment

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HDTMA-MODIFIED NEW ALGERIAN ILLITIC/KAOLINITIC CLAY FOR EFFECTIVE REMOVAL OF DIFENOCONAZOLE PESTICIDE FROM AQUEOUS MEDIA

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Abstract
The purpose of this research is to investigate the removal of DFZ using Algerian clay modified with cationic surfactant ($HDTMA^+$). X-ray diffraction, FTIR spectroscopy, TGA Thermogravimetric analysis and the point of zero charges (pHpzc) were used to characterize the prepared samples. The impacts of many experimental parameters, such as initial concentration of DFZ pesticide, contact time, and initial pH, on the adsorption capacity of Hc-HDTMA and THc-HDTMA towards DFZ pesticide were investigated. To understand the adsorption process, three kinetic models (Pseudo-first-order, Pseudo-second-order and Intra particle model) were applied. Adsorption isotherms such as the Langmuir, Freundlich and Tempkin models were used to identify the adsorption mechanism. The maximum removal efficiency of DFZ on Hc-HDTMA and THc-HDTMA are studied at pH 2 was found 399.94 599.91 and 799.64 µmol/g respectively for initial concentrations of 400, 600, and 800 µmol/L into THc-HDTMA and was found 399.94 599.91 and 799.64 µmol/g respectively for initial concentrations of 400, 600, and 800 µmol/L into Hc-HDTMA . DFZ adsorption was well described by the pseudo-second-order. In comparison to the Freundlich isotherm model, the Langmuir model provided the best fit to the experimental data. The maximum monolayer adsorption capacity was found to be 59.6 mg/g.

Key words: environment, wastewater, pesticide, contaminants, adsorption, clay, cationic surfactant.

METHYLENE BLUE REMOVAL FROM AQUEOUS SOLUTION USING MODIFIED COCONUT SHELL ADSORBENTS

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Abstract

This study explores the potential use of coconut shell powder, an abundant and low-cost natural by-product, as an effective biosorbent for the removal of methylene blue (MB), a cationic dye, from aqueous solutions. The adsorption process was found to be rapid and significantly influenced by various operational parameters. Finer particle sizes resulted in enhanced adsorption efficiency, while both the initial pH of the solution and the adsorbent dosage played key roles in maximizing dye removal. The adsorption data were best described by the Freundlich isotherm model, suggesting a multilayer adsorption on a heterogeneous surface. Furthermore, a preliminary desorption analysis revealed a notable recovery rate of the dye, indicating the potential for regeneration and reuse of the biosorbent. These findings highlight the feasibility of using coconut shell powder as a sustainable and efficient material for water treatment applications targeting dye pollutants.

Key words: Adsorption, Methylene Blue, Isotherms, Coconut Shell, Biosorbent.

APPLICATION OF BOX–BEHNKEN DESIGN FOR THE OPTIMIZATION OF CATIONIC DYE REMOVAL BY ADSORPTION.

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Abstract

Industrial effluents are a major contributor to water pollution, with hazardous synthetic dyes such as crystal violet (CV) posing significant environmental and health risks. CV, a cationic dye extensively used in the textile industry, is known for its toxic, mutagenic, and carcinogenic properties. Its high persistence, low biodegradability, and harmful effects on aquatic ecosystems and human health make its occurrence in wastewater particularly concerning, highlighting the need for effective removal prior to discharge. In this study, the adsorption performance of commercial zinc oxide nanoparticles (ZnO-NPs) for eliminating CV from wastewater was systematically investigated by evaluating the effects of adsorbent dosage (20–60 mg), contact time (10–60 min), and initial dye concentration (20–60 mg/L). Process optimization, carried out using Response Surface Methodology (RSM) with a Box–Behnken experimental design, yielded a maximum removal efficiency of 77.43% under optimal conditions, with a strong model correlation (R^2 = 98.46%), confirming the robustness of the predictive model. These findings demonstrate the potential of ZnO-NPs as a cost-effective and environmentally sustainable adsorbent for the treatment of dye-contaminated industrial effluents.

Key words: Optimization, Adsorption, crystal violet (CV), Commercial zinc oxide nanoparticles (ZnO-NPs), Operational parameters, Box–Behnken experimental design

ENVIRONMENTALLY BENIGN SYNTHESIS OF ZNO NANOPARTICLES FOR PHOTOCATALYTIC DEGRADATION OF REACTIVE RED 180

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Abstract:
Zinc oxide (ZnO) nanoparticles were successfully synthesized through a simple and sustainable co-precipitation route carried out at 75 °C. The method employed only zinc sulfate and sodium hydroxide as precursors, avoiding the use of surfactants, calcination steps, or hazardous solvents, which makes the process environmentally friendly and energy-efficient. The structural and optical properties of the obtained ZnO were examined using X-ray diffraction (XRD) and UV–Vis spectroscopy. XRD analysis confirmed the formation of highly crystalline ZnO with a characteristic wurtzite hexagonal phase, indicating good structural purity and stability. The sharp diffraction peaks further suggested well-defined crystallite domains without secondary phases. Optical studies by UV–Vis absorption revealed strong and broad absorption in the ultraviolet region, consistent with the electronic band gap of ZnO, supporting its suitability as a photocatalyst under UV irradiation.
The photocatalytic activity of the synthesized ZnO was evaluated for the degradation of the anionic dye Reactive Red 180 (RR180) in aqueous solution. Under optimized conditions (pH 8, catalyst loading 0.75 g/L, dye concentration 10 mg/L), ZnO achieved complete dye degradation within 30 minutes of UV exposure. This rapid photocatalytic response demonstrates the high efficiency of ZnO in mineralizing RR180, highlighting its promise as a low-cost and stable photocatalyst for wastewater treatment applications.

Key words: ZnO nanoparticles, cost-effective, photocatalysis, dye degradation, sustainability, X-ray diffraction (XRD).

TOWARDS ECO-FRIENDLY SCALE INHIBITION: EFFICIENCY OF A PLANT EXTRACT AGAINST $CACO_3$ PRECIPITATION

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Abstract:
The water sector in Algeria faces various problems, the most widespread and persistent of which is scaling, primarily caused by the precipitation of calcium carbonate ($CaCO_3$). The goal of this study is to evaluate the effect of a green inhibitor, derived from a plant extract, on the formation of $CaCO_3$.
To achieve this, an accelerated kinetic study was conducted using the critical pH method. This technique consists of titrating a pure calcocarbonically solution (CCP) at 30 °f and 30 °C with a 0.01 M NaOH solution under agitation, while monitoring the pH of the solution and the calcium concentration (TCa). To identify the crystalline phases of the precipitate formed, characterization by X-ray diffraction (XRD) was performed.
A new green inhibitor was tested. The aqueous extract was obtained by maceration in water, a gentle and economical extraction method. The results showed that the addition of a precise volume of the green inhibitor delayed the drop in pH as well as the drop in TCa, indicating that the plant extract is effective. It was demonstrated that it acts at low concentrations and that its threshold effect was highlighted. The inhibition efficiency increases with the concentration of the extract. Complete inhibition was achieved at a concentration of 15 mL/L.
Fourier-transform infrared spectroscopy (FTIR) was used to analyze the powdered plant extract, revealing the presence of several functional groups such as O–H, N–H, C–N, C–H, C–O, C=C, and C=O, which indicates the richness of the extract in bioactive metabolites.

Key words: $CaCO_3$; critical pH; CCP; green inhibitor.

SUSTAINABLE SYNTHESIS OF Fe_3O_4 NANOPARTICLES FROM RECYCLED IRON WASTE FOR EFFICIENT WASTEWATER TREATMENT

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Abstract:
The recovery and valorization of metallic waste offer a sustainable pathway for the development of functional materials. In this study, iron oxide nanoparticles (Fe_3O_4) were synthesized via a coprecipitation route using iron precursors extracted from scrap components of a discarded fan motor. The objective was to evaluate the potential of waste-derived precursors compared to commercial ones in producing catalytically active Fe_3O_4 for environmental applications. The synthesized materials were characterized by scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDS). Their catalytic performance was tested through the degradation of malachite green dye in a Fenton-like reaction, simulating wastewater treatment conditions. SEM analysis showed that Fe_3O_4 obtained from fresh, recycled precursors exhibited reduced nanoparticle aggregation and more uniform morphology. EDS confirmed the elemental purity of Fe and O in the recycled samples, with fewer impurities than those synthesized from commercial chemicals. Under optimized conditions ($[H_2O_2]_0$ = 0.5 mM, catalyst dose = 0.01 mg, $[MG]_0$ = 100 mg·L^{-1}, natural pH, V = 100 mL, T = 30 °C), the recycled Fe_3O_4 demonstrated superior catalytic efficiency. This work illustrates how metal waste can be successfully transformed into high-value-added nanomaterials, contributing to sustainable resource recovery and the circular economy. The approach combines environmental waste management with the production of efficient materials for pollutant degradation.

Key words: Magnetite, Coprecipitation, waste recycling, Fenton-like reaction, Catalysis, Environmental remediation.

SUSTAINABLE ELECTROCHEMICAL STRATEGIES FOR THE DEGRADATION OF IBUPROFEN: A GREEN APPROACH TO LIMITING THE ENVIRONMENTAL IMPACT OF PHARMACEUTICAL RESIDUES

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Abstract
Pharmaceutical residues are now recognized as emerging pollutants that pose a growing environmental threat due to their persistence, bioaccumulation, and continuous discharge into aquatic ecosystems. Ibuprofen, a widely consumed anti-inflammatory drug, is frequently detected in wastewater and surface waters, contributing to ecological disruption and long-term toxicity.
In this study, we explore a sustainable electrochemical approach for the removal of ibuprofen from water using anodic oxidation in an undivided electrochemical reactor equipped with a platinum (Pt) anode. The influence of operational parameters including supporting electrolyte type (NaCl and Na_2SO_4) and applied current was investigated to identify the optimal conditions for efficient degradation.
The electrolysis process was monitored by High Performance Liquid Chromatography (HPLC), and the extent of mineralization was assessed through Total Organic Carbon (TOC) and Chemical Oxygen Demand (COD) measurements. Results showed that a current intensity of 0.5 A achieved a degradation efficiency of 91%, with Na_2SO_4 showing better performance than NaCl.
This work demonstrates the effectiveness of green electrochemical technologies in addressing pharmaceutical pollution, offering a promising solution for the sustainable treatment of wastewater containing emerging contaminants.

Keywords : Pharmaceutical residues; Ibuprofen; Electrochemical degradation; Anodic oxidation; Sustainable water treatment; Emerging pollutants; Platinum electrodnable technology

ELECTROCHEMICAL NANOSTRUCTURED ELECTRODES FOR SUSTAINABLE WATER TREATMENT: APPLICATION TO ATRAZINE REMOVAL

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Abstract
The increasing contamination of water resources by persistent organic pollutants such as atrazine, a widely used herbicide, presents a major threat to environmental and public health. This study proposes a sustainable electrochemical method for the degradation of atrazine in water using innovative nanostructured textile electrodes. These electrodes are based on flexible carbon textiles coated with reduced graphene oxide (RGO) and platinum nanoparticles, offering high surface area and excellent electrical properties.
The synthesis of the RGO-Pt coatings was optimized to ensure uniform deposition and long-term structural stability. The materials were thoroughly characterized using Field Emission Scanning Electron Microscopy (FESEM) and Energy Dispersive X-ray Spectroscopy (EDX). Electrochemical degradation was carried out by anodic oxidation in both divided and undivided electrochemical cells, using NaCl and Na_2SO_4 as supporting electrolytes.
Process parameters such as applied potential, cell configuration, and electrolyte type were evaluated to maximize atrazine removal efficiency. The degradation process was monitored by High Performance Liquid Chromatography (HPLC), and the overall mineralization was assessed through Total Organic Carbon (TOC), Chemical Oxygen Demand (COD), and Total Nitrogen (TN) measurements. Results demonstrate rapid and effective degradation, especially in the undivided cell configuration at 1.3 V, confirming the potential of this green electrochemical approach for advanced water treatment applications.
Keywords: Electrochemical water treatment, atrazine, nanostructured electrodes, graphene oxide, platinum nanoparticles, environmental remediation, sustainable technology

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BIOSURVEILLANCE DE LA POLLUTION DES EAUX DU GOLFE D'ANNABA A L'AIDE DE LA PLANTE *POSIDONIA OCEANICA* ET DE SES EPIPHYTES COMME BIOINDICATEURS DE PERTURBATION

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Abstract :
Le golfe d'Annaba, confronté à diverses sources de pollution, subit les impacts des activités humaines et de l'activité maritime. Les herbiers de posidonie, essentiels pour l'écosystème côtier méditerranéen, sont utilisés comme indicateurs des perturbations environnementales. Cette étude vise à analyser les facteurs influençant la santé de l'écosystème côtier à travers l'herbier de *Posidonia oceanica* et ses épiphytes.
Pour évaluer l'état de santé de l'herbier dans le golfe d'Annaba, un suivi des paramètres physico-chimiques des eaux a été réalisé. L'étude a également mesuré la contamination métallique (zinc, cuivre, chrome, nickel, cadmium) dans l'eau et l'accumulation de ces métaux dans l'herbier et ses épiphytes. Un suivi biométrique saisonnier de *P. oceanica* a été effectué, et les épiphytes des feuilles ont été identifiés.
Les résultats montrent que les niveaux de métaux lourds (ETM) sont les plus élevés aux stations S3, S4 et S5. La station S4 présente la plus forte concentration de zinc et de nickel, tandis que la station S5 a des niveaux plus élevés de cuivre et S3 de chrome. L'accumulation des ETM dans *P. oceanica* et ses épiphytes varie en fonction de la saison et de la station d'échantillonnage. Ces résultats montrent que *P. oceanica* peut servir de système d'alarme précoce pour la détection de contamination, dont les effets restent réversibles. Dans la région méditerranéenne, cette plante joue un rôle majeur dans le cycle des ETM grâce à sa capacité d'accumulation.
Key words: *Posidonia oceanica* ; Epiphytes ; Elément trace métallique ; Golfe d'Annaba ; Pollution.

EFFET DU RAPPORT D'IMPREGNATION ET DE LA TEMPERATURE D'ACTIVATION SUR PREPARATION DU CHARBON ACTIF PAR ACTIVATION CHIMIQUE AVEC H_3PO_4

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Abstract:
Le charbon actif est un matériau carboné poreux, doté d'une surface spécifique très développée et enrichi en groupes fonctionnels, largement utilisé dans diverses applications telles que l'adsorption, le support de catalyseur, la séparation et le stockage des gaz, la récupération et la décoloration des solvants, les supercondensateurs et les électrodes. Sa porosité interne, ainsi que des propriétés associées telles que la surface spécifique, le volume des pores, la distribution de la taille des pores et la nature des groupes fonctionnels présents sur les surfaces poreuses, jouent un rôle essentiel dans ses capacités d'adsorption.
Les charbons actifs riches en micropores sont particulièrement efficaces pour l'adsorption de polluants de petites molécules, tandis que ceux présentant une mésoporosité bien développée sont mieux adaptés à l'adsorption de molécules de plus grande taille, comme les colorants.
Dans cette étude, le charbon actif a été préparé par activation chimique à l'aide de H_3PO_4, et ses propriétés ont été évaluées. Les effets de la température d'activation et du rapport d'imprégnation ont été analysés. L'étude de la surface a révélé que le charbon actif obtenu à 700 °C, avec un rapport d'imprégnation de 1,5 et un temps d'activation d'une heure, présentait une surface spécifique élevé. L'analyse par spectroscopie infrarouge à transformée de Fourier (FTIR) a confirmé la présence de nombreux groupes fonctionnels à la surface du matériau.

Key words: charbon actif, acide phosphorique, température d'activation, rapport d'imprégnation, surface spécifique, spectroscopie infrarouge.

OPTIMIZING MASS-TO-VOLUME RATIO AND CONTACT TIME IN CONGO RED ADSORPTION USING GREEN-SYNTHESIZED MgO NANOPARTICLES

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Abstract:
The contamination of water resources by synthetic dyes represents a serious environmental concern, as these compounds are often toxic, persistent, and resistant to biodegradation. Among them, Congo Red (CR) is widely used in the textile and paper industries, yet its stability and potential health impacts make its removal from wastewater a pressing challenge. In this study, magnesium oxide nanoparticles (MgO-NPs) were synthesized through an eco-friendly green chemistry route under optimized synthesis conditions, utilizing a plant extract as a natural reducing and stabilizing agent. The resulting nanoparticles were characterized using X-ray diffraction (XRD) to confirm their crystalline structure, Fourier-transform infrared spectroscopy (FT-IR) to identify surface functional groups, and morphological analyses to investigate particle size, shape, and surface texture. Adsorption experiments were carried out under controlled conditions to assess the effect of catalyst loading and contact time on CR removal efficiency. Three mass-to-volume ratios of adsorbent to dye solution were tested: 1:2, 1:1, and 2:1. Contact time was varied up to 180 minutes to monitor the adsorption kinetics and evaluate the relationship between active surface site availability and dye removal performance. The findings underline the importance of optimizing operational parameters to maximize adsorption efficiency, offering valuable insights for the design of sustainable, cost-effective, and environmentally friendly strategies for the remediation of dye-polluted wastewater.

