The 3rd International Electronic Conference on Processes

29–31 May 2024 | Online

Program and Abstract Book

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#ECP2024

The 3rd International Electronic Conference on Processes

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29–31 May 2024 | Online

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Welcome from the Chair

Dear Colleagues,

We are pleased to announce **the 3rd International Electronic Conference on Processes—Green and Sustainable Process Engineering and Process Systems Engineering (ECP 2024)**, which will be hosted online from **29 to 31 May 2024**.

This conference will present the latest studies in process/system-related research in chemistry, biology, material, energy, environment, food and engineering fields. The goal is to show the current state, challenges, and opportunities and future trends in process systems engineering.

All processes/system-related scientists or researchers are welcome to join this event and share their findings around the following general and related themes, including, but not limited to, the following:

- Green chemistry engineering and environment-relevant processes;
- Experimental, theoretical, and computational research on process development and engineering;
- Process modeling, simulation, optimization, and control;
- Food-relevant processing and improvement of food quality;
- Sustainable and renewable systems engineering;
- Energy system and current demand and electricity market;
- Supply chain management;
- Circular economies;
- Eco-friendly processes and methods.

Submitted abstracts will be reviewed by the conference committee. All accepted abstracts will be available online in Open Access form on Sciforum.net during and after the conference. Following the conference, selected contributions will be invited for submission to the *Processes* journal (ISSN: 2227-9717, Impact Factor: 3.5), with a **20% discount** on the publication fee.

We look forward to having you join us at this exciting event.

Prof. Dr. Giancarlo Cravotto
Conference Chair
Department of Drug Science
and Technology,
University of Turin,
Turin, Italy

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General Information

processes
an Open Access Journal by MDPI

Processes (ISSN 2227-9717) provides an advanced forum for process/system-related research in chemistry, biology, material, energy, environment, food, pharmaceutical, manufacturing, automation control, catalysis, separation, particle and allied engineering fields. The journal publishes reviews, research papers and communications. Our aim is to encourage researchers to publish their experimental, theoretical and computational results in as much detail as necessary. There is no restriction on the maximum length of the papers or number of figures and tables.

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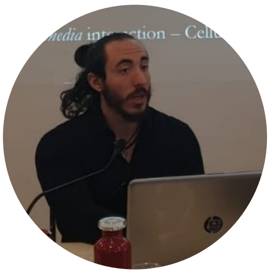

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Prof. Adina Magdalena Musuc
Institute of Physical Chemistry, Romanian Academy, Romania

Speakers

Invited Speakers

Dr. Vesna Middelkoop
Vlaamse Instelling voor Technologisch Onderzoek, Mol, Belgium

Dr. Nikolaos Diangelakis
Technical University of Crete, Chania, Greece

Prof. Dr. Chao-Hui Feng
Kitami Institute of Technology, Kitami, Japan, RIKEN Centre for Advanced Photonics, Saitama, Japan

Prof. Dr. Enrico Marsili
University of Nottingham Ningbo, Ningbo, China

Dr. Manuel Félix Ángel
Universidad de Sevilla, Sevilla, Spain

Professor George M. Bollas
University of Connecticut, Storrs, CT, USA

Dr. Xue Yong
University of Liverpool, Liverpool, UK

Dr. He Limo
Huazhong University of Science and Technology, China, National University of Singapore, Singapore

Dr. Gergely Kali
University of Innsbruck, Innsbruck, Austria

Dr. Carlos Sierra Fernandez
University of León,
Av/Silverio Fernández Tirador,
León, Spain

Prof. Dr. Chunhui Zhao
Zhejiang University,
Hangzhou, China

Dr. Dani Dordevic
University of Veterinary and
Pharmaceutical Sciences,
Czech Republic

Program at a Glance

The 3rd International Electronic Conference on Processes
29–31 May 2024, Online

DAY 1 Morning	DAY 2 Morning	DAY 3 Morning
Session A. Environmental and Green Processes	**Session C.** Food Processes	**Session E.** Process Control and Monitoring
DAY 1 Afternoon	**DAY 2 Afternoon**	**DAY 3 Afternoon**
Session A. Environmental and Green Processes **Poster Session**	**Session D.** Chemical Processes and Systems **Poster Session**	**Session B.** Energy Systems **Poster Session**

ECP 2024 Program

29 May 2024 (Wednesday)
Opening Ceremony
Session A. Environmental and Green Processes

CEST (Central European Summer Time)	CST Asia (China Standard Time)	Speaker	Title
9:30–9:40	15:30–15:40	**Welcome from the conference chair—Prof. Dr. Giancarlo Cravotto**	
9:40–9:45	15:40–15:45	**Welcome from the session chair—Prof. Dr. Juan. F. Garcia Martin**	
9:45–10:05	15:45–16:05	Invited Speaker **Prof. Dr. Chao-Hui Feng**	Assessing the Quality of Sausage Stuffed with Modified Casing Containing Waste Citrus Peel Extracts Using Response Surface Methodology and Hyperspectral Imaging
10:05–10:20	16:05–16:20	Selected Speaker **Al Mamun**	Advancement of Electrospun Carbon Nanofibers in Sensor Technology for Air Pollution Detection
10:20–10:35	16:20–16:35	Selected Speaker **Glory Makuwa**	The Physiochemical Properties of Metal-Organic Frameworks Suitable for CO_2 Capture: A Comparative Study of Magnesium-and Zinc-Based Materials
10:35–10:50	16:35–16:50	Selected Speaker **Hassan Soumadrass**	Improvement of Structural, Morphological and Mechanical Properties by Reinforcing Sisal Fibers in a Reinforced Concrete Slab
10:50–11:05	16:50–17:05	Selected Speaker **Sadur Rifki**	Review Green Extraction of Manganese from Leach Solutions in Hydrometallurgy Process of Nickel Laterite Ore
11:05–11:20	17:05–17:20	Selected Speaker **Shuying Cheng**	A Solution to Reduce the Carbon Footprint: Mineralization and Utilization of CO_2 in Recycled Construction Aggregates
11:20–11:35	17:20–17:35	Selected Speaker **Petronela Cozma**	Assessment of Rapeseed (*Brassica Napus* L.) Efficiency for Phytoremediation of Heavy Metal-Contaminated Soils
11:35–11:50	17:35–17:50	Selected Speaker **Fabiano Castrogiovanni**	Application of Electrochemical Processes to Membrane Bioreactors for Sustainable Wastewater Treatment: A Short Review
11:50–12:05	17:50–18:05	Selected Speaker **Alicia Castillo Rivas**	Identification of Value-Added Phenolic Compounds in Olive Stones Extracted Using Microwave-Assisted Extraction