Key words: Congo Red, Adsorption ,MgO nanoparticles, Water remediation.

EVALUATION OF THE EFFECTIVE DOSE IN DIFFERENT THERMAL STATIONS

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Abstract :
This study focuses on the evaluation of the effective dose received by individuals exposed to natural radioactivity present in thermal waters. Thermal waters may contain radionuclides such as uranium, thorium, radium, and their decay products, which can pose health risks through ingestion, inhalation, or dermal absorption. Water samples were collected from various thermal springs and analyzed for their radioisotope content using gamma spectrometry technique. Based on the measured activity concentrations, the annual effective dose was calculated according to international guidelines set by the ICRP and WHO. The results indicate that while most thermal waters present low radiological risk, some sources may exceed recommended dose limits, especially when used frequently for therapeutic or recreational purposes. Continuous monitoring and risk assessment are recommended to ensure the safety of users and comply with radiation protection standards.

Keywords : effective dose, thermal waters, gamma spectrometry

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VALORIZATION AGRICULTURAL WASTE INTO FUNCTIONAL MATERIALS FOR ADSORPTION OF ORGANIC DYES

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Abstract:
The contamination of water by synthetic dyes represents a major environmental concern due to their chemical stability, potential toxicity, and low biodegradability through conventional treatment methods. In this context, adsorption has proven to be a particularly effective technique for removing these compounds from wastewater. Among the various available methods, the use of bioadsorbents stands out as an eco-friendly and sustainable alternative. These naturally derived materials, such as eggshells (Eg), contain functional groups capable of interacting with molecules of Eriochrome Black T (EBT), thereby promoting their retention and removal. This process depends on several parameters, including neutral pH, the initial concentration of the dye (EBT) 50ppm, and the mass of the adsorbent (Eg) 3g. Optimizing these conditions allows for a high removal efficiency, reaching up to 98%, making this approach especially promising for treating water contaminated with this synthetic dye. The adsorption mechanisms involved include electrostatic interactions, complexation phenomena, and hydrogen bonding.

Keywords: Adsorption, Eriochrome Black T, Eggshells, Water

ASSESSMENT OF DISSOLVED OXYGEN VARIATION IN AERATION TANKS AND ITS EFFECT ON ACTIVATED SLUDGE PROCESS EFFICIENCY

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Abstract

The performance of activated sludge wastewater treatment plants strongly depends on the control of key biological processes, particularly the biochemical oxidation of organic matter and the nitrification of ammoniacal nitrogen. These processes, which are highly sensitive to operational fluctuations, often represent a major challenge for plant operators. The Saïda wastewater treatment plant (Algeria) ensures biological aeration through twelve mechanical aerators designed to meet the daily oxygen demand of the system. This study aims to evaluate the impact of dissolved oxygen variation in the aeration basin on pollutant removal efficiency and to assess aeration performance parameters to optimize treatment outcomes. The findings reveal that the raw effluents contain biodegradable organic matter with a BOD_5/COD ratio below 2, indicating moderate biodegradability. The plant achieves removal efficiencies exceeding 95% for BOD_5, COD, and TSS, confirming the robustness of the process. The estimated average daily oxygen requirement (AOR) in the aeration basins reaches 15,853.41 kg O_2/day, with a direct correlation between AOR and influent organic load. These results underscore the crucial role of dissolved oxygen management in maintaining both the efficiency and stability of activated sludge systems, particularly under fluctuating pollutant load conditions, and offer valuable insights for optimizing aeration strategies in urban wastewater treatment.

Keywords: Dissolved oxygen ; Aeration tank ; Activated sludge ; Treatment performance ; Oxygen demand (AOR).

SOL-GEL SYNTHESIS AND PHOTOCATALYTIC ACTIVITIES OF MIXED OXIDES

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Abstract:

The increasing contamination of natural ecosystems by industrial pollutants has intensified the need for efficient and sustainable treatment technologies. Photocatalysis presents a green and energy-efficient strategy for degrading organic contaminants, utilizing light-activated catalysts to mineralize pollutants into harmless by-products. Mixed metal oxides synthesized via the sol-gel method have attracted growing interest due to their tunable physicochemical properties and enhanced photocatalytic performance.

In this study, manganese ferrite ($MnFe_2O_4$) spinel was synthesized via the sol-gel method and thoroughly characterized to evaluate its structural, surface, and photocatalytic properties. X-ray diffraction (XRD) confirmed the successful formation of the $MnFe_2O_4$ spinel phase at 950 °C, with no detectable secondary phases. Surface area analysis using the Brunauer–Emmett–Teller (BET) method revealed a specific surface area of 15.633 m^2/g. Optical characterization via Tauc plot analysis demonstrated semiconducting behavior with a direct bandgap of 2.64 eV.

The photocatalytic activity of $MnFe_2O_4$ was assessed under solar irradiation using Methylene Blue (MB) dye as a model pollutant. The material exhibited high photocatalytic efficiency, achieving over 95% degradation of MB, underscoring its potential as an effective photocatalyst for wastewater treatment.

These findings highlight the promise of sol-gel-derived $MnFe_2O_4$ as a cost-effective, scalable, and environmentally friendly material for advanced water purification and sustainable pollution control.

Key words: Sol-gel, photocatalytic properties, $MnFe_2O_4$.

EFFECTIVE PHOTODEGRADATION OF TRAMADOL FROM AQUEOUS SOLUTION USING CITRIC ACID FUNCTIONALIZED MAGNETITE NANOPARTICLES.

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Abstract
This study investigates the optimal conditions for the degradation of 10 mg of Tramadol hydrochloride (TR) in aqueous solution using a photo-assisted Fenton-like process in a laboratory-scale double-walled photoreactor equipped with UVA lamps (λ = 365 nm). The influence of three key parameters (pH, nano-Magnetite concentration (Fe_3O_4), and hydrogen peroxide dosage (H_2O_2)) were systematically evaluated to maximize degradation efficiency. The results revealed that acidic conditions significantly enhance degradation kinetics, with complete degradation achieved within 3 minutes at pH 3, 5 minutes at pH 4.5, and 40 minutes at pH 6.3. At pH 3, only 0.5 g/L of Fe_3O_4 and 0.5 mM of H_2O_2 were sufficient for full degradation, while higher dosages were required at less acidic pH values. The process demonstrated multiple advantages, including its cost-effectiveness, eco-compatibility, and the use of a recyclable catalyst (magnetite) and a biodegradable chelating agent (citric acid). These findings highlight the potential of this approach as an efficient and sustainable method for removing pharmaceutical contaminants from water.

Mots-clés: Tramadol hydrochloride, Nano-Magnetite (Fe_3O_4),pH effect, UVA irradiation,Citric acid,Eco-friendly process

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SYNTHESIS AND PHYSICOCHEMICAL CHARACTERIZATION OF NEW CALCINED LAYERED DOUBLE HYDROXIDE Mg Zn Co Al-CO3; CLASSICAL MODELING AND STATISTICAL PHYSICS OF NITRATE ADSORPTION

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Abstract:
This research focuses on the study of a new material, a layered double hydroxide, which was synthesized using a co-precipitation method at pH constant and, then, tested for its retention of nitrate anions. The LDH was prepared from four metal cations Mg-Zn-Co-Al to produce the quadratic material mentioned, MgZnCoAl-CO3, which was calcinated to obtain metal oxides. Different techniques of characterization were used such as FTIR, X-ray diffraction, BET, SEM and EDX. The results of our research showed that 72.73% of nitrate can be removed under neutral conditions. Our kinetic data best fitted the Pseudo-Second Order model. The Sips model was the adsorption isotherm which best fitted the results of our experiments. Finally, for a deeper insight in the nitrate adsorption mechanism, the statistical physics model was used to quantify the number of adsorbed nitrate molecules per site, the anchorage number, the receptor sites density, the adsorbed quantity at saturation, the concentration at half saturation and the molar adsorption energy. A detailed thermodynamic analysis was performed demonstrating that the adsorption mechanism was endothermic and associated to physical forces. The thermodynamic analysis confirmed the feasibility and spontaneous nature of the adsorption of nitrate on tested adsorbent.

Key words: Layered double hydroxides; Adsorption; Statistical physics models; Nitrate.

STUDY AND CHARACTERIZATION OF A PLANT-BASED BIOSORBENT FOR WATER TREATMENT.

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Abstract:
The valorization of organic and plant-based by-products in industry through chemical processes has attracted considerable attention from researchers, primarily for two purposes: environmental protection and economic recovery. Various techniques have been explored to convert agricultural wastes into valuable materials for the removal of pollutants from industrial effluents, including membrane filtration, extraction, and adsorption. Among these, adsorption using low-cost and non-conventional adsorbent materials particularly those derived from biomass has emerged as one of the most promising approaches due to its efficiency, simplicity, and sustainability.
The present study focuses on the valorization and characterization of a biosorbent synthesized from a local plant waste collected in the Skikda region (Algeria). The prepared biosorbent was characterized using Fourier Transform Infrared Spectroscopy (FTIR) and Scanning Electron Microscopy (SEM). It was then applied for the removal of RB dye from aqueous solutions under batch adsorption mode. The influence of key operational parameters, including initial dye concentration(80mg/L), pH (pH=2), contact time (120 min),and adsorbent dose (50 mg) was investigated. The obtained results demonstrate that the developed biosorbent can be effectively employed for the efficient removal of RB from water.

Keywords: Biosorbent, characterization, plant waste, pollutants, valorization, adsorption, wastewater treatment.

ANALYSE COMPARATIVE DE LA QUALITE PHYSICO-CHIMIQUE ET BACTERIOLOGIQUE DES EAUX DE SOURCES ET LES EAUX DE CITERNES DURANT LEURS STOCKAGES ET DISTRIBUTIONS

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Abstract:
Dans le cadre de notre étude, nous avons réalisé des analyses comparatives de la qualité physiques, chimiques et bactériologiques des eaux de source et des eaux de citernes qui sont alimentés par ces source et commercialisés dans la région de Guelma. Afin d'atteindre les objectifs de cette étude ; quatre échantillons ont été prélevés : deux provenant des sources (Ain Souda et Dahwara) et deux autres des citernes alimentées par ces mêmes sources ; afin de déterminer si la qualité de l'eau y était préservée ou non après stockage ; transport et distribution de ces eaux de source par les citernes. Nos résultats ont montré que la majorité des paramètres physico-chimiques analysés répondent aux normes algériennes, donc nos eaux sont de qualité physico-chimique acceptable. Concernant les analyses bactériologiques, les eaux de source de Dahwara présentes une bonne qualité ; Tandis que les eaux de citerne de cette source sont de mauvaise qualité. En ce qui concerne les eaux de citerne de Ain Souda et Dahwara ; les deux présentent une mauvaise qualité dus aux présences des germes totaux ; ainsi que les indicateurs de contamination fécal avec des valeurs dépassent largement les normes de l'OMS pour les eaux de consommations. On a pu aussi montrer la présence de grande variété de germe très pathogènes telle que *Pseudomonas aeruginosa ; Serratia odrifera 1 ; Proteus mirabilis,… ,* dans les eaux de citerne de Dahwara et Ain Souda. Donc ces eaux sont impropres à la consommation humaine..

Mots clés: eau de source, citernes, Ain souda, Dahwara, analyses physico-chimiques, bactériologiques.

ECO-FRIENDLY HYDROTHERMAL SYNTHESIS OF ZINC OXIDE NANOPARTICLES USING EUCALYPTUS LEAF EXTRACT FOR PHOTOCATALYTIC APPLICATIONS

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Abstract:
The green synthesis of nanoparticles using plant extracts has attracted considerable attention due to its eco-friendly nature, cost-effectiveness, simplicity, and the abundance of bioactive compounds in plants. In this study, zinc oxide nanoparticles (ZnO NPs) were successfully synthesized via a green hydrothermal approach employing *Eucalyptus* leaf extract as a natural reducing and stabilizing agent. The synthesis involved a solution of zinc acetate dihydrate and sodium hydroxide, with varying volumes of *Eucalyptus* extract (10, 20, and 30 mL). The obtained mixture was subjected to hydrothermal treatment at 150 °C, followed by calcination at 500 °C for 2 hours.
The biosynthesized ZnO nanoparticles exhibited particle sizes in the range of 23–25 nm. Their photocatalytic efficiency was evaluated through the degradation of Rhodamine B (RhB) dye under UV irradiation for 90 minutes, achieving a high degradation rate of 94.77%. Furthermore, recyclability tests demonstrated that the green-synthesized ZnO maintained about 85% of its photocatalytic performance even after three consecutive degradation cycles.
These results confirm that *Eucalyptus*-assisted green synthesis provides a sustainable and economical pathway for producing ZnO-based photocatalysts with excellent structural stability and catalytic efficiency, highlighting their potential in environmental purification and wastewater treatment applications.

Keywords:
Zinc oxide nanoparticles (ZnO NPs); *Eucalyptus* extract; green synthesis; hydrothermal method; photocatalytic activity; Rhodamine B degradation

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ENHANCED ANTIBACTERIAL ACTIVITY IN SOL-GEL DERIVED Ag/ZrO_2-ZnO NANOCERAMICS

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Abstract
This research work focuses on the synthesis and characterization of ZrO_2-ZnO ceramic nanocomposites doped with different concentrations of silver (Ag) (0%, 0.1%, 0.3%, and 5%), prepared using the Sol-Gel method. The structural and physicochemical characteristics of the synthesized samples were systematically analyzed using XRD, FTIR, Raman spectroscopy, and zeta potential analysis. X-ray diffraction (XRD) revealed the presence of four crystalline phases (cubic, tetragonal, monoclinic, and hexagonal) and confirmed the nanometric size of the particles (ranging from 12.77 to 71.53 nm). Raman and FTIR spectroscopy validated the crystalline structure and the characteristic chemical bonds of ZrO_2-ZnO. Zeta potential measurements, with values above -35 mV, indicated good colloidal stability of the nanocomposites. Antimicrobial activity tests showed a positive response, with maximum effectiveness observed for the 5% Ag-doped sample.

Keywords: ZrO_2-ZnO, advanced ceramics, Ag doping, antibacterial activity, photocatalysis.

OPTIMISATION STATISTIQUE AVANCEE DE L'EXTRACTION DE GELATINE A PARTIR DE SOUS-PRODUITS AVICOLES : UNE APPROCHE DURABLE DE VALORISATION DES DECHETS

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Abstract:
Cette étude vise à valoriser des sous-produits avicoles, en particulier un mélange de têtes et de pattes de poulet, pour l'extraction de gélatine présentant des propriétés technofonctionnelles intéressantes. Un plan d'expériences orthogonal Taguchi L27 a été appliqué afin d'évaluer l'influence de la concentration en acide acétique (2, 3,5 et 5 %), de la température (55, 65 et 75 °C) et du temps d'extraction (2, 4 et 6 h) sur le rendement, la viscosité, l'indice d'activité émulsifiante (EAI) et la capacité moussante. Les résultats expérimentaux ont été modélisés et optimisés à l'aide de la méthodologie de surface de réponse (RSM) couplée à une fonction de désirabilité. Les conditions optimales (3,06 % d'acide acétique, 75 °C, 6 h) ont permis d'obtenir un rendement de 10,97 %, un EAI de 24,22 m²/g, une viscosité de 3,36 mPa·s et une capacité moussante de 45,07 %. L'excellente concordance entre les valeurs prédites et expérimentales confirme la fiabilité des modèles. Ces résultats démontrent que les sous-produits avicoles constituent une ressource durable et prometteuse pour la production de gélatine à haute valeur ajoutée.
Mots-clés : gélatine, sous-produits avicoles, optimisation statistique, valorisation des déchets, propriétés technofonctionnelles.

APPLICATION DES SYSTÈMES D'INFORMATION GÉOGRAPHIQUE À LA GESTION DES DÉCHETS MÉNAGERS: CAS DE LA COMMUNE DE BAB EL OUED, ALGER

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Abstract:
À l'heure actuelle, la problématique des déchets solides ménagers constitue un enjeu environnemental et un défi majeur pour les autorités locales, particulièrement dans les grandes villes algériennes. La gestion traditionnelle de ces déchets montre ses limites face à l'urbanisation croissante, à l'augmentation des volumes générés et à l'insuffisance des moyens techniques. Il est désormais admis que la gestion intégrée des déchets ménagers et assimilés (DMA) représente une feuille de route efficace pour corriger les écarts et améliorer durablement les pratiques existantes.
La présente étude vise à contribuer à l'amélioration du système de gestion des déchets solides ménagers dans la wilaya d'Alger, en se concentrant sur la commune de Bab El Oued. Pour ce faire, elle mobilise les outils des Systèmes d'Information Géographique (SIG) et la méthode d'Analyse Hiérarchique des Procédés (AHP), reconnue pour son efficacité dans l'aide à la décision en matière de gestion urbaine. L'approche adoptée permet de cartographier les points de production, les itinéraires de collecte, et d'évaluer l'accessibilité et la couverture du service.
Les résultats révèlent que la commune de Bab El Oued a produit environ 12 072,05 tonnes de déchets solides ménagers en 2023, soit près de 1 006,05 tonnes par mois et 33,07 tonnes par jour. Malgré cette production importante, le système de gestion est confronté à plusieurs contraintes : l'absence d'une base de données informatisée, l'insuffisance et l'inadéquation des moyens de collecte, le manque de civisme de certains citoyens, ainsi que la défaillance du réseau de collecte. Ces constats soulignent l'importance d'une approche géomatique intégrée pour optimiser les stratégies de collecte et améliorer l'efficacité globale du service.
Key words : Gestion des déchets, déchets solides ménagers, collecte, Système d'Information Géographique (SIG), Analyse Hiérarchique des Procédés (AHP).