CEST (Central European Summer Time)	**CST Asia (China Standard Time)**	**Speaker**	**Title**
14:20–14:25	20:20–20:25	**Welcome from the session chair—Prof. Dr. Juan. F. Garcia Martin**	
14:25–14:45	20:25–20:45	Invited Speaker **Prof. Dr. Enrico Marsili**	Biopolymer Production in Electroactive Biofilms
14:45–15:00	20:45–21:00	Selected Speaker **Lilia Sabantina**	Bryophytes as a Sustainable Alternative for Period Products
15:00–15:15	21:00–21:15	Selected Speaker **Elouafi Assaad**	Structural, Morphological, Thermal and Mechanical Study of a Geopolymer Based on Metakaolin Mixed with Oujda Clay
15:15–15:30	21:15–21:30	Selected Speaker **Khanyisile Lepota**	Municipal Solid Waste Biogas Production Enhancement Using a Hybrid Landfill Bioreactor: A Case Study
15:30–15:45	21:30–21:45	Selected Speaker **Sunday Olakunle Oguntomi**	Property-Specific Biopolymer Production in Electroactive Biofilms
15:45–16:00	21:45–22:00	Selected Speaker **Ntiyiso Faith Nyambi**	Physicochemical Characterization and Computational Studies of Tilapia Fish Scales as a Green Inhibitor for Steel Corrosion
16:00–16:15	22:00–22:15	Selected Speaker **Amit Kumar**	Removal of Micropollutant by Using Hydrocavitation/Ozone
16:15–16:30	22:15–22:30	Selected Speaker **El Houssaine Benaddi**	FCP: From Biomass Waste to Activated Carbon for the Removal of Methylene Blue from the Aqueous Environment

Poster Session

CEST (Central European Summer Time	**CST Asia (China Standard Time)**	**Speaker**	**Title**
Expected Duration: 16:35–17:20	22:35–23:20	Poster Session	The Poster Sessions will take place in Zoom break-out rooms.

30 May 2024 (Thursday)
Session C. Food Processes

CEST (Central European Summer Time)	CST Asia (China Standard Time)	Speaker	Title
9:30–9:35	15:30–15:35	**Welcome from the session chair—Prof. Dr. Dariusz Dziki**	
9:35–9:55	15:35–15:55	Invited Speaker **Dr. Manuel Félix Ángel**	Potential Uses of Waste and By-Products from the Red Crayfish Industry
9:55–10:15	15:55–16:15	Invited Speaker **Prof. Dani Dordevic**	Environmentally Friendly Production of Edible or Biodegradable Packaging
10:15–10:30	16:15–16:30	Selected Speaker **Marasingha Mudiyanselage Madhushani Thissa Marasingha**	Comparative Analysis of Milling, Appearance, And Cooking Qualities of Traditional, Improved Oryza Sativa Indica and Oryza Sativa Japonica White Rice Varieties Cultivated in Sri Lanka
10:30–10:45	16:30–16:45	Selected Speaker **Muskan Chadha**	Comprehensive Chemical, Nutritional, and Antioxidant Profiling of Homemade Milk Kefir Drink
10:45–11:00	16:45–17:00	Selected Speaker **Vijai Kumar**	Impact of Nitrogen Levels on Growth and Yield of Super Basmati Variety of Rice (*Oryza sativa* L.)
11:00–11:15	17:00–17:15	Selected Speaker **Dauda Garba**	Therapeutic Potential of Fractions of *Globimetula oreophila* (Oliv. ex Hook.f.) Leaf Extract Growing on *Azadirachta indica* against *Plasmodium berghei*-Infected Mice: An In Vivo Approach
11:15–11:30	17:15–17:30	Selected Speaker **Mariam Mir Memon**	Optimization of Caffeine Extraction from Various Tea Types Using Dichloromethane as an Organic Solvent

Session D. Chemical Processes and Systems

CEST (Central European Summer Time)	CST Asia (China Standard Time)	Speaker	Title
14:00–14:05	20:00–20:05	**Welcome from the session chair—Prof. Dr. Blaž Likozar**	
14:05–14:25	20:05–20:25	Invited Speaker **Dr. He Limo**	Catalytic Reforming of Biomass tar over Ni Catalysts for Co-Production of Hydrogen and Carbon Nanotubes
14:25–14:45	20:25–20:45	Invited Speaker **Dr. Vesna Middelkoop**	**To Be Confirmed**
14:45–15:05	20:45–21:05	Invited Speaker **Dr. Gergely Kali**	Thiolated Polysaccharides: Synthesis Possibilities and Applications
15:05–15:20	21:05–21:20	Selected Speaker **Alessandro Mattedi**	Use of Bioelectrochemistry Techniques and Machine Learning for the Characterization in Real-Time of Mixed-Species Biofilms
15:20–15:35	21:20–21:35	Selected Speaker **Nica Simona Luminita**	Conduction Characteristics of Some Polymer/Carbon Nanotubes Composites: The Effect of Polymer Matrix Features
15:35–15:50	21:35–21:50	Selected Speaker **Soraia Pedro**	Comparative Phytochemical Profiling of Flowers and Pods in *Acacia mearnsii*
15:50–16:05	21:50–22:05	Selected Speaker **Zakia Aribou**	Advanced Investigation of Indazole Derivatives as Corrosion Inhibitors for Brass in Acidic Environments: Electrochemical, Theoretical, and Surface Analysis
16:05–16:20	22:05–22:20	Selected Speaker **Najoia Aribou**	Dielectric Analysis of Polypropylene-Based Composites filled with Pyrolytically Stripped Pyrograf® III Carbon Nanofibers

Poster Session

CEST (Central European Summer Time	CST Asia (China Standard Time)	Speaker	Title
Expected Duration: 16:25–17:10	22:25–23:10	Poster Session	The Poster Sessions will take place in Zoom break-out rooms.

31 May 2024 (Friday)
Session E. Process Control and Monitoring

CEST (Central European Summer Time)	CST Asia (China Standard Time)	Speaker	Title
9:30–9:35	15:30–15:35	**Welcome from the session chair—Prof. Dr. Wen-Jer Chang**	
9:35–9:55	15:35–15:55	Invited Speaker **Dr. Carlos Sierra Fernández**	Optimizing Concentration Conditions through Attributive Analysis
9:55–10:15	15:55–16:15	Invited Speaker **Dr. Zhao Chun Hui**	Theoretical Exploration and Practice of Industrial Process Fault Diagnosis Based on Zero Sample Learning
10:15–10:30	16:15–16:30	Selected Speaker **Enver Salkim**	Bio-Impedance Analysis of Human Upper Limbs Based on Transient Simulation Using the Finite Element Method
10:30–10:45	16:30–16:45	Selected Speaker **Rabiaa Houili**	Hybrid Particle Swarm Optimization and Manta Ray Foraging Optimization for Parameter Estimation of Induction Motors
10:45–11:00	16:45–17:00	Selected Speaker **Dimitris Ipsakis**	Modeling and Control of Hydrogen Production Systems through Water Electrolysis and Res Power
11:00–11:15	17:00–17:15	Selected Speaker **Ulrike Reinhardt**	Comparing the Effects of Material Parameters on Drapability Using the VStitcher Simulation Program
11:15–11:30	17:15–17:30	Selected Speaker **T. Bhubaneswari**	Process Monitoring and Control in Dermatological Diagnosis: A Deep Learning Approach using Python, NumPy, Pandas, Keras, and TensorFlow