ECOLOGICAL DEGRADATION OF POULTRY FEATHERS: ROLE OF SOIL-ISOLATED KERATINOLYTIC FUNGI

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Abstract
In the context of poultry waste valorization, this study focuses on the isolation and characterization of keratinolytic filamentous fungi capable of degrading the keratin found in poultry feathers. Soil samples were collected from a poultry farm in the Oran region (Algeria), leading to the isolation and identification of four fungal strains belonging to the genus *Aspergillus*: *A. niger*, *A. flavus*, *A. fumigatus*, and *A. terreus*.The enzymatic potential of these isolates was assessed using a culture medium in which feather meal served as the sole source of carbon and energy. All four strains exhibited satisfactory growth on this medium, demonstrating their ability to utilize keratin. Enzymatic activity assays revealed strong keratinolytic activity in *A. flavus*, *A. fumigatus*, and *A. terreus*, confirming their efficiency in feather degradation.Furthermore, these three strains also exhibited amylolytic activity, indicating their capacity to produce α-amylase. However, no caseinolytic activity was detected, suggesting a specific enzymatic profile directed primarily toward keratinous and starchy substrates.
These findings highlight the biotechnological potential of these fungal isolates for enzymatic treatment and valorization of keratin-rich poultry by-products.

Keywords: Poultry waste valorization, feather meal medium, *Aspergillus*, keratin degradation, α-amylase**.**

IMPLEMENTING SELECTIVE COLLECTION OF WASTE IN ALGERIA: EXPERIMENTAL RESULTS FROM A PILOT PROJECT

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Abstract:
Polyethylene Terephthalate (PET) waste represents a growing environmental and economic challenge in Algeria.
This study examines the management of PET waste in the country, presenting the first comprehensive assessment of its collection and recovery value chain at the city level. By integrating social, technical, and economic dimensions, the research addresses a significant gap in literature. The objective is to ensure an original contribution to the establishment of a scientific foundation for the sustainable management of PET waste in Algeria.
The methodology involves conducting an experimental examination of a set of social and technical parameters associated with a pilot PET waste recovery value chain implemented through voluntary household waste sorting initiatives in eastern Algerian cities.
The social component of the research revealed that over 85% of those surveyed population expressed a willingness to sort PET waste using the designated metal collection containers. Furthermore, most of respondents viewed these tools as an effective solution for PET waste separation. Statistical analysis of the survey data, stratified by educational level, indicated that individuals with higher levels of education demonstrated greater environmental awareness compared to other demographic groups.
The technical and cost analysis revealed that overhead expenses, including diesel costs, constitute a significant portion of the total value chain costs, accounting for 42%. In contrast, PET sales cover only a small share of management costs. These findings highlight the economic challenges of formal PET waste recovery and may help shape future policies, regulations, and optimization plans aligned with circular economy goals.

Keywords: Waste recovery, PET, Waste sorting, Circular economy.

USING DATE PALM FIBER WASTE TO REDUCE SHRINKAGE AND CRACKING IN EXPANSIVE CLAY

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Abstract
The desiccation of clay soils is common in regions with significant moisture loss. Due to their high-water retention capacity, clay soils are prone to shrinkage and cracking when subjected to drying or extreme temperature fluctuations. These cracks weaken foundations by causing soil subsidence and increasing permeability, which promotes runoff and erosion. Additionally, desiccation alters the soil's mechanical properties, reducing its strength and load-bearing capacity. Date palm fiber waste can help mitigate these effects by improving the soil's mechanical properties and reducing cracking. This study investigates the impact of date palm fibers on desiccation in local clay soil. A mixture of native clay and date palm fibers of varying lengths (10 mm, 20 mm, 30 mm) and different contents (0%, 0.25%, 0.5%, 0.75% by weight) was tested. The results demonstrate that adding date palm fibers reduces cracking by limiting crack width, surface area, and propagation while delaying their formation. A 47% reduction in cracking was achieved using 10 mm fibers at a content of 0.75%.

Keywords: *Clay soil,* Date *palm fibersWaste, Desiccation cracks, Digital image analysis.*

TOWARDS CIRCULAR ECONOMY PRACTICES IN THE ALGERIAN PHOSPHATE SECTOR: VALORIZATION OF PROCESSING WASTES FOR RARE EARTH ELEMENTS RECOVERY

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Abstract:
The escalating global demand for rare earth elements (REEs) in high-technology industries, green energy technologies, and emerging economies has created an urgent supply crisis that necessitates the exploration of alternative sources beyond conventional mining operations. The phosphate mining industry in Algeria generates substantial volumes of processing wastes that remain largely unexploited despite their potential value as secondary REE resources. This study presents a comprehensive multi-analytical characterization of wastes generated from the phosphate complex processing plant in Algeria, with the objective of evaluating their potential for REE recovery within a circular economy framework.
The waste materials were systematically characterized using complementary analytical techniques including particle size distribution (PSD) analysis, scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy (SEM/EDS), Fourier-transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), X-ray fluorescence (XRF), inductively coupled plasma-atomic emission spectroscopy (ICP-AES), and neutron activation analysis (NAA). This multi-technique approach provided comprehensive insights into the morphological, structural, mineralogical, and elemental composition of the phosphate processing wastes.
The results demonstrated notable concentrations of rare earth elements (REEs) across the examined waste streams. These findings support the development of targeted recovery strategies capable of converting phosphate processing wastes into valuable secondary REE resources. Such valorization aligns with circular economy principles by reducing environmental impacts, enhancing resource efficiency, and establishing sustainable supply chains, thereby fostering circularity within the Algerian phosphate sector.

Keywords: Rare earth elements, phosphate wastes, circular economy, waste characterization, resource recovery, sustainable mining

TECHNIQUES DE DÉSULFURATION DES RÉSIDUS MINIERS SULFURÉS PROVENANT DE LA FLOTTATION DE LA BLENDE : MINE DE CHAABET EL HAMRA

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Abstract:
Les rejets de traitement du minerai sulfuré de Chaabet El Hamra contiennent des minéraux primaires de pyrite (FeS_2) et des minéraux secondaires de blende (ZnS), de galène (PbS) et de Chalcopyrite ($CuFeS_2$) à gangue carbonatée et siliceuse.
Il est connu que la présence d'une quantité de pyrite peut causer, en général, des menaces environnementales et en particulier le risque d'un drainage minier acide (DMA). Les analyses chimiques des rejets montrent que la teneur en soufre est supérieure à 9 %. Il est possible de séparer la pyrite des autres minéraux lourds tout en se basant sur la propriété interfaciale (mouillabité) de ces minéraux.
Pour se faire, nous avons testé la possibilité de séparation des rejets par une flottation de la pyrite à dépression des minéraux lourds par désulfuration environnementale et ce qui permet d'éliminer en grande partie la fraction riche en soufre.
Les résultats obtenus en récupération et en teneur en soufre sont notables après un temps de flottation de 12 mn par addition d'un collecteur de 140g/t d'Amyl xanthate de potassium et de moussant (huile de pin) de 10 g/t et d'activant de 60g /t de sulfate de cuivre ($CuSO_4$) à un pH optimal de 5.

Key words: Rejets miniers -Flottation - désulfuration - environnement – pyrite – revalorization.

DEVELOPMENT AND CHARACTERIZATION OF WALL TILES BASED ON BOROSILICATE WASTE, CHAMOTTE, AND SAND

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Abstract:
To preserve natural resources, optimize the use of sand deposits, and maximize the recovery of inorganic waste through recycling, this work contributes to advancing this vision by developing an eco-friendly construction material designed for wall cladding applications.
The present study involves the development and characterization of wall tiles formulated from cullet, sand, and chamotte. Cullet constitutes the primary component of the mixture (50–90 wt.%), offering significant economic advantages owing to its low-temperature fusibility and reduced production cost. Untreated sand acts as a binder; for this purpose, dune sand, abundantly available in the Saharan region of southern Algeria, was employed. Chamotte was incorporated to enhance thermal resistance during firing and to mitigate drying shrinkage. Various compositions were prepared, homogenized, and subjected to sintering at 950 °C for 40 minutes.
Physicochemical techniques such as density, porosity, water absorption, mechanical strength, and X-ray diffraction (XRD) were employed to characterize the developed wall tiles. The obtained results indicate that the CR5 tiles (composed of 90% cullet and 10% sand) exhibit the best performance, with a flexural strength of 8.86 MPa, a hardness of 8 on the Mohs scale, and a water absorption rate below 1.2%.

Keywords: Wall tiles, cullet, chamotte, waste valorization

VALORISATION DES COPRODUITS DE LA TRANSFORMATION DU POISSON-CHAT AFRICAIN (*Clarias gariepinus*) POUR LA PRODUCTION DE BIOMOLECULES D'INTERET : FARINE, COLLAGENE ET GELATINE

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Résumé :
Les coproduits issus de la transformation du poisson-chat africain (*Clarias gariepinus*) en conserve tels que les têtes et peaux, présentent un potentiel considérable pour la production de molécules d'intérêt biologique et industriel. Cette étude vise à valoriser ces coproduits dans la production de farine de poisson, de collagène et de gélatine. Les analyses biochimiques de la farine obtenue à partir des têtes ont révélé une teneur élevée en protéines (48,42%) et en matière minérale (32,88%). Les extraits de collagène et de gélatine issus des peaux ont montré des concentrations protéiques respectives de 89,09% et 77,4%. L'analyse par spectroscopie FTIR a confirmé la structure de ces biomolécules, comparable à celle des échantillons de référence et aux données rapportées dans la littérature. L'électrophorèse sur gel de polyacrylamide (SDS-PAGE) de l'extrait de gélatine a mis en évidence des protéines ayant un poids moléculaire variant de 20 à 150 kDa, suggérant l'identification de chaînes polypeptidiques de type α situées entre 100 et 150 kDa. Ces résultats démontrent le fort potentiel de valorisation des coproduits du poisson-chat africain, ouvrant des perspectives dans les secteurs pharmaceutiques, agroalimentaire et biomédical.

Mots clés : *clarias gariepinus*, coproduits, farine de poisson, gélatine, collagène.

VALORIZATION OF SHRIMP BY-PRODUCTS: SUSTAINABLE EXTRACTION AND BIOACTIVE PROPERTIES OF ASTAXANTHIN

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Abstract:
Astaxanthin, a marine-derived xanthophyll carotenoid abundantly present in shrimp by-products, has attracted considerable interest due to its strong anti-inflammatory properties and unique molecular structure. In this study, an eco-friendly extraction method was developed to recover astaxanthin from processing by-products of the red shrimp *Aristeus antennatus* (Risso, 1816) collected in Mostaganem, Algeria. Furthermore, the antioxidant and anti-inflammatory properties of the astaxanthin extract obtained from shrimp by-products were investigated *in vitro*. A maximum yield of 264.96 µg/g of shrimp by-products was achieved using sunflower oil at a solid-to-liquid ratio of 1:10, at 60 °C for 60 minutes. The antioxidant activity of the astaxanthin extract, measured using DPPH and FRAP assays, was found to be stronger than that of ascorbic acid. Meanwhile, the anti-inflammatory activity of the extracted astaxanthin was evaluated *in vitro* through two bovine serum albumin (BSA) denaturation assays, where astaxanthin demonstrated a clear, dose-dependent inhibition, reaching 64% at 250 µg/mL, compared to 80% for the reference drug diclofenac. Moreover, the anti-hemolytic assay on erythrocytes confirmed this effect, with an inhibition percentage of 41% for astaxanthin at 250 µg/mL, compared to 65% for diclofenac at the same concentration.

Key words: *Aristeus antennatus*, Astaxanthin, Extraction, Vegetable oils, Antioxydant, anti-inflammatory.

OPTIMIZED INTEGRATION OF EXHAUST GASES FROM GAS TURBINES IN THE FOOD INDUSTRY: TOWARDS A SUSTAINABLE FOOD INDUSTRY

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Abstract:
The considerable amount of energy contained in the exhaust gases from gas turbines represents a valuable potential that cannot be overlooked. These gases, rich in heat, can be utilized in various industrial processes. The use of these gases in the food industry is a growing trend worldwide. While initiatives exist in Algeria, there is still significant potential to develop these technologies.
This paper explores the optimization of exhaust gas recovery from a gas turbine, which allows for the transformation of these gases, reaching temperatures of 400 to 600 °C, into a useful energy source for the food industry, with an emphasis on energy efficiency and sustainability.
In this study, three exhaust gas recovery techniques were analyzed: conventional recovery, alternative recovery, and staged recovery. The goal of this study is to emphasize the benefits of the most effective recovery method regarding the enhancement of overall process efficiency, which can achieve up to 24.8%, the reduction in energy costs for food companies, with an estimated recovered thermal input of between 1 to 3 GJ per ton of product and the CO_2 emissions reduction that can reach 29.7%. To better understand the behavior of these technologies and achieve optimal integration, we analyze the influence of certain key parameters.
By integrating these gases into various processes, industries can not only optimize their production but also contribute to a more sustainable future.

Key words : Heat recovery, Processus optimization, Gas turbine, Food industry, Energetic efficiency, Sustainability.

THE COMBINED INFLUENCE OF RECYCLED AGGREGATE AND SLAG ON THE FRESH PERFORMANCES OF SELF-COMAPCTING CONCRETE

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Abstract:
One of the main causes of global pollution is the production of huge quantities of cement, witch generates considerable CO_2 emissions into the atmosphere, as well as the landfilling of construction and demolition waste. In order to address this major issue, it is important to decrease the utilization of cement by substituting the cement with by product such as slag or natural pozzolan, and using recycled aggregates obtained from concrete waste of construction and demolition as a replacement of natural aggregates. This research aimed to evaluate the performance of sustainable self-compacting concrete which is produced with recycled aggregate and slag and reinforced with recycled steel fibers. 50% of natural aggragate was replaced with recycled aggragates, cement was substituted with 15 and 25% granulated ground blast furnace slag and Steel fibers are used up to 0.8%. The fresh properties of mixes were determined by using slump flow diameter, slump flow time, V-funnel flow time and segregation resistance. The results showed that the increase in slag content increases the slump flow diameter by 0.7 to 2.1% without any sign of segregation, and decrease the slump flow time from 1.6 to 1.9 secondes. However, the remplacement of NA increase segregation resistance of 15.8%, and the use of fibers increased the segregation resistance up to 24%.
Key words: Self-compacting concrete, recycled aggregates, slag, rheology.

FTIR BASED CHEMICAL CHARACTERIZATION OF FAVA BEAN RESIDUES FOR SUSTAINABLE VALORIZATION

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Abstract:
The valorization of fava bean residues is part of a sustainable development and circular economy strategy aimed at reducing post-harvest losses and optimizing the use of local resources. In this study, residues derived from fava bean processing were characterized using FTIR spectroscopy , revealing a richness in proteins, polysaccharides, starch, and essential amino acids, the chemical fingerprint of fava bean residues was assessed using FTIR spectroscopy. The spectrum displayed well-defined absorption peaks corresponding to polysaccharides (starch, cellulose, and hemicellulose), proteins (amide I and amide II bands), and lipids (C–H stretching vibrations). These findings highlight the biochemical richness of this biomass and confirm its potential as a valuable raw material for feed formulation.Proximate analysis showed crude ash (188 g/kg), starch (35 g/kg), cellulose (190 g/kg), acid detergent fiber (ADF 201 g/kg), neutral detergent fiber (NDF 288 g/kg), and acid detergent lignin (ADL 11 g/kg). The amino acid profile confirmed appreciable concentrations of lysine (0.89%), methionine (0.19%), cystine (0.18%), alanine (0.93%), valine (0.88%). These results confirm that fava bean residues are a valuable protein and polysaccharide source that can be integrated into poultry feed as a partial replacement for conventional raw materials. Their valorization contributes to protein self-sufficiency, reduces dependence on imported soybean, and supports more sustainable poultry production systems.

Keywords: Fava bean residues; FTIR; Poultry feed; Sustainable valorization

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RECYCLING AND VALORIZATION OF ALUMINUM WASTE IN CERAMIC MATERIALS DEVELOPMENT

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Abstract:
Aluminum dross is a hazardous waste that poses a risk due to its abundance and the numerous toxic elements it contains, particularly aluminum nitrides (AlN). Several studies have already been carried out to treat this waste using pyrometallurgical processes, essentially based on thermal treatment, similar to that applied to ceramics. In this work, we chose to incorporate aluminum dross into ceramic raw materials with the aim of performing a single treatment (sintering) that simultaneously achieves two objectives. In this case study, a mixture of clay and aluminum dross (up to 12 wt%) was ground and then processed into a slurry. After drying, the samples were analyzed by TG-DSC. The temperature increase revealed two endothermic reactions at 263.32 °C and 649.73 °C, associated with mass losses of 0.69% and 3.16%, respectively, as well as a pronounced exothermic reaction at 895.27 °C corresponding to a mass gain of 0.5%. To assess the effect of sintering, samples treated at 910 °C were characterized by XRD. The diffractograms showed no detectable trace of AlN, and the major phase identified was gehlenite, with some traces of calcium aluminum silicate. Based on these results, it can be concluded that sintering the mixture not only eliminates the toxic element (AlN) but also produces a gehlenite-type ceramic. Furthermore, a temperature of 910 °C proves sufficient to ensure both the treatment of the waste and the sintering of the mixture.

Key words: Pyrometallurgy, Aluminum dross, Gehlenite, AlN

VALORIZATION OF WASTE MARBLE POWDER AS A REPLACEMENT FOR CEMENT IN CELLULAR CONCRETE PRODUCTION

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Abstract:
This research integrates both environmental and economic factors regarding to the use of waste marble powder (WMP) in the production of cellular concrete. Various types of cellular concrete were created by incorporating different percentages of aluminum (0.25%, 0.50%, 0.75%, and 1%) as an expansive agent. WMP was used to replace 10%, 15%, and 20% of the cement in the mixtures. The objective of this experimental study is to assess the impact of these substitutions on the thermo-mechanical properties of cellular concrete. The results suggest that replacing 10-15% of cement with WMP significantly enhances mechanical strengths (compressive and flexural strength at both 28 and 90 days) when compared to conventional mixtures and provides improved thermal conductivity. Furthermore, the use of WMP could be effectively utilized as a cementitious addition for cement replacement, thereby providing a sustainable source of raw materials for the construction industry while offering an environmentally friendly solution for WMP disposal, aligning with the industry's focus on sustainability and waste reduction.

Key words: cellular concrete; strengths; waste marble powder; environmental; construction industry.

A SUSTAINABLE COSMETIC PRODUCT WITH VEGETABLE OILS: APPLICATION IN A NATURAL SOLID SHAMPOO

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Abstract:
With growing concerns for health and the environment, natural and sustainable cosmetics are gaining popularity. The circular economy encourages better resource use, waste reduction, and the creation of eco-friendly products. Natural cosmetology is an alternative like solid shampoos that minimize packaging and use local, biodegradable ingredients.
This study aligns with that approach by promoting the use of local vegetable oils : apricot kernel oil and castor oil both known for their functional and antioxidant properties, to develop a solid shampoo that is healthy natural, and environmentally friendly.
Castor oil and apricot kernel oil meet Codex Alimentarius standards, with acid, iodine, saponification, and peroxide values within acceptable ranges. Their densities (0.92 and 0.96) and refractive indices (1.4805 and 1.4730) also comply with standards. Their respective densities (0.92 and 0.96) and refractive indices (1.4805 and 1.4730) also fall within acceptable ranges.
Both oils have similar carotenoid levels (2.2 vs. 2.06 mg/kg), but castor oil has higher chlorophyll content (6.72 mg/kg). The β-carotene bleaching test revealed apricot kernel oil has significantly greater antioxidant potential than castor oil.
The formulated shampoos have an alkaline pH (8.5–10), total fat content of 78.02–80.19%, moisture of 8.23–11.10%, and hardness between 0.3–0.5 N. They contain higher chlorophyll and carotenoids than the control, with acceptable polyphenol and flavonoid levels. Their antioxidant activity is high and comparable to vitamin C.
This study highlights the potential of local vegetable oils to create effective, natural, and eco-friendly solid shampoos, supporting greener innovation in cosmetics.
Key words: Valorization, natural cosmetic products, solid shampoo, apricot kernel oil, circular economy.

RECOVERY OF METALS AND PLASTICS FROM WEEE WASTE BY ELECTROSTATIC SEPARATION

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Abstract:
The sustainable management of complex waste, such as electrical cables or waste electrical and electronic equipment (WEEE), requires effective sorting techniques to enable its recovery. This study focuses on electrostatic separation as a method for sorting granular mixtures, derived from shredded electrical cable waste, comprising millimetre-sized metal and plastic particles using an experimental electrostatic separation device comprising an electrostatic actuator consisting of two copper electrodes. The upper electrode consists of a series of parallel segments constructed on the upper face, while the lower electrode is a copper plate. A vacuum cleaner is also positioned above the electrostatic actuator. An electroadhesion force is applied to the metal particles deposited on the upper face of the electrostatic actuator in order to fix the metal particles, while the suction force of the air is used to recover the plastic particles. The experimental results obtained demonstrate the feasibility of separating metal and plastic particles with high recovery rates.

Key words: Electrostatic separation ; electrostatic actuator; electro-adhesion force ; metal particles; plastic particles.

WASTE TO VALUE APPROACH: RECYCLING DATE SEEDS THROUGH ROASTING FOR HIGH-VALUE OIL PRODUCTION

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Abstract
Date seeds, a major by-product of date processing, represent 10–15% of the fruit mass and are often discarded as waste. Date seed oil is known for its high oleic acid content, natural antioxidants, and remarkable oxidative stability, making it a promising target for valorization.
This study investigates the recycling of Deglet Nour date seeds through oil extraction, with a particular focus on the effect of roasting on oil quality. Seeds obtained from the Prestige Dattes processing plant (Sétif), were roasted (200 °C, 22 min) and compared to unroasted controls. The extracted oils were analyzed for physicochemical properties, fatty acid composition, phenolic content, antioxidant activity, and oxidative stability. The results showed that roasting significantly improved oil yield, enhanced phenolic levels and antioxidant capacity, and extended oxidative stability, while maintaining a stable fatty acid profile. Overall, these findings confirm that roasting enhances the nutritional and functional properties of date seed oil, positioning it as a high-value product. This recycling approach contributes to sustainable waste recovery and supports circular economy practices.

Keywords: Date seed oil, Roasting, Quality parameter, Antioxidant property, Physicochemical characteristic.

TREATMENT OF PLASTIC WASTE BY AN INDIGENOUS SOIL MICROBIOME

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Abstract:
Plastic waste in the environment poses a growing ecological threat. Due to its resistance to biological processes, it accelerates the risk of pollution. The objective of this study was to search for indigenous bacteria capable of degrading polyester, as a sole source of carbon and energy, from soil from the El Berka Zarka public landfill. Fermentation was conducted at 30°C with a stirring speed of 150 rpm. The culture was monitored by measuring optical density (OD), dry weight, and determining the weight of the polyester. The hydrophobicity of the selected consortium was also studied.
The results obtained after five months of cultivation reveal that the bacterial consortium is capable of growing and degrading polyester present in the medium as a sole source of carbon and energy, with yields of 19%, 49%, 20%, and 23%, respectively. The maximum biodegradation rate of 49% was obtained when the initial weight of polyester was 0.4 g. The microbiological study identified two bacterial strains capable of using the molecule: *Aeromonas hydrophila and Burkholderia cepacia*. These indigenous bacterial strains exhibit a high hydrophobicity towards the xenobiotic estimated at 50% and 69%, respectively. Obtaining an indigenous microbial consortium highly adapted to this substrate may prove to be an interesting alternative for possible application in the treatment of waste containing this molecule or other related molecules.

Key words: Plastic waste, Polyester, Indigenous bacteria, Biodegradation

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PROCESS ENGINEERING STRATEGIES FOR WASTE VALORIZATION: GLASS WASTE AS A RESOURCE FOR GREEN CERAMICS

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Abstract:
The sustainable management of industrial waste requires innovative process engineering strategies capable of reducing environmental impacts while generating value-added products. In this study, post-consumer soda-lime glass waste was transformed into a secondary raw material for the elaboration of eco-friendly ceramics. Bentonite–glass mixtures (30–50 wt.%) were prepared and processed through controlled grinding, homogenization, shaping, and firing at 900 and 950 °C. Experimental results confirmed that glass enhances sintering by promoting vitrification, which significantly reduces porosity and water absorption while improving microstructural cohesion.
From a process engineering perspective, the proposed route integrates critical steps such as waste collection, particle size control, and optimized firing cycles. Environmental assessment highlights two major benefits: reduced extraction of virgin raw materials and limitation of landfill disposal. In addition, the potential recyclability of ceramic by-products into the same process loop was evaluated, opening perspectives for closed-loop production systems.
This work demonstrates how process engineering can design innovative recycling pathways, converting waste into resources while supporting circular economy principles. The approach provides a sustainable strategy for green ceramic production and contributes to industrial decarbonization and resource efficiency.

Keywords: Waste valorization, Green ceramics, Process engineering, Recycling, Environmental impact.

ADSORPTION DU CUIVRE CU(II) SUR UN BIOPOLYMÈRE EXTRAIT D'UN DÉCHET VÉGÉTAL : APPLICATION À LA CONCEPTION D'UN BIOCAPTEUR MINIATURISÉ.

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Résumé :
Cette étude porte sur l'adsorption des ions cuivre à l'aide d'un biopolymère naturel extrait de l'écorce de grenade (*Punica granatum L.*), considérées comme un déchet végétal. Les essais réalisés en mode statique ont permis d'étudier la cinétique en optimisant les paramètres expérimentaux. Les modèles du pseudo-second ordre et de la diffusion intraparticulaire se sont avérés les plus adaptés pour décrire le phénomène. L'analyse thermodynamique ($\Delta H°$; $\Delta S°$) montre une réaction de surface spontanée et exothermique, impliquant à la fois une physisorption et une chimisorption, avec une efficacité de rétention du cuivre atteignant 94 % et une capacité maximale d'adsorption de 23,41 mg/g. Sur la base de ces résultats, l'adsorbant a été intégré dans un biocapteur miniaturisé. Ce dispositif présente une sensibilité élevée (limite de détection jusqu'à 10^{-8} M) et permet la détection simultanée de plusieurs métaux lourds avec une sélectivité remarquable pour chacun d'eux.

Mots clés: adsorption, biopolymère, *Punica granatum L*, cuivre, biocapteur.

BIOACTIFS ISSUS DE DECHETS ORGANIQUES A POTENTIEL ANTIMICROBIEN

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Résumé :
Le marc de café, sous-produit largement disponible, suscite un intérêt croissant en raison de ses propriétés biologiques potentielles. Riche en composés bioactifs, il représente une ressource prometteuse pour le développement de solutions naturelles alternatives aux agents antimicrobiens classiques. Cette étude a pour objectif d'extraire l'huile contenue dans le marc de café et d'évaluer son activité antifongique et antibactérienne.
L'extraction de l'huile a été réalisée à partir de 20 g de marc de café en utilisant deux méthodes : la macération et l'extraction par Soxhlet. Les rendements obtenus étaient respectivement de 2,3 % et 16,65 %. L'activité antimicrobienne de l'extrait a été testée contre *Aspergillus niger*, *Staphylococcus aureus* et *Bacillus subtilis* par la méthode de diffusion sur disque. L'extrait a montré une activité antifongique modérée contre *Aspergillus niger*, indiquée par la présence de zones d'inhibition à faible densité, traduisant une certaine efficacité face à un champignon très résistant. En revanche, des zones d'inhibition significatives ont été observées autour des disques en présence de *Staphylococcus aureus* et de *Bacillus subtilis*, montrant une activité antibactérienne marquée de l'extrait contre ces deux bactéries pathogènes.
Ces résultats sont prometteurs pour la valorisation du marc de café en tant qu'agent antimicrobien naturel, avec un potentiel d'application dans les domaines pharmaceutique, alimentaire ou cosmétique.

Mots-clés : Recyclageé,valorisation, déchets organiques, agent antimicrobien

OLIVE POMACE: BIOCHEMICAL CHARACTERIZATION AND VALORIZATION STRATEGIES

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Abstract:
The insecticidal effect of four crude olive pomace oils extracted from pomace collected from four localities of Kabylia, and extra virgin olive oil were assessed under laboratory conditions for the control of adults of Sitophilus oryzae(Linnaeus, 1763) (Coleoptera: Curculionidae).The doses used range from 0.1 to 0.4ml/25g of durum wheat. In addition, the quality indices and the fatty acid composition of these oils were evaluated. The results show that the legal quality indices were well within the legal limits for COP and EVO categories,acidity values ranged between 0. 43± 0.22 and 34.13% and petoxyde values between 10.83 ± 0.76 and 50.65±0.19 (meq O2/kg). The main fatty acids from all samples tested, were oleic (61.89-79.25%), palmitic (8.34 - 15.71%) and linoleic (8.17 - 16.52 %) acids. The results obtained show that after 24 h of exposure, all adults of S. oryzae died in the presence of durum wheat treated with EVO at the highest dose (0.4 ml/25g). For COP, mortality increased with exposure time and generally reaches 100% after 72 h. Comparison of LD50 (ml/25 g) indicates that olive oil was generally more toxic than crude pomace oils, , values varies from 32 0.005 to 0.189. . Likewise, oils significantly reduce the F1 offspring of Sitophilus oryzae and seed weight losses. No F1 adults were observed at the highest dose, and grain weight loss was 0 %., compared to 2.75 % in the control.
The results obtained provide strong encouragement for the consideration of natural substances as valuable components of integrated pest management strategies against insect pests of stored grains.

Key words: Valorisation,oil of olive cake, gas chromatography, contact toxicity, stored product pests.

VALORIZATION OF ORGANIC WASTE: TRANSFORMING KITCHEN RESIDUES INTO SUSTAINABLE MATERIALS

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Abstract
Waste management is a major issue, both ecological and economic, requiring sustainable solutions such as recycling and valorization, which transform waste into useful resources.In this context, the valorization of organic waste whether through the production of compost humus or the extraction of polymers from cellulosic residues represents a promising strategy to limit waste accumulation while creating high-value materials applicable in various sustainable sectors. A collection of different kitchen wastes (beverage cans, peels, plastics, eggshells, etc.) was carried out for composting, during which bacteria act as the primary agents, followed by actinomycetes that degrade more complex compounds such as cellulose and lignin.
This process allows for more complete decomposition and improved quality of the final compost. Furthermore, coffee residue underwent alkaline treatment to disrupt the lignocellulosic structure, followed by three bleaching phases involving acetic acid and sodium hypochlorite, with successive rinses using distilled water until neutral pH was achieved. A depectinization step was then performed using a mixture of nitric acid and acetic acid, combined with autoclave treatment to disaggregate the cell walls.
The obtained cellulose was purified using alcoholic agents with centrifugation to precipitate pectins, remove salts, and eliminate persistent organic impurities. These steps enabled the production of cellulose of sufficient quality for the formulation of various materials across different applications.

Key words: Waste recovery, valorization, composting, cellulose, sustainable Solutions

VALORIZATION OF PHOSPHATE SLUDGE: TOWARD SUSTAINABLE RECOVERY OF MINING BY-PRODUCTS

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Abstract:
The management of phosphate sludge, a waste product of phosphate beneficiation processes, presents both an environmental burden and a missed opportunity for resource recovery.
This study explores the potential for valorizing phosphate sludge within the framework of sustainable and circular economy principles. Physicochemical and mineralogical analyses were conducted to determine the sludge's composition, including residual phosphate content, silicates, and trace metals. Based on these properties, several recovery pathways were evaluated, such as incorporation into building materials (cement, bricks) and use as a soil amendment. Laboratory-scale experiments demonstrated that stabilized sludge can enhance the mechanical properties of construction materials and contribute essential nutrients when applied to degraded soils. Additionally, the recovery of residual phosphorus could provide an alternative source of fertilizer components.
The results support the feasibility of transforming phosphate sludge into a valuable secondary resource, reducing environmental pollution and promoting sustainable waste management. This study contributes to ongoing efforts to close resource loops in the mining sector and reduce the ecological footprint of phosphate production.

Key words: Phosphate sludge; Waste valorization; Circular economy; Resource recovery; Sustainable development

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VALORIZATION OF THE POWDERED BREAD WASTE AS A BASE MEDIUM FOR AMYLASE PRODUCTION

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Abstract:
Bread waste is one of the most commonly discarded food items worldwide. As bread waste contains minerals, proteins, and starch that are ideally suited for fermentation processes, it can serve various biotechnological applications. Our research explores its potential to be transformed into a renewable substrate for enzyme production, specifically focusing on the use of fermentation—a widely discussed and promising strategy for recycling starchy materials. By utilizing bread waste in this manner, we aim to not only reduce food waste but also support sustainable practices within the framework of a circular economy.
Utilizing BWP for amylase production by Geobacillus sp. Sd15 strain , which was isolated from an unexplored thermal spring in Algeria. This extremophile is known for its ability to thrive under harsh environmental conditions, making it an ideal candidate for producing thermostable enzymes, also known as thermozymes, which are highly sought after in various industrial applications. Additionally, the thermotolerance of the crude amylase enzyme makes it a promising choice for various long-term industrial applications. Our findings demonstrate the production of thermostable amylase using bread waste powder as a fermentation substrate, showcasing a novel biotechnological solution for the upcycling of bread waste into value-added products.