Session B. Energy Systems

CEST (Central European Summer Time)	CST Asia (China Standard Time)	Speaker	Title
14:00–14:05	20:00–20:05	**Welcome from the session chair—Rafal Gieleciak**	
14:05–14:25	20:05–20:25	Invited Speaker **Dr. George Bollas**	**To Be Confirmed**
14:25–14:45	20:25–20:45	Invited Speaker **Dr. Nikolaos Diangelakis**	Robust (explicit) Optimization and Control via Mixed-Integer Programming
14:45–15:05	20:45–21:05	Invited Speaker **Dr. Xue Yong**	Bi-Layer Single Atom Catalysts Boosted Nitrate-to-Ammonia Electroreduction with High Activity and Selectivity
15:05–15:20	21:05–21:20	Selected Speaker **Oluwasola O. Ademulegun**	Flexing the Energy Per Day of Electric Vehicles in Northern Ireland
15:20–15:35	21:20–21:35	Selected Speaker **Rachid Zriouile**	Performance Analysis of Maximum Power Point Tracking Techniques for Photovoltaic Battery Charging Systems
15:35–15:50	21:35–21:50	Selected Speaker **Marah Bacha**	An Intelligent Diagnosis and Fault Detection Model Based on Fuzzy Logic for Photovoltaic Panels
15:50–16:05	21:50–22:05	Selected Speaker **Bemgba B. Bevan Nyakuma**	Characterisation of Oil Palm Trunks for Potential Bioenergy Recovery and Utilization
16:05–16:20	22:05–22:20	Selected Speaker **Murugapoopathi Saravanamuthu**	Comprehensive Performance Evaluation of Biodiesel Blends with Nanoparticles in VCR Engine

Poster Session

CEST (Central European Summer Time	CST Asia (China Standard Time)	Speaker	Title
Expected Duration: 16:25–17:10	22:25–23:10	Poster Session	The Poster Sessions will take place in Zoom break-out rooms.

Poster List

Poster Session—29 May 2024 Session A. Environmental and Green Processes	
Name	**Title**
Damodar Neupane	Comparative Study of Titanium Dioxide and Lysozyme-Added Titanium Dioxide Nanoparticles for Enhanced Photocatalytic Degradation
Gloribel Vázquez Cornejo	Ultrasonic Synthesis for the Efficient Zr_{4+} Modification of Hydrotalcite Adsorbents for Fluoride Removal
Sonia Rostami	Enhancing Trench Stability: A Geogrid Reinforcement Approach
Stephanie Arias Lugo	Development and Evaluation of a CO_2 Capture System Using Hollow Fiber Membranes for Industrial Emissions Applications
Padinchare Veettil Gayathri	Solar-Enhanced Photocatalytic Decontamination of Water from Tetracycline Antibiotics and Its Application in Aquaculture
John Lloyd Beltejar Enguito	SNAMBOO: Handmade Bag from Natural Fibers of Snake Plant (*Dracaena trifasciata*) Leaves and Bamboo (*Bambusa vulgaris*) Sheaths
Araceli Olivares-Miralles	Effect of a Beer Bagasse Dehydration Process on the Recovery of Ferulic Acid and Other Phenolic Compounds as an Alternative to Agroindustrial Waste Revalorization
Nnadikwe Johnson	Optimizing Carbon Capture Efficiency in Coalfired Power Plant Using Pinch Assessment Techniques for Clean and Sustainable Energy Production
Zaid Mohammad Ahmad Al-Zrigat	Energetic Echoes: A Commencement into Exploring Building Materials and Their Embodied Energy in Old Downtown Amman with a Focus on Process System Engineering and Electronic Elements
Prosper Onochie	Microplastics and Their Impact on Moss Ecosystem Functions: A Comprehensive Review
Elohor-Oghene Amarie	Microplastic Pollution in *Leuciscus baicalensis* and *Rutilus rutilus*: An Impending Danger to Aquatic Biodiversity in Western Siberian Riverine Fishes

Poster Session—30 May 2024 Session C. Food Processes and Session D. Chemical Processes and Systems	
Name	**Title**
Alina Matei	SSynthesis and Characterization of In_2O_3-ZnO Nanostructures via the Precipitation Method
Forough Sharif	Predicting the Volumetric Mass Transfer Coefficient in a Double Coaxial Mixer: An Artificial Neural Network Approach
Paloma L. Barros	Investigation of Scale-Up Strategies for an Aerated Bioreactor Comprised of a Coaxial Mixer with Yield-Pseudoplastic Fluid
Diyana Dimitrova	Synthesis of N-flurbiprofen-substituted 1,2,3,4-Tetrahydroisoquinolines
Ali Rahimzadeh	Analyzing Power Consumption in a Coaxial Bioreactor Using Machine Learning Techniques with Computational Fluid Dynamics
Massimo Barbieri	Hydrogen Peroxide Industrial Production: A Patent Prior Art Analysis
Yenisha Thisarani Senaweera	Functional Properties of Wala Ripened Jackfruit Seed Flour
Kazeem Ajadi ibraheem	Impact of Various Drying Techniques on the Nutritional Components of Plum Tomato
Beatriz Pereira de Freitas	Sage Essential Oils: Chemical Characterization and Evaluation of the Antioxidant Activity of Commercial Samples
Ali Hassan	A comparative Evaluation of Various Extraction Methods for the Extraction of Pectin from Peach Pomace
Summaia Fordos	Revolutionizing Quality: Exploring Advanced Food Processing Techniques for Elevated Food Quality
Shakeel Ansari	Application of Thiolated Silica Nanoparticles in Food Industries

Poster Session—31 May 2024 Session E. Process Control and Monitoring and Session B: Energy Systems	
Name	**Title**
Aimad Boudoucha	A Novel Optimal Power Management and Control Strategy for Marine Microgrids Integrated with Renewable Energy Sources and Hybrid Energy Storage Devices
Iqbal Muhammad	Experimental Performance Evaluation of Aqueosus KCl and PEG6000 Solutions as Eutectic Phase-Change Materials (PCMs) for Portable Cold Storage Applications
Ali Berboucha	Sliding Mode Control of a Photovoltaic Water Pumping System
Isadora Dos Santos Pires Soares	Development of Composite Electrodes for Efficient Generation of Green Hydrogen through Photovoltaic Energy
Souhaila Khalfallah	Object Detection for Autonomous Logistics: A YOLOv4 Tiny Approach with ROS Integration and LOCO Dataset Evaluation
Sabina Jasinski	Implementing Sustainable Development Goals into European Textile Companies
Ujban Hussain	Advancements in Real-Time Monitoring and Control for Enhanced Process Efficiency
Beata Sarecka-Hujar	Do Plastic Packages Provide Sufficient Photoprotection for Moisturizing Creams?
Khomchan Promneewat	An Affordable IoT System for Weather Monitoring and Emergency Assessment in a Confined Space: A Case Study of Muang-On Cave, Northern Thailand
Marianna V. Kharlamova	Spectroscopy Insight in the Nickel Catalyst State in Carbon Nanotube Growth inside Metallic Single-Walled Carbon Nanotubes
Fares Bettahar	A High-Performance Single-Stage Photovoltaic Solar Pumping System Under Partial Shading Conditions (PCS) Using a Horse Herd Optimization Algorithm (HOA)

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Abstracts

Session A. Environmental and Green Processes

sciforum-087639: *Linum usitatissimum* L. Seeds as a Natural Coagulant for the Removal of Colloidal Matter from Urban Wastewater: Process Optimization Using the Box–Behnken Response Surface Methodology

Anes Ghazi [1], Khedidja Benouis [1], Soufiane Guella [1], Sid Ahmed El Khalil Ahed Messaoud [1] and Fouzia Ouazani [2]

1 Process Engineering, Materials and Environment Laboratory, Faculty of Technology, Djillali Liabes University of Sidi Bel Abbes, Sidi Bel Abbes 22000, Algeria
2 Process Engineering, Materials and Environment Laboratory, Faculty of Technology, Djillali Liabes University of Sidi Bel Abbes, Sidi Bel Abbes 22000, Algeria

This study investigates the effectiveness of *Linum usitatissimum* L. seeds as an ecological and natural coagulant for the treatment of urban wastewater. By adopting the Box–Behnken method within the framework of the response surface methodology, the objective of this work is to evaluate the coagulant's effectiveness and optimize the conditions of the coagulation process, particularly for the removal of colloidal and suspended matter. Three key variables are studied: the concentration of the aqueous extract of *Linum usitatissimum* L. seeds (expressed in mL per liter of wastewater), the coagulation speed (expressed in rpm) and the coagulation duration (expressed in min). The effectiveness of this treatment is evaluated through the turbidity removal rate, serving as an indicator of the presence of colloidal matter in suspensions.

The obtained results suggest that the optimal conditions for the maximum removal of harmful colloidal matter, as indicated by turbidity reduction, involve the use of 1 mL of coagulant extract per liter of effluent, a coagulation speed of 300 rpm and a coagulation duration of 4 min. An average turbidity removal rate that exceeded 60% has been recorded, demonstrating the effectiveness of *Linum usitatissimum* L. seeds as an eco-friendly and natural coagulant, which can be a good alternative to chemical coagulants.

sciforum-084412: *Moringa arborea*-Mediated Iron Oxide Nanoparticles, Their Characterization and Their Anti-Cancer Potential on Highly and Weakly Metastatic Human Breast Cancer Cells

Huzaifa Umar [1] and Maryam Rabiu Aliyu [2]

[1] Operational Research Centre in Healthcare, Near East University
[2] Cyprus International University

Iron oxide nanoparticles stabilized with *Moringa arborea* were synthesized. The study aimed to investigate the cytotoxic potential of IONPs through various assays, such as trypan blue and MTT assays, of the synthesized iron oxide nanoparticles (IONPs). The *Moringa arborea*-mediated IONPs (M A IONPs) were analyzed using a range of techniques, including Fourier-transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), UV-vis spectroscopy (UV-vis), scanning electron microscopy (SEM), and energy-dispersive X-ray spectroscopy (EDX). The FTIR, XRD, and SEM-EDX results confirmed the successful synthesis of IONPs. A gas chromatography–mass spectrometry (GC-MS) analysis of the plant revealed various compounds of medicinal value. The analysis of the UV-vis spectra indicates an absorption peak at 314 nm, thereby ensuring both the successful synthesis and remarkable stability of the nanoparticles. The nanoparticles exhibited a uniform spherical morphology and contained Fe, O, N and some minor elements, confirming the formation of IONPs NPs. The cytotoxic potential on MCF-7 and MDA-MB 231 human breast cancer cells was observed with various concentrations of M A IONPs, and the cytotoxicity results revealed an IC_{50} of 48.7 μg/mL and 54.6 μg/mL, respectively. Stable IONPs were synthesized using a methanolic extract of *Moringa arborea*. The nanoparticles exhibited cytotoxic potential on highly and weakly metastatic human breast cancer cell lines.

sciforum-090566: Recent Developments in the Removal of Heavy Metals from Water and Wastewater

Ana Olívia Serra Jorge [1], F. Chamorro [2], M. Carpena [2], P. Barciela [2], A. Perez-Vazquez [2], M. Beatriz P. P. Oliveira [3] and M. A. Prieto [2]

1 Universidade do Porto, Faculdade de Farmácia
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Heavy metal contamination in water sources is a pressing global issue, necessitating continuous advancements in removal technologies [1]. This review provides an overview of recent developments in removing heavy metals from water and wastewater, addressing the urgent need for effective and sustainable solutions to mitigate environmental pollution and safeguard public health.

We will cover various removal techniques, including adsorption [2], ion exchange [3], membrane filtration [4], electrochemical methods [5], and biological treatment [6]. Special emphasis is placed on recent advancements such as developing novel adsorbents with enhanced efficiency and selectivity, integrating nanotechnology for improved performance [7], and applying advanced oxidation processes for the degradation of metal complexes. Furthermore, innovative approaches such as hybrid systems and integrated treatment schemes are discussed for their potential to achieve comprehensive heavy metal removal.

In addition to technological advancements, this communication examines challenges and opportunities to implement heavy metal removal technologies, including scalability, cost-effectiveness, and environmental sustainability. Furthermore, regulatory frameworks and policy considerations about heavy metal discharge limits and water quality standards are addressed, highlighting the importance of interdisciplinary collaboration between researchers, policymakers, and industry stakeholders.

Overall, this communication provides valuable insights into recent developments in heavy metal removal technologies, offering a comprehensive perspective on the state-of-the-art approaches and future directions for addressing the challenges posed by heavy metal contamination in water and wastewater.

sciforum-088739: Optimizing Carbon Capture Efficiency in Coal-Fired Power Plant Using Pinch Assessment Techniques for Clean and Sustainable Energy Production

Nnadikwe Johnson

Johnson Global Scientific Library

Carbon capture and storage (CCS) technologies play a critical role in mitigating greenhouse gas emissions from coal-fired power plants, which is essential for achieving global climate goals. Pinch assessment techniques offer a systematic approach to optimizing carbon capture efficiency and energy utilization within these facilities. By integrating heat exchange networks and identifying optimal heat transfer points, a pinch analysis enables the reduction in energy consumption and the environmental impact associated with carbon capture processes. In the context of coal-fired power plants, achieving high-purity CO_2 capture is a key objective. The use of a 30% MEA solution, despite introducing an initial 17.6% energy premium, results in a significant 12.3% reduction in overall energy consumption. This translates to a substantial 50% decrease in energy requirements for carbon capture operations, along with an impressive 90% CO_2 capture efficiency. These findings underscore the potential of pinch assessment techniques to enhance the sustainability and cost-effectiveness of carbon capture technologies. Furthermore, the implementation of a pinch analysis offers a pathway towards achieving cleaner energy production and reducing environmental footprints. The systematic optimization of heat exchange networks not only leads to energy savings but also contributes to operational efficiency improvements within coal-fired power plants. By strategically matching hot and cold streams, the consumption of water and energy in carbon capture processes can be minimized, paving the way for greener and more sustainable power generation practices. In conclusion, the comprehensive application of pinch assessment techniques presents a promising opportunity for enhancing carbon capture efficiency and advancing clean energy technologies in coal-fired power plants.