Key words: Amylase production, Bread waste powder, Valorization

SUSTAINABLE PERFORMANCE OF SELF –COMPACTING CONCRETE USING RECYCLED AGGREGATES AND SLAG

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Abstract:
This research investigates the durability of self-compacting concrete (SCC) incorporating recycled aggregates and ground granulated blast furnace slag. In this study, 15% of cement was replaced by slag, while recycled aggregates were used in two levels: (i) 50% recycled coarse aggregate and 50% recycled fine aggregate, and (ii) 100% recycled coarse aggregate with 50% recycled fine aggregate. The concrete mixes were evaluated through tests on workability, compressive strength, water absorption, and resistance to external actions. The results showed that the addition of slag improved the microstructure, reduced porosity, and enhanced durability, which helped compensate for the negative effects of recycled aggregates. The mixture with 50% recycled aggregates presented the best balance between strength and durability. In contrast, the higher replacement level led to lower performance, although partly improved by the pozzolanic activity of slag. Overall, combining slag with recycled aggregates provides a sustainable way to produce durable self compacting concrete.

Key words: Self-compacting concrete, recycled aggregates, slag, durability, sustainability

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ECO-VALORIZATION OF INDUSTRIAL SLUDGE THROUGH A STABILIZATION/SOLIDIFICATION (S/S) APPROACH FOR SUSTAINABLE WASTE RECOVERY.

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Abstract:
Industrial activities generate substantial amounts of hazardous sludge enriched with toxic heavy metals, posing significant environmental and public health risks. This study proposes an eco-valorization strategy to manage and recover such hazardous waste through the Stabilization/Solidification (S/S) technique as a sustainable remediation approach. Portland cement and sodium silicate were incorporated into the sludge to immobilize heavy metals and enhance its physical integrity for safe disposal or potential reuse.
The treated matrices were comprehensively characterized using scanning electron microscopy (SEM) coupled with energy-dispersive spectroscopy (EDS) to assess morphological and elemental changes, while Fourier-transform infrared spectroscopy (FTIR) and X-ray diffraction (XRD) were employed to identify mineralogical transformations. Elemental quantification was performed using inductively coupled plasma atomic emission spectrometry (ICP-AES), cold vapor atomic absorption spectrophotometry (CV-AAS), and atomic absorption spectrophotometry (AAS).
Results indicated a substantial reduction in heavy metal leachability, with stabilization efficiencies of 89.2% for zinc, 72.1% for iron, and 70–80% for other metals, demonstrating the effectiveness of the treatment. The findings highlight the dual benefit of S/S technology as both an environmentally sound disposal method and a pathway toward the sustainable recovery and valorization of industrial sludge, in alignment with circular economy principles and waste-to-resource strategies.

Key words: Stabilization/Solidification, Heavy metals, Industrial sludge, Portland cement, Sodium silicate, Sustainable waste recovery

ENVIRONMENTAL IMPACT OF RECYCLING PLASTIC WASTE

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Abstract:

Waste management and recycling are two crucial practices essential to maintaining a sustainable environment. Recycling helps preserve natural resources, reduce greenhouse gas emissions, and minimize pollution. It plays a vital role in sustainable waste management, where resources are used more efficiently and sustainably. Individuals, businesses, and governments can all play a crucial role by actively participating in the recycling process and adopting environmentally friendly practices. In this work, we have shown the environmental importance of the recycling treatment of a quantity of plastic waste, by evaluating the concentrations of gases (NOx, SO_2, CO and dust) emitted following their incineration which is a waste treatment currently used in this factory. The same quantity of plastic waste is subjected to recycling treatment, we recovered 1829 kg of plastics which corresponds to a gain of 1463 kg of oil, we were thus able to obtain a reduction in pollution of harmful gases and dust of 90% and a significant gain in reusable raw materials.

Key words: Recycling, Incineration, gas (NOx, SO_2, CO and dust)

CHARACTERIZATION AND VALORIZATION OF CARBONIZED GREEN TEA RESIDUES

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Abstract:
In order to valorize green tea residues, which are rich in carbon, these residues were collected. After rinsing and drying, they were carbonized at 700 °C for 1 h. In the first step, the carbonized product was subjected to several processes: activation with KOH, centrifugation, and subsequent drying at 80 °C. The structural characterization of carbonized green tea (CGT) was carried out using FTIR spectroscopy. In addition, the antioxidant activity of CGT was evaluated through the DPPH° assay and the Total Antioxidant Capacity (TAC) test.
The FTIR results of CGT revealed several spectral peaks:
Peak at (879.5–891.1) cm^{-1}: indicative of C–O bonds (ethers or alcohols).
Peak at (1028.06–1056.99) cm^{-1}: attributed to C–O–C bonds (ethers or anhydrides).
Peak at (1066.6–1074.3) cm^{-1}: associated with S=O bonds, linked to C–C or aromatic structures.
Peak at (1381.0–1394.5 cm^{-1}): attributed to phenolic –OH functional groups.
Peak at 1406.1 cm^{-1}: possibly related to C–H bonds (aromatic rings).
The antioxidant activity results of CGT (600 µg/mL) revealed values of approximately 16.9% and 21.1% for DPPH° and TAC, respectively. These findings provide essential insights into the chemical composition and structural features of CGT residues, opening perspectives for their potential applications in various fields.

Keywords: Green tea, activation, FTIR, antioxidant activity

SIMULATION OF AN AUTONOMOUS ROBOTIC ARM FOR INDUSTRIAL SORTING USING FUZZY LOGIC

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Abstract:
In modern industrial contexts, the automatic sorting of objects based on their color is a key operation in several sectors, including agri-food, recycling, and packaging. This work presents a 3D simulation, developed using the Webots platform, of an autonomous robotic arm with three degrees of freedom, capable of sorting colored balls using fuzzy logic, an artificial intelligence technique well suited for uncertainty management. The Webots simulation environment enables the complete modeling, testing, and visualization of the robotic system's behavior, offering a realistic validation framework. A fuzzy control model was designed based on the RGB components of images captured by an embedded camera. Through a set of fuzzy rules, the system identifies the dominant color of each ball in real time and automatically assigns it to a predefined category (red, green, or blue). The arm's movements are computed using inverse kinematics to ensure precise spatial positioning. Simulation results showed cycle times ranging from 11.05 to 17.8 seconds, confirming the efficiency and reliability of the sorting process.This project highlights the contribution of artificial intelligence, through fuzzy systems, to enhance the autonomy, flexibility, and adaptability of automated production systems.

Key words: Fuzzy logic; Artificial intelligence; Industry; Robotic arm; Automatic sorting; Webots.

ELECTRONIC STRUCTURE AND MAGNETIC PROPERTIES OF CUFES2: AN AB INITIO DFT/GGA+U CALIBRATION STUDY

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Abstract
Chalcopyrite is a copper ore and is the primary source of copper. Other names of chalcopyrite are copper pyrites, Cupropyrite, Towanite, yellow copper, yellow copper ore, yellow pyrite. The name chalcopyrite is derived from the Greek words chalkos, means "copper" and pyrites means, "strike fire".
Fortunately, both structure and composition affect certain physical properties. It is through theproper use of these properties that minerals can reliably be identified. Over 9 million tons of copper are produced each year for mineral processing plants around the world. It is the most commonly encountered copper mineral. Chalcopyrite is a composition sulfide of copper and iron (34.5% Cu, 30.5% Fe, 35% S copper pyrite).The role of ternary chalcogenide CuFeS2 should be specially emphasized, historically, it is interesting to note that application for this natural mineral in art reaches antiquity (2500 years ago), when it was used as a materiel for ancient statuettes. Chalcopyrite is probably also one of the oldest known semiconductors leading to its use as one of the first materials for detecting radio waves.
In all this background, the electronic and magnetic properties of the CuFeS2 compound have been investigated in both ferromagnetic (FM) and antiferromagnetic (AFM) states through the first-principles Density Functional Theory within the framework of the FPLAPW method as implemented in the Wien2K package [8].Relative energies of the different spin arrangement for the unpaired electrons were obtained applying Density Functional Theory (DFT). In order to obtain a set of energies for the magnetic states, a Hubbard correction term U_{eff}has been considered for the Fe(3*d*) states. The value of U_{eff} is element-specific, usually determined empirically, to fit some specific physical property, most often the crystal lattice parameters or the band gap between the occupied and unoccupied states.
The obtained results are compared with available experimental data and are used as a basis to critically discuss existing discrepancies between theory and experiment as well as inconsistencies.

Keywords: Ferromagnetism, Computational physics, Density functional theory, Chalcopyrite structure.

NUMERICAL SIMULATION OF COLD-FORMED STEEL BUILT-UP COLUMNS UNDER COMPRESSION

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Abstract:
The predominant types of cold-formed thin-walled structural elements featuring open cross-sections, when subjected to axial or flexural loads, experience at least three distinct modes of instability: local, distortional, and global. These are referred to as pure modes of instability, which typically manifest in interaction with one another. The adoption of cold-formed steel built-up sections is on the rise, attributed to their excellent strength-to-weight ratio and cost-effective design. These structural elements are constructed by bolting or welding individual components together, providing effective solutions in lightweight steel construction where a single section fails to meet the necessary load capacity or serviceability standards. The objective of our study is to investigate the performance of cold-formed steel columns under axial compression featuring different types of cross-sections (Hat+U, C+U, Sigma+U). The models, which were assembled through welding, were modeled using finite element software ABAQUS. This simulation emphasizes the nonlinear analysis of the compressive behavior and instability modes of the built-up columns. The numerical results have been validated with the Analytical results, which were based on the European standard Eurocode 3, indicating a significant correlation between the numerical and analytical findings, with discrepancies remaining below 7%. The failure modes demonstrated that all models displayed local instability.

Key words: Thin-walled elements; Built-up sections; Axial compression; Finit element; Local instability.

INNOVATIVE APPROACHES TO INVERSE KINEMATICS RESOLUTION: COMBINING OPTIMIZATION AND LEARNING

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Abstract:
This study aims to optimize the solution of inverse kinematics for 4-DoF SCARA robots using an approach based on artificial neural networks (ANNs). Although analytical methods remain essential, they often face challenges due to the complexity and computational intensity involved in manipulator kinematics, such as with SCARA robots. The main objective of this study is to develop an innovative approach leveraging ANNs to optimize inverse kinematics and reduce the Mean Squared Error (MSE).To evaluate their performance, four different training algorithms—Levenberg-Marquardt (LM), Scaled Conjugate Gradient (SCG), Genetic Algorithm (GA), and Gradient Descent—are applied to various datasets. These varied datasets enable a comprehensive assessment of the ANNs' adaptability to different operational scenarios. Artificial Neural Networks offer notable advantages, such as increased speed and accuracy, making them particularly effective for real-time control and robotic planning applications. A thorough comparison of various training algorithms and configurations has identified the most effective combinations for improving the inverse kinematics performance of SCARA robots. The results highlight the relevance of ANNs as an alternative solution to conventional analytical methods, overcoming their limitations and enhancing the performance of SCARA robots in complex environments.

Key words: Neural networks, synthetic datasets, kinematic inversion, optimization techniques, SCARA robot, training methods, performance improvement.

SMART MODELING TECHNIQUES FOR COMPLEX CHEMICAL MIXTURES

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Abstract:
Multivariate analysis play a crucial role in modern chemistry by enabling the extraction of relevant information from complex and multivariate data sets. In this work, Partial Least Squares Regression (PLS), Gaussian Process Regression (GPR), and Artificial Neural Networks (ANN) were applied to address analytical and predictive challenges in chemical systems. PLS and GPR models made it possible to quantify key chemical properties with high accuracy, while ANN was used to capture nonlinear patterns and improve prediction reliability. These techniques proved particularly effective in the interpretation of spectroscopic data, the identification of hidden trends, and the prediction of target variables in reaction mixtures and complex formulations. Their application contributed significantly to data-driven modeling, optimization of experimental conditions, and the reduction of time and resources required for traditional analysis. By integrating PLS, GPR, and ANN into the chemometric workflow, it was possible to build robust, interpretable, and efficient models. The results demonstrate the potential of these tools to support innovation and improve decision-making processes in various fields of chemistry.

Key words: Chemometrics; Partial Least Squares Regression (PLS); Gaussian Process Regression (GPR); Artificial Neural Networks (ANN); Spectroscopic Data; Property Prediction.

REINFORCEMENT LEARNING BASED APPROACHES FOR OPTIMIZING WAREHOUSING PERFORMANCE

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Abstract:
Automated Storage and Retrieval Systems (AS/RS) play a vital role in modern logistics and manufacturing, especially within the framework of Industry 4.0. Their overall efficiency strongly depends on real time decision making, a task where traditional methods such as rule based or heuristic strategies often struggle to cope with the variability of product flows and the dynamic nature of rack configurations. Reinforcement Learning (RL), and particularly Q-learning, emerges as a promising solution by allowing agents to gradually acquire optimized retrieval policies through repeated interaction with their environment.
This work explores the application of RL to the retrieval optimization problem in AS/RS. The study emphasizes how adaptive learning can outperform conventional techniques by providing greater robustness and flexibility under dynamic operating conditions. Preliminary results suggest notable improvements in retrieval performance and system responsiveness. Furthermore, the discussion addresses potential limitations, such as scalability issues and computational requirements, while also identifying perspectives for integrating RL into large-scale industrial systems.
By highlighting the adaptability and performance gains enabled by RL, this study contributes to the advancement of intelligent control strategies for next-generation automated warehouses.

Key words: Automated Storage and Retrieval Systems, Q-learning, Reinforcement Learning, Optimization, Smart Warehousing.

PERFORMANCE ANALYSIS OF PPM-TH-UWB SYSTEMS IN INDUSTRIAL CHANNEL

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Abstract:
In the industrial sector, UWB has emerged as a particularly appealing transmission technique due to its exceptional capabilities in accurate location tracking, real-time data transfer, and secure communications. which is why it is considered an excellent candidate for variety of industrial applications.
Discrete time channel impulse response is used to build up revised channel model for Industrial Environment which is based on the UWB Channel model proposed by IEEE802.15.3a with the observation that the profusion of scatters due to presence of industrial metallic equipment's creates dense multipath scattering. With the revised channel model, we compare the performance of the system in IEEE channel and industrial channel and evaluate the performance of a RAKE receiver employing maximal ratio combining (MRC), simulation results and analysis show that the industrial wireless communication system of UWB based on TH-PPM can effectively with-stand multipath fading and has the advantages of low bit-error rate.

Key words: UWB, Industrial Channel, Rake receiver.

DESIGN AND IMPLEMENTATION OF AN ERP SYSTEM FOR PRODUCTION MANAGEMENT AT CARTONNERIE EL AMINE

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Abstract:
This study was conducted within the company "Cartonnerie El-Amine," a major player in Algeria's packaging industry, aiming to deploy an ERP system to manage production and inventory. Faced with growing information flows and increasing customer demands, the company needed a tailored digital solution to improve efficiency and traceability. The project involved evaluating three open-source ERP systems Odoo 12, Axelor, and ERPNext against 37 technical and functional criteria, including modularity, mobile accessibility, multilingual support, documentation, real-time updates, and production planning capabilities. After extensive testing and comparison using the TOPSIS decision-making method, Odoo 12 was selected as the most suitable ERP for the company's specific needs. The final phase of the project involved implementing a production management module within Odoo 12, adapted to the company's workflows. The implementation included the design of the system architecture, module development using Python, and the integration of functionalities such as bill of materials management, manufacturing orders, machine scheduling, and product traceability. This deployment allowed for better synchronization between departments, improved visibility of production data, and enhanced decision-making. The project demonstrates the relevance of a structured ERP selection process and highlights the benefits of customizing open-source solutions to match the operational realities of manufacturing SMEs.

Key words: Enterprise Resource Planning (ERP), Odoo 12, Open-source software, Production management.

MODERNIZATION AND IMMIGRATION SOLUTIONS FOR HEAT RECOVERY STEAM GENERATOR IN RAS DJINET POWER PLANT USING TIA PORTAL

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Abstract:
This project addresses the modernization of the Heat Recovery Steam Generator (HRSG) control system at the Ras Djinet Combined Cycle Power Plant, focusing on the immigration from an Emerson-based platform to a Siemens-based solution using TIA Portal (v15.1). The primary motivation behind this transition is to overcome the communication limitations and interoperability issues caused by the OPC protocol, which currently restrict integration and operational reliability. By adopting Siemens technology, the project eliminates OPC protocol dependencies, ensuring smooth integration and enhanced system performance.
The work consisted of re-engineering core HRSG control functions and implementing them in TIA Portal, supported by the development of a comprehensive Human-Machine Interface (HMI). The HMI was designed to provide user-friendly monitoring and structured visualization of plant components, including HRSG sections, turbines, condenser, thus improving operator interaction and process transparency.
To validate the proposed solution, selected control strategies, such as a low-pressure (LP) drum level control loop, were modelled and simulated using TIA Portal in conjunction with Factory I/O. A Proportional-Integral-Derivative (PID) controller was applied to the LP drum level loop, demonstrating improved stability, precision, and overall reliability under varying load conditions. Overall, the project demonstrates a complete transition to Siemens automation technology, leading to improved efficiency, reliability, and durability in Algerian power plants.