sciforum-085958: Batch Mode Adsorption of a Cationic Dye on a Biomass Waste: Modeling and Optimization of Operating Conditions Using Experimental Design

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The treatment of wastewater generated by industries is challenging due to various xenobiotic and dangerous pollutants, notably multi-category carcinogenic dyes. The existing conventional treatment methods employed in developed countries are costly, prompting the search for a suitable alternative to achieve sustainable and economically viable development. Researchers interested in sustainable development widely adopt the biosorbent adsorption method to effectively remove micropollutants from water. This involves using low-cost materials as an alternative to dangerous and expensive products.

This work focuses on the modeling of adsorption in batch mode, with the main objective being to study the adsorption of Methylene Blue (MB), a cationic dye, on Grape Pomace (GP), an oenological waste product. The influence of parameters such as dye concentration, biosorbent mass, adsorption time, and pH of the MB solution are studied for process optimization. The acquired results undergo a comprehensive analysis employing kinetic models, including the pseudo-first- and second-order models, and the intra-particle diffusion model. Furthermore, the results are subjected to optimization through the application of the Box–Behnken design.

The results of the kinetic analysis reveal that the pseudo-second-order kinetic model describes the adsorption of MB on GP more appropriately with a coefficient of determination R^2 = 0.999 compared to the pseudo-first-order and intra-particle diffusion models. The application of the experimental design methodology (Box–Behnken model) allows us to estimate and optimize the adsorption capacity to 37.38 mg/g of MB removal at pH = 5, m = 75 mg, and C = 40 mg/L for the factors studied with a reduced number of experiments. The results of both approaches confirm the effectiveness of using oenological waste in wastewater treatment, enabling precise control of the parameters influencing adsorption.

sciforum-090397: Biopolymer Production in Electroactive Biofilms

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Biofilms comprise of microorganisms encased in self-produced extracellular polymeric matrix, which provide resistance to antimicrobials and favors adhesion to nearly any surfaces. When biofilms grow onto electrodes, they are termed electroactive biofilm (EABs). The microorganisms in EABs are also known as electricigens. EABs are capable of extracellular electron transfer (EET) to and from solid acceptor, through direct or mediated mechanism. A thorough comprehension of the mechanism underlying EET is needed to develop productive EABs for bioprocesses. The EET mechanisms are investigated through a combination of electrochemical techniques (e.g., chronoamperometry and potentiostatic electrochemical impedance spectroscopy) and microscopy techniques. Following early studies on strong electricigens like *Geobacter* sp. and *Shewanella* sp., recent research has shown that most microorganisms exhibit weak electricigens activity under specific conditions, thus showing the possibility to develop novel bioelectrochemical industrial processes like electrofermentation (EF). EF can be applied to produce biopolymers in biofilms at higher yield and with different properties than conventional fermentation processes. Fluctuations in redox conditions in bioprocesses can alter the end-products, reduce their concentration, and lengthen the process time. EF enables rapid metabolic modulation of biosynthesis and allows control of redox imbalances in biofilm-based fermentation processes. In this presentation, I will give a brief introduction to electrochemical biofilm, with particular regards to weak electricigens. I will also show our recent work on electrofermentation to produce γ-PGA in *Bacillus subtilis* biofilms.

sciforum-090424: Deep Learning Models for Reference Evapotranspiration Prediction in Bangladesh

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Evapotranspiration is a critical component of water balance equations, playing a pivotal role in the water and energy cycle of the region. The accurate estimation of reference evapotranspiration (ETo) is crucial for effective regional water resource management and irrigation scheduling. This study employs deep learning models, including CNN, GRU, BiLSTM, and LSTM, to predict daily evapotranspiration using meteorological data from Bangladesh. In the present study, the dataset consisted of measured meteorological data collected on a daily basis, including parameters such as maximum temperature, minimum temperature, relative humidity, solar radiation, and wind speed. The dataset spanned a time period of 18 years, from 1 January 2000 to 31 December 2017. The dataset was split into two subsets: 70% of the data were allocated for training purposes, while the remaining 30% were allocated for the testing phase. The performance of these models was assessed using five accuracy matrices. A novel aspect of this research is that it utilized deep learning models to estimate reference ETo, an approach that is not commonly employed in the literature. In the case of the Sreemangal station, a comparative analysis of the CNN and GRU algorithms revealed superior performance, achieving the best values for various statistical matrices during both training and testing phases. The correlation coefficient values were approximately 0.95. Notably, the statistical parameter RMSE indicated superior results in the CNN and GRU models, approximately 0.225 and 0.174, respectively. The comparison suggests that deep learning models, particularly CNN and GRU, are well suited for accurate predictions with limited meteorological data. The outcomes of this research underscore the efficacy of deep learning methods in predicting evapotranspiration and identifying dominant variables influencing changes in the context of Bangladesh. These findings contribute valuable insights for regional water resource management and underscore the potential of advanced modeling techniques in enhancing predictive capabilities for critical hydrological processes.

sciforum-090283: Enhancing Sustainability and Energy Savings in Cement Production via Waste Heat Recovery

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Cement production is one of the most energy-efficient industries. During the clinker formation and cooling processes, excess heat is lost to the atmosphere. For this reason, using waste heat to generate useful energy is considered the most promising approach to sustainable cement production. In this study, advanced modeling tools, Aspen Plus and Aspen Energy Analysis, are employed to identify the potential for enhancing energy efficiency and sustainability in a cement plant with an annual output of 1 million metric tons. The analysis reveals two primary sources of recoverable waste heat: 29.7 MW from the preheater flue gas and 30.82 MW from the cooler gas stream, totaling 60.52 MW. Two case studies are examined to evaluate the feasibility and benefits of different heat recovery strategies. In the first case, excess heat from the preheater flue gas is utilized for raw material dehydration and power generation through a waste heat recovery unit (WHRU), producing 5.026 MW, while the cooler gas stream is used in another WHRU for an additional 7.901 MW of power. In the second case, power generation from excess heat and steam production for an amine-based CO_2 absorption unit were considered. Our research underscores the substantial opportunities for energy savings and environmental improvements in the cement industry through waste heat recovery, offering viable solutions for more sustainable and efficient cement production processes.

sciforum-088884: Green Synthesis of Zinc Oxide Nanoparticles Embedded in Sodium Alginate Matrix for Efficient Slow-Release Biofertilizers with Antibacterial and Antioxidant Properties