Key words: HRSG, Immigration, TIA Portal, Siemens, Emerson, Factory I/O.

DFT CALCULATIONS AND MOLECULAR DOCKING ANALYSIS OF ANTI AND SYN ISOMERS OF SIMPLE MANNICH TYPE COMPOUNDS

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Abstract:
In this study, a comprehensive simulation was performed to investigate the structural, electronic, and biological properties of syn and anti isomers of Mannich-type compounds. Density Functional Theory (DFT) calculations were employed to evaluate the relative stability and chemical reactivity of both isomers. The results revealed that the syn isomer possesses a higher energy gap, indicating greater molecular stability and lower chemical reactivity compared to the anti isomer, possesses a lower energy gap, indicating lower molecular stability and greater chemical reactivity . Subsequently, molecular docking studies were carried out to assess the biological activity of the two isomers against a acetylcholine esterase target. The docking results demonstrated that the anti isomer exhibits stronger binding affinity and, consequently, higher predicted biological activity, whereas the syn isomer shows weaker interactions and lower biological reactivity. These findings suggest a structure–activity relationship where increased chemical reactivity correlates with enhanced biological interaction in these Mannich derivatives.

Key words: Mannich compounds, DFT Study, Syn-Anti isomers, docking design evaluation

NUMERICAL INVESTIGATION OF PIN TAPER ANGLE EFFECTS ON HEAT GENERATION AND PLASTIC STAINS IN FSW PROCESS

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Abstract:
The welding tool in the Friction Stir Welding (FSW) process is a critical component responsible for generating frictional heat through rotation and plunging into the workpiece. It softens the material, promotes material mixing, and enables the formation of a solid-state weld without the need for filler metal, while consolidating the joint under pressure. The tool generally consists of two main parts: the shoulder and the pin (or probe). Both the design and the material of the FSW tool are tailored to the specific application and the materials being joined. Proper tool selection is crucial for achieving high-quality welds and prolonging tool life.
The pin is the protruding section of the tool that penetrates into the workpiece. Its designdefined by parameters such as length, shape, and profilevaries according to material thickness and joint configuration. Common pin shapes include cylindrical, conical, polygonal, and threaded designs, among others.
This study investigates the welding of AZ31B magnesium alloys using SS304 tools. Finite element simulations were performed in ALTAIR software to examine the effects of various pin taper angles for a conical pin profilespecifically 0°, 5°, 10°, and 15°on temperature distribution within the welded plates during the process, as well as on plastic strain, to assess how this critical parameter influences the stirring zone. The results emphasize the significant role of pin geometry in determining thermal behavior, offering valuable insights for optimizing welding parameters to improve weld quality.

Key words: Friction stir welding (FSW), Numerical simulation, Pin taper angle, Temperature distribution, Plastic strains, magnesium alloys.

EFFECT OF BUFFER LAYER THICKNESS (CDS) ON Cu_2O-BASED HETEROJUNCTION SOLAR CELL

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Abstract:

Cuprous oxide (Cu_2O) solar cells have attracted significant interest from researchers due to the Cu_2O is an abundance, non-toxic, and high theoretical photovoltaic efficiency, which can reach up to approximately 20%. Particularly, the cuprous oxide heterojunction solar cell with different buffer layer as a ZnO, CdS, etc.The buffer layer plays an importance role in this structure by forming a junction with Cu_2O, facilitating efficient transporting and charge separation, and it is minimizing recombination losses at the interface. Moreover, the thickness of the buffer layer significantly influences key output parameters. In the present work, the CdS/Cu_2O heterojunction solar cells have been simulated by Silvaco- atlas software. And we study the effect of the buffer layer thickness on the solar cell efficiency where we changed the CdS thickness (buffer layer) ranges from 10 to 100 nm. And, we found that the optimal thickness has corresponding to the highest efficiency (6.03%) of this solar cell is 30 nm.

Key words: Simulation, Solar Cell, Cuprous Oxide, Heterojunction, Buffer Layer, Thickness.

CONVOLUTIONAL AUTOENCODER BASED HEALTH INDICATOR CONSTRUCTION FOR BEARING REMAINING USEFUL LIFE ESTIMATION USING ANFIS

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Abstract:
Accuratly remaining useful life estimation of rolling element bearings is critical in industrial machinery, enabling a shift from preventive to predictive maintenance to minimize unplanned failures. However, traditional data driven approaches often rely on manual feature engineering, involving feature extraction, selection for health indicator construction, these approaches are computationally expensive, depending on expert knowledge, also, it may fail to capture the most salient degradation signatures hidden within raw data. To overcome these limitations, this study proposes a hybrid framework that automates the health indicator construction process for bearings remaining useful life estimation. The proposed methodology consists of two synergistic stages: First, a convolutional autoencoder is used to learn the high representation of a time-frequency transformation of vibration data in an unsupervised manner, to automatically extract discriminative spatio-temporal features, for constructing a robust health indicator that reflects bearing's degradation process without any manual intervention, or prior domain knowledge. Second, the use of an adaptive neuro-fuzzy inference system as a predicting model, that combines the learning capability of neural networks and the reasoning ability of fuzzy logic to model the non-linear dynamics of bearing's degradation process. The prediction accuracy of our framework is validated using XJTU-SY dataset, achieving the lowest prediction error over conventional methods, also showcasing enhanced robustness and generalizability across different operating conditions. By levraging convolutional autoencoders as unsupervised network for heath indicator construction, and the adaptive neuro fuzzy inference system as a predicting model, the proposed method is a promissing solution in Prognostics and Health Management field.

Key words: Rolling Element Bearings , Remaining Useful Life, Prognostics and Health Management, Convolutional Autoencoder, Health Indicator, Adaptive Neuro-Fuzzy Inference System.

LEVERAGING GENERATIVE AI FOR ENHANCED SAFETY AND TRAINING IN INDUSTRIAL ENVIRONMENTS

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Abstract:
Industry today needs new tools that make training and safety easier to understand. This project uses generative artificial intelligence, such as Stable Diffusion, to create industrial images and short videos automatically from text. The goal is to help workers and trainers by showing complex procedures, safety rules, and dangerous situations that are hard to demonstrate in real life.
Our method is simple: write precise prompts, generate the visual content with AI, and check its usefulness with experts. First results show that this approach gives easy-to-understand and context-based images that improve traditional manuals and training materials. Using generative AI also saves time, reduces costs, and makes it possible to train workers safely for hazardous tasks.
The originality of this work is the use of state-of-the-art text-to-image models in industrial training. It shows how AI can improve safety, process understanding, and worker preparation in Industry 4.0.

Key words: Industry 4.0, Generative AI, Training, Safety, Stable Diffusion.

MACHINE LEARNING APPROACHES FOR PREDICTING THE TOXICITY OF IONIC LIQUIDS.

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Abstract:
Ionic liquids (ILs) are emerging alternatives to conventional organic solvents, attracting considerable attention due to their unique physicochemical properties, including non-flammability, extremely low vapor pressure, low melting point, high solvation capacity, and low volatility. However, several studies have indicated potential toxic effects of ILs on ecosystems, making toxicity a critical parameter in their selection.
In this study, toxicity was evaluated using the logarithm of the median effective concentration (logEC50), with IL structures represented by SMILES strings obtained from PubChem. A dataset of 134 ILs was compiled from the literature, and molecular descriptors were calculated with AlvaDesc software. From the 5666 generated descriptors, a Genetic Algorithm (GA) was employed to select 11 relevant descriptors.
A predictive model was then constructed by integrating the Dragonfly Algorithm with Support Vector Machine (DA_SVM). The dataset was randomly divided into a training set (80%) and a test set (20%) using MATLAB, ensuring prevention of overfitting. The DA_SVM model exhibited excellent predictive performance. For the training set, the root mean square error (RMSE), correlation coefficient (R), and coefficient of determination (R^2) were 0.0446, 0.9967, and 0.9988, respectively. For the test set, the corresponding values were RMSE = 0.0401, R = 0.9946, and R^2 = 0.9984.

Key words: Ionic Liquids (ILs), Dragonfly Algorithm (DA), Support Vector Machines (SVM), Toxicity Prediction, Molecular Descriptors.

INTELLIGENT OBJECT DETECTION AND PROXIMITY ALERT SYSTEMS FOR ENHANCING SAFETY IN INDUSTRIAL ENVIRONMENTS

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Abstract:
This paper introduces an artificial intelligence-based object detection system designed to enhance safety in industrial environments by monitoring the proximity of workers and objects around machines and robots. In modern factories, accidental collisions or unsafe approaches remain a major cause of injuries and equipment damage. The objective of this work is to develop a vision-based safety framework that automatically detects any object whether human or material when it enters a predefined danger zone close to industrial equipment. The proposed methodology relies on state-of-the-art object detection algorithms, such as YOLOv8, combined with real-time distance estimation techniques to continuously monitor the area around machines. Each machine or robot is equipped with a camera that defines a virtual safety boundary . If an object crosses this boundary, the system generates immediate alerts through visual or acoustic signals, and in the case of robotic operations, can trigger automatic responses to prevent collisions. Preliminary tests confirm that the system can accurately detect objects approaching dangerous zones and effectively issue timely warnings. The originality of this research lies in its adaptation of computer vision for dynamic proximity monitoring, offering a low-cost and scalable solution to accident prevention. This work demonstrates how artificial intelligence can play a critical role in improving occupational safety and operational reliability within Industry 4.0.

Key words: Object Detection, Industrial Safety, Proximity Monitoring, Computer Vision, YOLO, Industry 4.0.

SMART MONITORING SYSTEM USING MEDIAPIPE POSE ESTIMATION FOR WORKER SAFETY IN INDUSTRIAL ENVIRONMENTS

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Abstract:

This paper presents an intelligent monitoring system designed to improve worker safety in industrial environments by leveraging real-time human pose estimation. The system utilizes MediaPipe, a lightweight and efficient computer vision framework, to accurately detect and track body keypoints with precision. After pose estimation, a rule-based decision layer analyzes the extracted skeleton data to identify abnormal or dangerous postures. For example, in factories, the system can detect when a worker is bending or lifting incorrectly, which may lead to injury, or when entering restricted zones, and immediately trigger an alert.

The objective is to provide a preventive and supportive tool that enhances occupational safety, reduces accident risks, and enables timely intervention without relying solely on manual supervision. The methodology integrates skeleton-based feature extraction, condition-based classification of unsafe postures, and real-time alert mechanisms. Expected results include accurate detection of risky situations, reduced false alarms, and reliable system responsiveness, highlighting the potential of pose estimation as a safety solution for Industry 4.0 environments.

Key words: Pose Estimation, MediaPipe, Industrial Safety, Human Monitoring, Industry 4.0.

REAL-TIME SHORT-TERM LOAD FORECASTING USING LSTM WITH WEATHER AND HISTORICAL LOAD FEATURES

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Abstract:

Accurate short-term load forecasting directly supports demand–supply balancing, unit commitment, and the reliable operation of power systems. Conventional approaches, however, often lose accuracy when demand is affected by abrupt weather changes or shifts in consumption patterns, leading to systematic prediction errors. To mitigate these issues, this study develops a forecasting model based on Long Short-Term Memory (LSTM) networks, which can exploit temporal dependencies in load data while simultaneously accounting for external drivers such as temperature and humidity.

The proposed model integrates multiple input features, including the previous day's load curve sampled at 15-minute intervals, a historically similar day's load profile, as well as the temperature and humidity profiles of both the previous and current day. The system generates the forecasted power demand for the current day while maintaining the ability to update predictions in real time as new information becomes available. This dynamic adjustment significantly improves forecasting accuracy under volatile operating conditions.

The approach is validated using the Italian load curve dataset, chosen for its strong similarity to Algerian consumption patterns. Results demonstrate that the proposed LSTM framework outperforms conventional forecasting techniques in terms of accuracy and adaptability. The originality of this work lies in the integration of real-time updates with weather-sensitive load forecasting in a deep learning environment.

Key words: Short-Term Load Forecasting, Long Short-Term Memory (LSTM), Power Demand Prediction, Weather Variables (Temperature and Humidity), Real-Time Forecasting, Italian Load Curve Dataset.

DFT SIMULATION OF H_2S ADSORPTION ON PURE AND DOPED B_{36} NANOCLUSTERS

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Abstract:
Hydrogen sulfide (H2S) is a toxic gas commonly released by industrial activities, posing serious risks to human health and the environment. The development of effective materials for its capture is therefore of considerable importance. In this work, the adsorption behavior of H2S on pure and doped boron (B36) nanoclusters is studied using density functional theory (DFT).
Geometric optimizations and electronic structure analyses were performed to evaluate the adsorption mechanisms. The frontier molecular orbitals, energy gap, and molecular electrostatic potential (MEP) were analyzed to evaluate the reactivity of the systems. In addition, the reduced density gradient (RDG) method was applied to characterize the nature of intermolecular interactions and visualize the non-covalent contacts between H_2S and the surface of the nanoclusters.
The results reveal that B36 shows a notable affinity for H2S, which is further enhanced by doping, improving the strength and stability of adsorption. RDG analysis confirms the presence of weak to moderate interactions governing the adsorption process.
This study provides valuable insights into the design of boron-based nanomaterials for the efficient removal of hazardous gases, highlighting the potential of doped B_{36} clusters as promising adsorbents for environmental remediation.

Key words: DFT, Adsorption, Nanocluster, toxique molecule

TOWARDS A THEORETICAL FRAMEWORK FOR DYNAMIC CYBER-PHYSICAL RISK ASSESSMENT IN INDUSTRY USING ARTIFICIAL INTELLIGENCE

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Abstract:
The rise of industry is profoundly transforming industrial environments, which are now increasingly based on interconnected cyber-physical systems. While this interconnection enhances productivity and efficiency, it simultaneously introduces new vulnerabilities, particularly through the convergence of cyber and physical risks. However, most existing risk assessment approaches remain static and compartmentalized, addressing cyber and industrial dimensions separately.
This contribution proposes a theoretical conceptual framework for the dynamic assessment of cyber-physical risks, incorporating the contribution of Artificial Intelligence (AI). The model is structured around three pillars. The first focuses on the dynamic modeling of hybrid risk scenarios, encompassing both physical events and cyber vectors. The second concerns the integration of AI, through machine learning, anomaly detection, and escalation prediction, in order to strengthen anticipatory capacity. Finally, the third emphasizes organizational resilience, achieved through the real-time adaptation of prevention and protection measures.
Although theoretical, this approach opens new perspectives for both researchers and practitioners, by proposing a methodology that unifies industrial safety and cybersecurity. Through this integrated vision, it becomes possible to envision proactive risk management, continuously adaptable to the evolving threats inherent in intelligent industrial environments.

Key words: Dynamic risk assessment, cyber-physical systems, artificial intelligence, industrial safety, organizational resilience, proactive risk management

AI-BASED COMPARISON OF MACHINE LEARNING AND DEEP LEARNING MODELS FOR RETENTION BEHAVIOR ON THREE POSITIONAL ISOMER LIQUID CRYSTAL STATIONARY PHASES

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Abstract:
Liquid crystal stationary phases offer unique selectivity arising from their mesogenic structure and anisotropic interactions. In particular, subtle structural modifications in mesogenic units, such as the position or nature of a substituent, can significantly alter retention behavior.
This work presents a comparative study of machine learning (ML) and deep learning (DL) models for predicting retention behavior on three liquid crystal-based stationary phases: two bearing lateral benzoloxy substituents that differ in methyl group position (meta-3-CH_3 and para-4-CH_3) [4], and a third in which the methyl substituent is replaced by chlorine (4-Cl) . These structurally related stationary phases provide an excellent framework to evaluate and contrast the predictive performance of AI-driven approaches in chromatography.
We compared conventional ML algorithms (linear regression, SVR, random forest) with DL architectures using SMILES-derived molecular descriptors. DL models showed superior predictive accuracy by capturing nonlinear relationships, while ML models remained more interpretable and computationally efficient. The study highlights both the potential and trade-offs of AI in chromatographic retention prediction, as well as the strong influence of subtle structural variations on liquid crystal-based selectivity.

Key words: Liquid crystal stationary phases; positional isomers; chromatography; machine learning; deep learning; retention time prediction

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FAULT-TOLERANT SECOND-ORDER SLIDING MODE CONTROL FOR ROBUST SPEED REGULATION OF A SQUIRREL-CAGE ASYNCHRONOUS MACHINE UNDER DISTURBANCES

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Abstract:
In the field of electrical machine control, various research efforts are progressively focusing on the application of modern control techniques. From this perspective, robust and fault-tolerant control of induction machines has become a significant challenge for advanced electrical systems, particularly in disturbance-prone industrial environments. This work proposes and analyzes a second-order sliding mode control (SMC) strategy applied to a squirrel-cage induction machine, targeting optimal speed performance while controlling chattering. The dynamic model includes inertia, friction, a variable load, and realistic noise on the speed measurement.
Our approach combines a tailored sliding surface structure and an inverse control law to ensure robustness, rapid adaptation, and stability of the motor under load. MATLAB simulations demonstrate rapid convergence to the setpoint, significant chattering reduction, and effective resistance to mechanical disturbances and sensor noise. These results highlight the potential of the proposed algorithm for demanding industrial applications and pave the way for future experimental validations.

Key words: Asynchronous machine, sliding mode control, robust control, chatter reduction, electric drive simulation.

AI-DRIVEN SIMULATION IN INDUSTRIAL DEVELOPMENT: INSIGHTS FROM GEOSCIENCE DATA

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Abstract:
Artificial Intelligence (AI) and simulation are reshaping modern industry by enabling the integration of complex datasets, predictive modeling, and process optimization. These approaches are now widely applied to improve efficiency, enhance decision-making, and create innovative solutions in fields ranging from resource management to industrial development. Machine learning methods such as Extreme Gradient Boosting (XGBoost) offer powerful tools to process heterogeneous data and generate reliable predictive outputs.
As a case study, we apply XGBoost to legacy aero-geophysical and remote sensing data, including gamma-ray spectrometry, magnetic surveys, satellite imagery, and elevation models. By integrating these diverse inputs, the models achieved far greater accuracy than single-source approaches, providing improved predictions and clearer detection of geological boundaries. Beyond geoscience, this workflow highlights how AI-driven simulation can support industrial development by optimizing resource exploration strategies, reducing uncertainty, and strengthening decision-making processes in complex environments.

Key words: Artificial inteleggince, simulation, data science, remote sensing

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CARBON MANAGEMENT THROUGH CCS: SIMULATION-DRIVEN ASSESSMENT OF GEOLOGICAL CO_2 STORAGE IN ALGERIAN DEEP SALINE AQUIFIER

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Abstract:
The energy and power sectors are the leading sources of greenhouse gas emissions, significantly contributing to climate change and environmental deterioration. The Algerian government, therefore, committed to reducing emissions by 7%—and potentially up to 22%—by 2030, based on the level of international technical support it would receive. The study aims to evaluate the viability of geological carbon storage as a long-term mitigation alternative, with an emphasis on deep saline aquifers in southern Algeria. The CMG-GEM simulator was used to construct a compositional reservoir model, incorporating key geological parameters such as formation heterogeneity, porosity, permeability, and caprock quality. The simulation framework accounted for structural, residual, and solubility trapping alongside geochemical interactions between CO_2, brine, and formation minerals to evaluate chemical stability. Results demonstrate that the modeled aquifer exhibits strong storage capacity, with favorable injectivity and limited leakage potential due to the sealing capacity of the anhydritic caprock. Significant mineral trapping and CO_2 dissolution were also noted, enhancing long-term sequestration. This work underlines the untapped potential of deep saline aquifers as a secure and sustainable option for large-scale carbon storage. It also supports the integration of geological sequestration into the national climate policy, particularly when it is preceded by robust reservoir modeling, risk assessment, and environmental monitoring.

Key words: CO_2 Sequestration, geological storage, CMG-GEM, Reservoir Modeling.

MULTI-OBJECTIVE MAINTENANCE PLANNING FOR MULTI-STATE SYSTEMS

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Abstract:

The problems encountered in the real world, particularly in industrial maintenance, are often multi-objective optimization problems, with conflicting objectives and multiple constraints. Furthermore, the nature of the systems concerned is that of multi-state systems, where each component can have several levels of operation, from perfect operation to total failure. This work focuses on the optimal maintenance planning of a series-parallel multi-state system. Three multi-objective algorithms, speed-constrained multi-objective Particle Swarm Optimization (SMPSO), multi-objective grey wolf optimizer (MOGWO), and multi-objective flow direction algorithm (MOFDA), were compared. All three algorithms employ external archives to store non-dominated solutions and use mechanisms such as crowding distance or grid-based approaches to ensure a well-distributed Pareto front and effective convergence. The results show that SMPSO stands out for its robustness, convergence speed, and the quality of the distribution of solutions on the Pareto front, followed by MOFDA, while MOGWO sometimes achieves good results but occasionally gets trapped in local optima.

Key words: multi objective optimization, preventive maintenance, multi-state systems.

OBSERVER-BASED SENSORLESS STRATEGY FOR MULTIPHASE INDUCTION MOTOR DRIVES VIA EXTENDED KALMAN FILTER

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Abstract:

The major control law poses a problem which is the need to use a mechanical value sensor (speed, flux, load torque), and imposes an extra cost and increases the complexity of the process. To ovoid this problem, an Extended Kalman filter EKF estimator has been detailed for the objective of reducing costs (no sensor to implement) or presented as a degraded but functional solution to applications with sensors in case of malfunction. The simulation results are presented to illustrate the performance of the proposed control approach associated with the Kalman filter.

In this work:

- The short exposition of the vector control equations by orientation of the direct rotor flux DFOC which will be use to define low of control.
- we use the control algorithm to synthesize a stabilizing control for the double stator asynchronous machine DSIM to control the speed and flux.
- The Kalman filter is proposed to reconstruct the speed, the flux, and the essentially as the resistive torque. In fact, the resistive torque is very necessary for the implementation of the all-controls law, and in practice the value of the resistive torque (load) is unknown.

Key words: DSIM Motor, DFOC Control, Sensorless Control, Extended Kalman Filter EKF.

MULTI OBJECTIVE REDUNDANCY ALLOCATION PROBLEM FOR MULTI-STATE POWER SYSTEM

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Abstract:

In the industrial sector, the reliability and availability of electrical power generation and transmission systems are essential in order to avoid interruptions that could lead to economic losses, production stoppages, and negative impacts on public services. This type of issue can be addressed as a multi-objective optimization problem for the structure of these systems, allowing for improvements in their overall performance in terms of reliability and availability. In this study, two reference algorithms, the Non-Dominated Sorting Genetic Algorithm (**NSGA-II)** and the multi-objective differential evolution (**GDE3)**, are applied to find the optimal structure of a multi-state series-parallel power system with the aim of minimizing the investment cost and maximizing the reliability of the system. The results demonstrate the robustness of both algorithms in terms of convergence and solution quality, offering decision-makers a wide range of choices depending on the situations they face. These observations confirm the relevance of their use for effectively addressing multi-objective optimization problems in complex systems.

Key words: multi objective optimization, reliability, power system, multi-state system.

ANALYTICAL INVESTIGATION OF COMBINED POTENTIALS FOR SELECTED DIATOMIC MOLECULES VIA THE PATH INTEGRAL FORMALISM

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Abstract:
In this research, we present an analytical solution for a combined potential system consisting of the *q*-deformed Hulthén potential and the modified inversely quadratic Yukawa potential, both of which belong to the class of exponential-type potentials. This framework enables the investigation of diatomic molecules through the Feynman path integral approach. Our analysis reveals the effect of the deformation parameter *q* on the energy spectrum and the corresponding wave functions. In addition, we evaluate several special cases, and the obtained results show good agreement with previously reported studies. The aim of this work is therefore to apply the Feynman path integral approach in the nonrelativistic case to study the combined system of the *q*-deformed Hulthén potential and the modified inversely quadratic Yukawa potential, which is defined as

$$V(r)=\frac{-V_0 e^{-2ar}}{1-qe^{-2ar}}-\frac{-V_1 e^{-2ar}}{r^2} \qquad (1)$$

where θis the deformation parameter, ς0 and ς1 are the potential depths, is the screening parameter, this potential is proposed as an intermolecular potential and is widely used in molecular physics and quantum chemistry .

Keywords: Path Integral; diatomic molecules; modified inversely quadratic Yukawa potential; q-deformed Hulthén potential; the deformation parameter.

WATER JET IMPINGEMENT HEAT TRANSFER AT LOW NOZZLE-PLATE SPACINGS AND HIGHER REYNOLDS NUMBER

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Abstract:

This study focuses on the numerical analysis of heat transfer from a jet impacting a flat plate subjected to a constant heat flux. The geometric configuration is two-dimensional, and the impact distance relative to the jet diameter (h/d) varies from 0.66 to 2, while the Reynolds number ranges from 3,800 to 88,000. The equations of motion and energy are solved using the ANSYS Fluent 22 solver, with the turbulent flow modelled using the k-ω SST turbulence model.

The local Nusselt number profiles indicate that the highest values are observed around the stagnation point, while the lowest values are found at the end of the heated plate. The results demonstrate that at low Reynolds numbers, the first peak remains fixed, and the second peak is absent. In contrast, at high Reynolds numbers, the second peak is present and shifts radially outward with increasing nozzle-plate spacing and higher jet Reynolds numbers.

Key words: High Reynolds number, low nozzle-plate spacings, second peak, Impinging Jet, Turbulent flow.

HALF-HEUSLER NANOPARTICLES FOR SPINTRONICS APPLICATIONS

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Abstract:

The family of half-Heusler (HH) alloys is considered to be prime candidates for spintronic and thermoelectric applications. In order to identify more potential HH materials, herein we discuss for the first time the structural, elastic, electronic, magnetic and thermoelectric properties of the AuCrGe half-Heusler (HH) alloy using density functional theory (DFT) and the full potential linearized augmented plane wave (FP-LAPW) method, which is implemented in the WIEN2k code. The exchange correlation potential is evaluated using two different approaches: GGA) and GGA plus modified Tran and Blaha Becke-Johnson potential plus Hubbard parameter (mBJ-GGA+U). Analysis of the total energy as a function of volume reveals that AuCrGe adopts a type 1 ferromagnetic configuration. Negative values for cohesion and formation energies indicate the synthesizability and stability of HH AuCrGe. Elastic results show that AuCrGe is anisotropic and ductile. Magneto-electronic results reveal that the AuCrGe compound exhibits a half-metallic nature with a total integer magnetic moment of 3.00μB, with 100% spin polarization in minority spin channels, in agreement with the Slater-Pauling rule. Thermoelectric properties are investigated by the BoltzTrap code. The ZT figure of merit reaches ~1 at 300 K, underlining the remarkable thermoelectric efficiency of the AuCrGe alloy. From the above results it is expected that AuCrGe ternary compound will be useful for spintronics as well as thermoelectric devices..

Key words: half-Heusler (HH) ; thermoelectric properties ; spintronics ; WIEN2k ; FP-LAPW method.

ELECTRONIC STRUCTURE AND MAGNETIC PROPERTIES OF CUFES2: CFD ANALYSIS OF PADDLE IMPELLER STIRRED TANKS: INFLUENCE OF BLADE HEIGHT ON MIXING PERFORMANCE

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Abstract:
Stirred tanks are essential in numerous industrial processes, particularly in the chemical, pharmaceutical, and food industries, where effective mixing influences reaction rates, heat transfer, and product uniformity. Among various impeller types, paddle impellers are commonly used due to their simple geometry and predictable flow patterns. However, the geometric parameters of the impeller—especially blade height—play a crucial role in determining the hydrodynamic behavior within the tank. This study presents a computational investigation of flow behavior in a standard cylindrical stirred tank equipped with a paddle impeller. Three blade height-to-diameter ratios (h/D) were evaluated: 0.1 (standard design), 0.4, and 0.7. Using ANSYS Fluent, steady-state and transient CFD simulations were performed to analyze the influence of blade height on velocity distribution, vortex formation, power consumption, and flow circulation patterns.
The simulation results show significant variations in flow structure with increased blade height. While a higher h/D ratio intensifies axial and radial flows, enhancing fluid circulation and mixing uniformity, it also results in higher power draw and potential dead zones near the tank bottom and walls. Conversely, the standard configuration provides moderate mixing at a lower energy cost but may be insufficient for high-viscosity fluids or complex reactions.
These findings provide practical insights for impeller design optimization, helping engineers tailor stirred tank configurations to specific process needs, improving mixing efficiency while minimizing energy consumption

Key words: Mixing; Stirred tank; ANSYS Fluent; Paddle impeller; Blade height; CFD simulation.

ELECTRONIC STRUCTURE AND OPTICAL RESPONSE OF $CsPbCl_3$: A DFT-BASED INSIGHT INTO LEAD HALIDE PEROVSKITES

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Abstract:
Lead halide perovskites have recently emerged as one of the most promising families of materials for optoelectronic and energy-harvesting applications owing to their exceptional structural tunability and outstanding electronic and optical properties. Among them, cesium lead chloride ($CsPbCl_3$) is particularly attractive due to its chemical stability and potential use in environmentally robust devices. In this work, we investigate the structural, electronic, and optical properties of cubic-phase $CsPbCl_3$ using density functional theory (DFT) within the framework of the generalized gradient approximation (GGA). The calculated electronic band structure confirms its semiconducting character and provides insights into the nature of its band gap. To further assess its optoelectronic performance, the frequency-dependent dielectric function, absorption coefficient, refractive index, and energy-loss spectrum were systematically analyzed. The results reveal strong optical absorption extending from the visible to the ultraviolet region, combined with favorable dispersion of the refractive index, suggesting excellent light-harvesting capability. Such features underline the potential of $CsPbCl_3$ for applications in photovoltaic devices, photodetectors, and other photonic technologies. Overall, this theoretical investigation provides a comprehensive understanding of the fundamental properties of $CsPbCl_3$ and contributes to the design and optimization of future halide perovskite-based optoelectronic devices.

Key words: $CsPbCl_3$, DFT, Halide perovskite, Band gap, Photovoltaics.

PHASE-FIELD MODELING OF MICROSTRUCTURE EVOLUTION IN LASER BORONIZING: A COMPUTATIONAL STUDY OF Fe-B SYSTEM DYNAMICS

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Abstract:
In This work we present a computational study of microstructure evolution during laser boronizing within the Fe-B system, utilizing the phase-field method. Laser boronizing is a critical surface treatment technique, as highlighted in current trends in boriding, known for its ability to create non-equilibrium, non-uniform microstructures due to rapid solidification. This work addresses the inherent challenges in computationally modeling such processes by implementing a modified double-obstacle potential within the OpenPhase framework, a powerful tool for phase-field simulations as detailed in relevant literature. Specifically, the research focuses on simulating the formation of the dominant Fe2B phase under laser processing conditions, a crucial step for understanding the intricate solidification dynamics of the Fe-B system. The study reveals detailed temperature-dependent boride growth kinetics and composition profiles, offering insights into the complex interplay between processing parameters and microstructure development. While primarily focusing on binary Fe-B interactions, the work also identifies critical limitations and considerations for extending these methodologies to more complex tertiary and quaternary alloy systems.

Key words: Phase-field, Laser boronizing, Microstructure evolution, Solidification dynamics, Fe-B system, OpenPhase.

STUDY BY NUMERICAL SIMULATION THE EFFECT OF INSTABILITY INDUCED DEFECT IN PEROVSKITE SOLAR

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Abstract:
The aim of this work is to study the instability issues prevalent in perovskite solar cells using numerical modeling, by simulation software SCAPS. The n-i-p structure of the solar cell included: Titanium dioxide (TiO_2) as ETL,($MAPbI_3$) as the active region for absorption and Spiro OMeTAD as HTL.The. This study deals with instability issues affecting TiO_2-$MAPbI_3$-Spiro OMeTED (n-i-p type) perovskite solar cells, employing SCAPS-1D simulation software. Special attention is given to defects induced by various degradation factors like prolonged illumination, UV radiation, corrosion, oxidation, humidity, etc... These defects, denoted as N_R (recombination center), N_{Dp} (deep donor), N_{DT} (shallow donor), and N_{AT} (shallow acceptor). The novelty of this investigation lies in its meticulous examination of the potential origins of these defects, positing three plausible locations: at interfaces between the electron transport layer (ETL) and perovskite or the hole transport layer (HTL) and perovskite and within the bulk perovskite layer. Initial electrical parameters align enough with many experimental data, highlighting J_{sc}=22.92 mA/cm^2, V_{oc}=1.184 V, FF=83.67%, and PCE=22.72%. It was revealed that high-density defects within the bulk layer (10^{16} cm^{-3}) exert the most significant influence, reducing PCE to 2.43%, attributable probably to thermal stress. Defects at the ETL/perovskite interface, exhibiting a surface density of 10^{14} cm^{-2}, decrease PCE to 16.61%, correlating with illumination effects. Conversely, defects at the perovskite/HTL interface lead to a more modest decline in PCE to 21.73%, associated with hysteresis effects.

Keywords: instability issues, perovskite, solar cells, SCAPS-1D, interfaces defects, bulk defects.