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This study's objective was to investigate the feasibility of utilizing zinc oxide nanoparticles, known for their antibacterial and antioxidant properties, in combination with sodium alginate, a natural biopolymer, to produce cost-effective biofertilizer formulations with a slow-release mechanism. In this research project, zinc oxide nanoparticles were produced in an environmentally friendly manner by combining sodium hydroxide, zinc acetate salt, and a *Lepidium sativum* seed extract. The use of XRD and SEM enabled the confirmation of the creation of alginate nanocomposites. In addition to having nearly one hundred percent encapsulation efficiency, the alginate beads that were created were spherical in shape. The nutrients' release rate was determined using dissolution experiments in an alkaline buffer solution with a pH of 7.4, conducted at 37 °C and 500 rpm. The nutrient release was examined using UV spectroscopy with a UV–visible spectrometer. A test was performed to see how biogenic beads of zinc oxide (ZnO) nanoparticles containing nutrients would affect the growth and development of lentil plants in cotton and compost. According to the findings of the research, the beads exhibited a steady and continuous release of nutrients for a period of up to one hour of dissolution testing. For a period of three weeks in compost and cotton growth, the encapsulated nutrient beads were very effective in fostering the growth of lentils. These ZnO nanoparticles have excellent properties that allow them to combine with alginate without getting in the way of the creation of alginate gel beads when they crosslink with Ca^{2+} ions. This is the reason why the improved encapsulation approach works so well.

sciforum-088214: Inhibition Effect of Benzimidazolium Salts on Swaring Motility on Pseudomonas Aeruginosa PAO1

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Introduction

Bacteria can move across semisolid surfaces in colonies of flagella-driven cells. And this coordinated type of movement is called swarming motility. Swarming has been linked to increased antibiotic resistance and virulence in a variety of human infections, and it may be viewed as a beneficial adaptation to the many problems that bacteria encounter in quickly evolving settings. *Pseudomonas aeruginosa* is one of the species that uses swarming motility in pathogenicity. In this study, the inhibition effect of benzimidazolium salts on swarming motility in *P. aeruginosa* PAO1 was investigated.

Methods

P. aeruginosa PAO1 was grown overnight in Luria Bertani medium at 37 °C. The next day, 20 mL of the molecules whose inhibitory effects were investigated were added to the swarming medium at a sub-mic concentration and poured into Petri dishes. Two µL of bacteria supernatant was inoculated in the center of the agar and incubated at 37 °C for 18–24 h. Positive control *P. aeruginosa* PAO1 was inoculated into media without adding extract. After incubation, the inhibition effect of compounds was evaluated by measuring the diameter of the swarming at the inoculation site. The study was carried out three times and the results were compared with the control.

Results

One of the virulence factors that is crucial to Pseudomonas' pathogenicity is swarming motility. Both compounds had a high rate of inhibitory effect (78%) in the swarming motility data, and all results were found to be statistically significant.

Conclusions

In recent years, when antibiotic resistance has become a major problem, alternative solutions have been tried against infectious diseases. Inhibition of bacterial communication, which is important in pathogenicity, is one of the promising options. This compound may be useful in future research investigations into drug development.

sciforum-087302: Mechanical Performance of Bio-Based Modification of Asphalt Concrete Mix: A Study for Eco-Friendly Sustainable Development in Developing Countries

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Bio-based modification of bitumen can be used to replace the stiffening effect of asphalt pavement. It can help to improve the efficiency of the asphalt projects for sustainable development. The eco-friendly utilization of waste materials also helps in the maintenance of a desirable, clean environment. In this study, different percentages of bio-based waste cooking oil (WCO) have been used for the modification of bitumen. Asphalt concrete mix can help to develop a sustainable infrastructure using waste materials. Marshal stability analysis methodology was used to analyse the performance of modified asphalt concrete mixtures. The various characteristics of the modified asphalt mixtures were analysed to determine the performance of modified asphalt. The results of the study revealed that the recycling process of waste bio-based oil maintained the performance of the asphalt mixtures compared to the control ones. Marshal Stability Analysis showed that stability value, with the modification of 2% WCO in Bitumen, increased from 29.363 to 31.855 but even at 6% the modification value remained within an acceptable limit. Flow values also remained within the range, i.e., (2–4). Overall, strength and performance evaluation showed a successful production of asphalt concrete mix using proposed waste materials at a local level. This study will aid in the eco-friendly sustainable development of road infrastructures and sustainable cities in developing countries.

sciforum-083660: Microplastic Pollution in *Leuciscus baicalensis* and *Rutilus rutilus*: An Impending Danger to Aquatic Biodiversity in Western Siberian Riverine Fishes

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Microplastic pollution is increasingly recognized as a significant threat to aquatic ecosystems and human health, prompting growing concern among environmental scientists. As a response, this literature review aims to provide a comprehensive overview of the existing research on microplastic pollution, specifically focusing on *Leuciscus baicalensis* and *Rutilus rutilus* in Western Siberian Riverine ecosystems. Previous research findings have shown that microplastics found in their gastrointestinal tract asmicro-fragments are the most abundant compared to sea fish. This study delves into the extent of microplastic contamination, striving to quantify the levels of microplastics present in these fishes and to elucidate their morphology and sources within the species. Recent studies also proved that microplastics below 0.150 mm in size are absorbed in the intestine, underscoring the urgent need for a thorough investigation of their impact on both the aquatic environment and potential transfer through the food chain to human consumers. By emphasizing the potential long-term implications of plastic accumulation in these delicate ecosystems, this review underscores the critical need for effective conservation and management strategies. This analysis represents a crucial step in fostering a deeper comprehension of the threats posed by microplastic contamination, ultimately contributing to the preservation and restoration of Western Siberian Riverine ecosystems and their associated aquatic biodiversity. Furthermore, this research aims to provide insights into the development of targeted measures to mitigate the impacts of microplastic pollution, thereby fostering the conservation of these vital aquatic environments.

sciforum-090257: Synthesis of Antibacterial Sorbent Based on Waste Photographic Fixing Solution

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Clean water is of great importance for human life and health; however, water does not always meet the necessary microbiological standards and needs to be purified before it is delivered to the end consumer. One of the dangerous indicators is the presence of Escherichia coli bacteria in water, which can cause dangerous illnesses and death, thereby causing harm to both individuals and the economy. To purify water from this type of bacteria, the use of silver-containing adsorbents is promising.

Our institute has long been working on the sorption of antibacterial adsorbents, the action of which is enhanced by silver. This metal has been used for centuries as an antimicrobial agent, and in recent years, interest in its antibacterial properties has increased due to the emergence of antibiotic resistance.

In medicine, radiography is used to diagnose certain diseases. In the process of producing a photograph, waste remains: a spent photographic fixing solution, which contains on average up to 1% silver. It was decided to develop a method for modifying montmorillonite-containing clay with silver from these solutions. In this way, two problems are solved at once: a method is generated for the useful disposal of waste solutions and a method is created for the synthesis of an antibacterial adsorbent.