NANOSILVER -PLASMON -RESONANCE -BASED GLUCOSE SENSING

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Abstract:
The early detection and continuous monitoring of diabetes remain critical challenges in modern healthcare, driving extensive research in the field of biosensing technologies. Among these, Surface Plasmon Resonance (SPR) has emerged as a powerful, label-free optical technique capable of detecting minute changes in the refractive index at a metal-dielectric interface. In this study, SPR simulation was carried out using the Kretschmann configuration to evaluate its effectiveness in detecting varying concentrations of glucose in solution — a key biomarker for diabetes diagnosis and monitoring.
The simulation results revealed a clear correlation between glucose concentration and SPR response: as glucose concentration increased, both the resonance angle and the refractive index showed measurable shifts. A physiologically relevant range of glucose levels, corresponding to normal and diabetic conditions, was explored. The system demonstrated a high sensitivity of 149.51°/RIU, indicating strong potential for accurate and reliable glucose sensing. Notably, the use of a silver (Ag) thin film as the plasmonic material contributed significantly to the sharpness and depth of the resonance curve, enhancing the detection performance of the SPR sensor.
This SPR-based approach provides a non-invasive, real-time, and highly sensitive method for glucose monitoring, which is crucial for the early diagnosis, management, and prevention of diabetes-related complications. The simulation outcomes serve as a promising foundation for the development of compact, low-cost, and portable biosensor devices.

Key words: plasmon, Kretschmann, biosensor, Glucose, biomarker, sensitivity

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ANALYTICAL AND FEM INVESTIGATION OF PRESSURE EFFECTS ON STRESSES IN DAMAGED PIPELINES

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Abstract:
Pipelines are not only essential for the transportation of vital resources, but they also have a significant economic impact. It is important to understand that the integrity of the pipeline can be compromised by the presence of defects. These defects may threaten the integrity and durability of the pipeline under internal pressure. Evaluating the stresses such as the hoop stress and the longitudinal stress is crucial in the analysis and design of pipelines, it is also essential to estimate potential risks and take appropriate corrective measures. In this study, we considered a pipeline with an external rectangular defect, assessing a numerical simulation of its mechanical behavior and compared the results of stresses obtained from the theoretical equations with those from the finite element method (FEM).To expand our study, we varied the internal pressure to analyze the stresses in the damaged zone after the determination of the boundary conditions. We noticed that, for the hoop stress, the values from the finite element method are higher than those from the theoretical equations, and the error is moderate to high. For the longitudinal stress, the values from the theoretical equations are slightly higher than those obtained from the finite element method with a low error. In conclusion, the stresses have a proportional relationship with the variation in internal pressure in the pipeline, and the material remains in the elastic zone during all the considered pressure values, as the hoop and longitudinal stresses are below the material elastic limit.

Key words: Pipeline, Defect, Stress, FEM

COMPARISON OF OPTIMIZATION METHODS FOR SOLVING INVERSE KINEMATICS OF THE 5250 LABVOLT 5-DOF ROBOT: ANFIS, GENETIC ALGORITHM, AND ANT COLONY OPTIMIZATION

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Abstract:
This paper investigates the inverse kinematics problem for the 5250 LabVolt 5-DOF robot arm, presenting an in-depth analysis of both forward and inverse kinematics using various optimization techniques. The inverse kinematics problem is defined as the transformation from Cartesian space to joint space, and its solution is critical for trajectory planning and position control. The Denavit-Hartenberg (D-H) representation is employed to model the robot's links and joints, providing a clear description of the robot's kinematic structure.To solve the inverse kinematics problem for the 5250 LabVolt robot, three advanced methodsANFIS (Adaptive Neuro-Fuzzy Inference System), Genetic Algorithm (GA), and Ant Colony Optimization (ACO)are explored and compared. These methods are employed to compute the joint angles required to move the robot's end-effector to a specified target position in space.

- ANFIS is used to develop a neuro-fuzzy model capable of learning the relationship between the robot's target positions and corresponding joint angles. The system is trained with a dataset containing joint angle positions and their corresponding Cartesian coordinates.
- Genetic Algorithm (GA) optimizes the joint angles by exploring the search space through a population of possible solutions, using crossover, mutation, and selection strategies.
- **Ant Colony Optimization (ACO)**, inspired by the foraging behavior of ants, is applied to explore the joint space and find the optimal solution by simulating multiple agents (ants) searching for the best path.

The results are compared in terms of **precision**, **convergence speed**, and **robustness**. The performance of each method is evaluated by measuring the accuracy of the calculated joint angles and their ability to bring the robot's end-effector to the desired target positions.

Key words: Forward Kinematics, Inverse Kinematics, Denavit-Hartenberg, ANFIS, Genetic Algorithm, Ant Colony Optimization.

DESIGN OPTIMIZATION OF MULTI-AISLE AS/RS EQUIPPED WITH A MULTI-SHUTTLE S/R MACHINE VIA GENETIC ALGORITHM

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Abstract:
This study investigates the optimal design of a multi-aisle Automated Storage and Retrieval System (AS/RS) utilizing a multi-shuttle Storage/Retrieval (S/R) machine, focusing on the operational scenario where all storage and retrieval activities occur within the same aisle—excluding cross-aisle movements. A multi-cycle time model is developed to capture the system dynamics under these constraints. To determine the optimal temporal parameters that maximize system performance, a Genetic Algorithm (GA) is employed. The optimization results indicate that as the volume of operations increases, the timing parameters follow discernible patterns that contribute to improved throughput and minimized cycle times. These findings validate the effectiveness of the proposed model and optimization strategy in enhancing the performance of complex automated warehouse systems operating under same-aisle restrictions.

Keywords: Automated Storage and Retrieval System (AS/RS), Multi cycle, Optimization, Genetic Algorithm,

SMART MATERIALS FOR SMART MACHINES: EXPLORING SILICENE NANORIBBONS WITH DFT STUDY FOR FUTURE AI DEVICES

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Abstract:

In this work, utilizing the ab initio Density functional theory DFT, we aim to study the impacts hydrogen H edge atom passivation on the stability and electronic properties of planar bare (without H- edge passivation) Silicene NanoRibbon (PLSiNRs) with armchair (PLASiNRs) edges on both sides. The obtained results show that H- edge passivation is a new approach to stabilize and open the band gap in planar armchair SiNRs, (PLASiNRs). This passivation transforms the bare PLSiNRs from metallic states to a nonmagnetic semiconductors with a band gap depend on their width. The band gaps of PLASiNRs–H present oscillatory behavior and can be classified into three branches Eg(3n +1) > Eg(3n) > Eg(3n +2), where n is an integer. Our results provide that edge passivation is a key issue to integrate PLASiNR-H in electronic devices like short ASiNRs field-effect transistors (FETs), which are integrated with Artificial Intelligence (AI) for applications like high-sensitivity biosensing and neuromorphic computing. These FETs serve as AI-powered sensors for early disease detection and enable more efficient AI processing through neuromorphic applications. The optical parameters show that the most dominant absorption peaks centered at 5.17eV for 7-PLASiNR-H and systems, respectively, indicate a high absorbance in the UV range, making them prospective nanomaterials for photovoltaic devices which is necessary for clean energy to power AI systems.

Key words: DFT, Planar Silicene NanoRibbon, edge passivation, electronic properties, AI systems.

DEEP LEARNING-ENHANCED SLIDING MODE CONTROL FOR FAULT-TOLERANT WIND TURBINE SYSTEMS: INTEGRATION OF CNN-BASED DIAGNOSIS AND ADAPTIVE ROBUST CONTROL

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Abstract :

This paper proposes a fault tolerant control strategy for wind turbine systems, integrating a deep learning based diagnostic module and an adaptive robust controller. A convolutional neural network (CNN) is designed and trained to detect electrical and mechanical faults in real time from operational signals, enabling fast and accurate identification under various conditions. Upon detection, the sliding mode control (SMC) law is reactively adapted based on the CNN output, enhancing the controller's resilience to faults and external disturbances. Comparative simulations show that the proposed CNN and SMC framework significantly reduces the RMS tracking error by more than 40% in the presence of large disturbances compared to conventional SMC and PID strategies.

The method also maintains high stability and tracking performance in the presence of Gaussian noise, outperforming classical approaches. These findings confirm the practical effectiveness and resilience of combining deep learning diagnostics with robust adaptive control for modern wind energy conversion systems, aligning with trends seen in recent literature and industrial deployments.

Keywords: Convolutional Neural Network (CNN), sliding mode control (SMC), fault-tolerant control, wind energy, robustness, intelligent diagnosis.

FEASIBILITY STUDY FOR THE REPLACEMENT OF A RA1K E-8 CONDENSER WITH EA-52 AIR COOLERS

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Abstract:
The E-8 heat exchanger, a key component in cooling the overhead vapors from the C-55 column used in unit 200 for aromatics recovery at the RA1K refinery, is currently completely out of service. Due to recurring fouling and corrosion issues, the reliability of this heat exchanger has been seriously compromised, prompting the unit to consider replacing it.
In this context, we conducted an in-depth study to assess the possibility of providing the required cooling without using the E-8 exchanger, by leveraging the existing EA-52 air coolers. To this end, two simulations of the C-55 column were carried out: a simulation of the design case, which validated the process modeling and the choice of thermodynamic model, and a simulation of the current case, to confirm the actual operation of the column and determine its operating parameters, in particular the flow rate of the overhead products.
Additional simulations with Aspen EDR verified the EA-52's ability to provide cooling under current conditions and at full capacity. The ultimate goal is to determine whether the EA-52 can completely eliminate the E-8 exchanger without risk to the process, while ensuring proper cooling and complete vapor condensation.

Key words: Aromatics, Exchanger, Dry Coolers, Simulation, Aspen HYSYS, Aspen EDR.

DESCRIPTOR PREPROCESSING AND STRUCTURAL INSIGHT INTO MESOGENIC PHASES WITH TUNABLE ALKYL CHAINS

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Abstract:
Liquid-crystal stationary phases offer tunable selectivity arising from the interplay between mesogenic structure and molecular interactions. In this study, three homologous mesogenic phases sharing the same aromatic core but bearing lateral alkyl chains of different lengths were examined. From SMILES representations of selected analytes, an extensive set of 2D and 3D molecular descriptors was generated and treated through a rigorous preprocessing workflow, including normalization, constant-descriptor removal, variance filtering and multicollinearity reduction. Correlation-based screening was then applied to retain only the most informative features.
The refined descriptor sets revealed coherent structural tendencies associated with chain elongation, particularly in descriptors related to hydrophobic surface distribution, volume contribution and topological organization. These trends, highlighted during preprocessing, suggest that alkyl chain length subtly influences the descriptor landscape and may later affect chromatographic behavior. By improving descriptor quality and reducing redundancy, the adopted workflow ensures cleaner inputs for future modeling and facilitates a clearer interpretation of structure–property relationships.
This work underlines the importance of preprocessing as a decisive step in the analysis of mesogenic systems and provides a robust and interpretable foundation for subsequent AI-based retention prediction and the rational design of advanced liquid-crystal stationary phases.This ongoing study seeks to evaluate the strengths and limitations of both ML and DL approaches in chromatographic prediction and to establish a comparative framework for modeling retention behavior on liquid crystal-based stationary phases.

Key words: Artificial intelligence, GC, preprocessing, deep learning, SMILES.

INVESTIGATING SHEET METAL MATERIAL BEHAVIOR DURING DEEP DRAWING THROUGH NUMERICAL SIMULATION AND ARTIFICIAL NEURAL NETWORK MODELING

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Abstract
The recurrent occurrence of fractures at the end of the deep drawing operation for DC04 mild steel sheets led to a high product rejection rate. To address this issue, a comprehensive experimental study was conducted, complemented by the collection of information regarding product geometry and operational parameters. A 3D numerical simulation model of this forming operation was developed using Abaqus/Explicit to analyze possible scenarios and propose solutions. The main objective of this work is to achieve a deep drawing operation without fracture or probable damage. To this end, a series of tests was carried out following a full factorial experimental design to examine the material behavior of the sheet metal under plastic stresses and strains during the deep drawing process. Concurrently, Artificial Neural Network (ANN) modeling of the deep drawing process was performed using the R programming language. This ANN modeling allows for predicting the evolution of material behavior under plastic deformation as a function of the deep drawing parameters within the defined study range. The optimal levels for punch speed and die radius were determined. The effectiveness of the ANN models was evaluated using the coefficient of determination (R-squared), Mean Squared Error (MSE), predicted results, and residual analysis.

Keywords: Numerical Simulation; Deep Drawing; Artificial Neural Network; Punch speed; Die radius.

DFT STUDY AND ADMET PREDICTION OF A HYDRAZINE-BENZAMIDE DERIVATIVE DRUG CANDIDATE

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Abstract:
The hydrazine-benzamide derivatives are a significant class of organic compounds with broad biological activities. Understanding their chemical reactivity is essential for rational drug design. A dual computational methodology was employed, involving density functional theory (DFT) calculations at the B3LYP/6-311G (d,p) level to optimize the molecular geometry of N-(4-(1-(2-(2,4- Dinitrophenyl)hydrazono)ethyl)phenyl) benzamide and elucidate its fundamental electronic properties, complemented by in silico pharmacokinetic(SwissADME) and toxicity (ProTox-III) profiling. The DFT results, including Molecular Electrostatic Potential (MEP) revealed negative potential regions localized on the oxygen atoms of the carbonyl and nitro groups. FMO analysis showed that the HOMO is mainly delocalized across the central conjugated π-system,including the hydrazine linage (-C=N-NH-) and the central phenyl ring to wich is attached. The LUMO was found to be concentrated on the dinitrophenyl moiety, identifying it as the favored site for electron acceptance. Global reactivity descriptors confirmed that the compound behaves as a soft electrophile, suggesting high reactivity. However, in silico profiling predicted a challenging pharmacological profile, characterized by poor solubility and limited oral absorption. A critical finding was the prediction of mutagenicity, a major liability attributed to the nitroaromatic functional group. ProTox-III analysis further confirmed significant toxicity concerns, including carcinogenicity and moderate acute oral toxicity.
This work provides valuable information on the electronic structure and reactivity of the studied hydrazine-benzamide deriJvative. However, the significant toxicity liabilities identified necessitate structural modification of the nitroaromatic moiety to guide future rational drug design

Key words: Hydrazine-benzamide derivative, DFT, FMO, ADMET, Mutagenicity, reactivity

FIRST-PRINCIPLES STUDY OF ELECTRONIC STRUCTURE, MAGNETIC, AND MECHANICAL PROPERTIES OF $Sr_{1-x}Ti_xO$

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Abstract:
We have performed a first-principles study to investigate the electronic structure, the magnetic, elastic and mechanical properties strontium sulfide SrS semiconductor doped with transition metal impuritiy Ti i.e. $Sr_{1-x}Ti_xO$ at concentration x = 0.25 using the full-potential linearized augmented plane wave (FP-LAPW) approach to the density functional theory (DFT).
Total energy calculation allowed us to determine the ground-state parameters, namely the lattice constant, the bulk modulus ant its first pressure derivative. The electronic properties are calculated using both the generalized gradient approximation proposed by Wu and Cohen (GGA+WC) and the Tran Blaha modified Becke-Jonhnson (GGA-TBmBJ) for the exchange and correlation potential. The $Sr_{0.75}Ti_{0.25}O$ is found to be half-metallic ferromagnet with complete spin polarization. We also report results on elastic constants and mechanical properties of these compounds.The objective is to seek new ferromagnetic material for an application in the new emerging field of spintronics and the studied compound is suitable candidate for such application.

Keywords : First-principles calculation - Spintronics - Electronic structure - Half-metallic ferromagnets

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STUDY BY NUMERICAL SIMULATION THE EFFECT OF ZINC-DOPED TiO_2 LAYER IN PEROVSKITE SOLAR CELL

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Abstract:
A numerical simulation of perovskite solar cell was conducted using SILVACO ATLAS with preliminary device structure of FTO/ETL/active layer/HTL/Au. TiO 2 , Spiro-OMeTAD and MAPbI 3 are ETL, HTL and active layer with 50 nm ,180 nm and 300 nm thickness respectively. The HTL is connected to the metal back contact Au with 80 nm. The solar cell are illuminated on the side of the transparent FTO with 300 nm under AM 1.5G solar spectrum with an incident power density of 1000 W/m 2 and at room temperature T=300 K. Improving the electrical performance of a solar cell is related to its parameters. These parameters are: short circuit current density (J SC) constitutes the maximum current, which can be obtained from a solar cell. The open circuit voltage (Voc), is the voltage for which the current across the cell terminals is zero (I=0).
FF is the ratio of the maximum electrical power of the solar cell (PSC) to the product of V OC and J SC . Finally, efficiency (PCE) is defined by the relationship between the optimal electrical power obtained across the cell and the power of the incident radiation. In our study,.The simulation was validated against measurements. The measured of 12.4% was nearly matched by the simulated photovoltaic conversion efficiency, which reached 12.53%. then, study the effect of Zinc-Doped TiO 2 as Electron Extraction Layer . We have successfully simulated Zn: TiO 2 with various dopant levels from 1% mol to 7mol%. The energy level diagram of various Zn:TiO2. As results, increasing in PCE=17.1%.

Keywords: perovskite, solar cells, SILVACO ATLAS, HTL, ETL, PCE.