An ammonia solution of silver was prepared by adding ammonia to the spent fixing solution. Then, a glucose solution, which contains an aldehyde group, was added to this solution and montmorillonite-containing clay was added as an initiator of sediment aggregation. When heated, the silver was reduced and precipitated.

Further research indicated a silver content of 0.5% in the sediment. Theoretically, this is enough for the manifestation of antibacterial properties. Practical tests of the effect of the sorbent on the growth and development of Escherichia coli in vitro are currently being carried out.

sciforum-087209: The Impact of Sodium Chloride (NaCl) Concentrations on Electrocoagulation in Simultaneous Tartrazine Dye Removal and Hydrogen Production

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Liquid waste frequently contains a large variety of hazardous substances, including tartrazine-based dyes. These color compounds can present a significant hazard to both human health and the natural environment. Moreover, there is a growing demand for sustainable energy, and hydrogen is emerging as a promising alternative energy source that does not produce carbon emissions. To address the aforementioned concerns, it is necessary to conduct research that is aimed at eradicating tartrazine while concurrently generating hydrogen gas as a viable substitute for energy. This study aims to investigate the effect of different concentrations of NaCl electrolytes on the rate of tartrazine elimination and hydrogen production simultaneously using electrocoagulation. The electrocoagulation procedure was used, with various concentrations of NaCl (0, 0.2, 0.4, 0.6, 0.8, and 1 g/L). UV-Vis spectrophotometers and gas chromatography were employed to evaluate the elimination of tartrazine and the hydrogen production. The study shows that the elimination of tartrazine at 0, 0.2, 0.4, 0.6, 0.8, and 1 g/L of NaCl for 60 min is 30%, 39%, 42%, 69%, 80%, and 86%, and for 240 min, it is 66%, 86%, 90%, 92%, 93%, and 94%, respectively. The hydrogen production at 60 min is 8.64, 14.37, 45.00, 77.18, 97.04, and 135.16 [mol H_2/m^2], and for 240 min, it is 63.16, 99.06, 135.45, 177.80, 208.09, and 217.44 [mol H_2/m^2], respectively. It can be concluded that higher electrolyte concentrations generally lead to an increase in the proportion of tartrazine elimination and hydrogen production.

sciforum-085101: Utilization of Raw and Treated *Arundo donax* L. Biosorbents for the Removal of Industrial Dye from Aqueous Solutions

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This study involved the preparation of treated *Arundo donax* L. biomasses by combining specific amounts of raw *Arundo donax* L. powder with predetermined volumes of phosphoric acid (H_3PO_4), ammonia (NH_4OH), and acetone (C_3H_6O) individually. These treated *Arundo donax* L. biomasses were employed for adsorbing Bemacid red dye. Various techniques, including SEM, RX, and FTIR analysis, were employed to characterize the treated *Arundo donax* L. The impact of contact time, pH, initial dye concentration, and adsorbent amount on the adsorption of Bemacid red dye onto the various treated *Arundo donax* L. samples was investigated.

The optimal conditions for adsorption were identified as a pH value of 2.0, an adsorbent amount of 25 mg, and a contact time of 40 min. Notably, the basic treated *Arundo donax* L. achieved an impressive dye removal efficiency of 98.91% under these optimal conditions. Additionally, the adsorption process was analyzed using isotherm, kinetic, and thermodynamic models. The Freundlich model provided the most accurate description of the removal of Bemacid red dye by the different treated *Arundo donax* L. samples. Meanwhile, the Elovich model and the second-order kinetic model offered reliable descriptions at concentrations of 10 and 20–30 mg/L, respectively.

In conclusion, the adsorption of Bemacid red dye by treated *Arundo donax* L. was found to be feasible and occurred spontaneously.

sciforum-090428: Water of Increased Ionic Strength and Spiked Ion Concentrations on Surface Interactions with Labradorite

Malibongwe Manono

University of Cape Town

Labradorite is a beautiful and popular mineral known for its iridescent play of color. Labradorite is commonly found in igneous rocks and belongs to the feldspar group of minerals. Labradorite is primarily composed of calcium, sodium, aluminum, and silicon. Labradorite has various uses, such as as an ornamental stone, as well as many industrial applications, such as being an additive in ceramics and in glassmaking. Understanding its behaviour under various water conditions is therefore important to consider. This study therefore examines the behaviour of labradorite in changing water chemistry. The results of this study showed that the adsorption of sodium carboxy methyl cellulose, a polysaccharide often used in flotation as a depressant with binding properties, is enhanced in water of high ionic strength and spiked ion concentrations. It was also shown that the electrokinetic potential of labradorite increased in water of higher ionic strength and in spiked ion concentrations, thus demonstrating a passivation effect at the mineral surface. The findings of this study can be extended to implications on the behaviour of the feldspar group of minerals which are commonly present as gangue minerals in sulfide ore mineral flotation. These findings may also be useful for ceramics and glass-making industries where labradorite is used as an additive.

sciforum-086051: A Comprehensive Review of Green Solvents and Their Applications

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The chemical process industry relies heavily on solvents that are typically important in reactions and separation. Beyond their facilitative role, solvents dictate the solubility and stability of reactants, and significantly shape economic and environmental outcomes. However, despite their crucial impacts, conventional solvents pose environmental and health risks. That is why the adaptation of green chemistry, which is established to reduce the production and usage of potentially harmful chemicals and promote the use of green solvents, is of utmost importance. This paper explores the typical sources, advantages and disadvantages, physical and chemical properties, mechanisms, and applications of green solvents as aligned with the principles of green chemistry for sustainable and environmentally responsible practices. It includes a discussion of the currently studied green solvents such as bio-based solvents, ionic liquids, deep eutectic solvents, petroleum alternatives, liquid polymers, fatty acid esters, supercritical fluids, and terpenes. Challenges in terms of economic feasibility, application limitations, and life-cycle environmental impact assessments were indicated. This paper emphasizes the importance of discerning environmental claims, considering toxicological evidence, and scrutinizing the challenges of industrial scaling for effective adoption. Future research outlooks encompass integrating green solvents into industrial practices using sustainable synthesis methodologies, intermolecular interactions, and reliable predictive models to enhance performance and safety.

sciforum-089604: A Meta-Analysis of Emerging Green Technologies for Sustainable Solid Waste Management

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National Institute of Technology Patna

Solid waste management (SWM) is a vital issue for environmental and human health, as the increasing waste generation poses serious challenges to conventional methods of waste disposal. These methods are often associated with high costs, low efficiency, and negative impacts, such as greenhouse gas emissions, leachate, and odors. To address these challenges, emerging green technologies have been developed to manage waste in a more effective and sustainable way, while reducing the environmental and social burdens of SWM. This paper provides a meta-analysis of the emerging green technologies for SWM, based on a systematic review of the literature from 2019 to 2023. The paper covers four main aspects: (1) the current status and challenges of SWM, such as the lack of regulations, infrastructure, and awareness; (2) the techno-economic, environmental, and social impacts of SWM technologies, such as the costs, benefits, risks, and opportunities; (3) the optimization strategies for minimizing waste and maximizing resource recovery, such as the waste hierarchy, life cycle assessment, and circular economy principles; and (4) the applications of artificial intelligence in SWM. The paper reveals that green technologies such as waste-to-energy, recycling, composting, and bioreactor landfills can offer significant advantages for SWM, but they also encounter various barriers and limitations, such as technical, financial, institutional, and behavioral challenges. The paper recommends that policymakers and stakeholders should cooperate to create a conducive environment for the adoption and implementation of these technologies.

sciforum-086232: A Review of Carbon-Dot-Based Nanocomposites in the Photocatalytic Degradation of Pharmaceutical Compounds

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Carbon dots (CDs) are types of carbon-based nanomaterials that have recently gained interest from both researchers and scientists due to their diverse and interesting physicochemical attributes, such as biocompatibility, tuneable optical properties, low cost, sufficient functional groups, and photocatalytic properties. Alongside their innate advantages, recent studies have been conducted by incorporating some new materials to create carbon-dot-based nanocomposite (CD-nanocomposite) matrices which enhance a particular property like photocatalytic activity. The aim of creating this emerging nanomaterial is to address the prevailing concern of removing persistent organic pollutants like pharmaceutical compounds which are known to be detrimental to both humans and animals. Photocatalytic degradation is a method of removing harmful substances present in water using a photocatalyst under light exposure. Photocatalysts are being modified to create CD-nanocomposites intended to degrade this type of pollutant. In this paper, a comprehensive discussion of past and present studies on the synthesis and utilization of CD-nanocomposites in the photocatalytic degradation of different pharmaceutical compounds like antibiotics and paracetamol ispresented. This includes the sources of CDs, synthesis methods, mechanism types, and degradation efficiency. In addition, a straightforward presentation of the research gaps and future research opportunities related to this study is established. Finally, this review paper is essential in the extension of research work that would enhance CD-nanocomposites and their application to photocatalysis.

sciforum-086080: A Review of Heat Exchanger Materials for High-Temperature Applications

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The need for a proper selection of working materials that could withstand high-temperature environments has been the focus of recent research in the field of heat exchanger design. Heat exchangers are considered important for transferring thermal energy at different temperatures between two or more fluids to ensure efficient energy transport. Recent studies establish the current operational temperature limit to be 600 °C, which highlights the need for an appropriate design and appropriate material considerations in a high-temperature condition. A typical design problem involves the large-scale deployment of renewable energy due to the scarcity of the material of choice. Despite the developments in carbon-based materials and polymers, problems arise in terms of the extraction procedure, sustainable supply, and cost-effective fabrication. In this review paper, an expansive review of the role of different materials, their fabrication compatibility for high-temperature heat exchangers (HTHXs), financial considerations, design limitations, and their general application across varied industries is presented. In addition, HTHX materials such as ceramics, carbon-based compounds, coatings, and surface treatments are presented, together with their benefits and drawbacks when selected as materials. Finally, this review paper explores current challenges, advancements, and research gaps that are available to interested researchers as a venue for their future works in the field of HTHX design and its application as a cost-effective approach.

sciforum-086164: A Review of Room Temperature Ionic Liquids (RTILs): Past, Present and Future Works

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Solvents have been known to be important and play a crucial role in the extraction, separation, and synthesis process due to their innate physicochemical properties. Recently, ionic liquids like room temperature ionic liquids (RTILs) have gained popularity because of their high chemical and thermal stability, density, viscosity, low electrical conductivity, low toxicity, and high reusability. RTILs are a class of ionic systems, usually consisting of salts of organic cations and inorganic anions, whose melting temperature falls below the conventional limit of 100 °C. In this review article, past and present studies of RTILs available in the literature are presented, as well as their future trends. This paper gives an overview of the discovery and development of RTILs, their fundamental aspects and properties, their synthesis, route mechanisms, and their applications in diverse scientific fields. This also includes the purification and recovery of the RTILs as solvents and catalysts through crystallization, distillation, and extraction. In addition, an emphasis on research gaps and future works that explore these green solvents, addressing their high cost and unavailability, toxicity, and the lack of biodegradability data, will serve a starting point for both researchers and scientists. Finally, the results presented in this paper serve as helpful information for future research to improve the current state of RTILs in terms of their applicability.

sciforum-087970: A Solution to Reduce the Carbon Footprint: Mineralization and Utilization of CO_2 in Recycled Construction Aggregates

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This study introduces an innovative strategy to mitigate global carbon emissions by integrating carbon dioxide (CO_2) absorption and sequestration through the carbonation of recycled concrete aggregate (RCA). This approach not only promotes the recycling of concrete waste but also alleviates the demand for new natural resources, addressing both environmental impact and geographical challenges associated with mining. The integrated process utilizes ammonia to capture flue gas emissions from natural gas combined cycle (NGCC) power plants, employing the captured solution to carbonate RCA for effective CO_2 sequestration and to enhance the quality of RCA.

The study comprehensively assesses the process's viability, considering capture performance, energy penalty, compliance with ammonia emissions standards, and capital costs. A techno-economic analysis (TEA) highlights the potential and economic feasibility of the proposed approach. Bench-scale experiments, conducted at low CO_2 concentrations (3~5%), focused on optimizing the carbonation process. The concentration of carbonated ammonia solution and its ratio to RCA were investigated to enhance the yield of carbonated RCA, resulting in an approximate 10% CO_2 capacity when using a 5% carbonated ammonia solution with a 0.25 ratio. The design of a large-scale plant, with an annual carbonated RCA production capacity of around 150 k tonnes, was formulated, and TEA calculations using Aspen Plus® V14 indicated a cost of approximately S$13 per tonne of carbonated product. These findings underscore the promising potential of the proposed process in efficiently reducing carbon emissions while providing economic viability at a larger scale.

sciforum-089568: A Systematic Review of Metal–Organic Framework (MOF)-Based Nanocomposites and Their Application in the Photocatalytic Degradation of Pharmaceutical Compounds

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Photocatalytic degradation has emerged as a promising and sustainable solution to the rising environmental concerns caused by the emergence of pharmaceutical contaminants in aquatic bodies. Given its sustainability, nontoxicity, and energy-efficient attributes, extensive research has been conducted to investigate this approach and explore the synthesis of various photocatalysts. Metal–organic framework (MOF)-based nanocomposites exhibit a broad spectrum of applications across various fields due to their substantial surface area and versatile functionality. In these fields, MOF-based nanocomposites have proven to be excellent photocatalysts in water treatments, particularly in the breakdown of pharmaceutical pollutants in aquatic environments. This systematic review provides an overview of MOF-based nanocomposites and their applications in the photocatalytic degradation of pharmaceutical products. Several studies have explored different synthesis techniques for various MOF-based nanocomposites, and their degradation efficiencies against pollutants, under varying conditions such as catalyst loading, pollutant concentration, light intensity, and exposure time, among others, have also been reported. Moreover, modifications to these synthesis techniques have been made to enhance the degradation capability and stability of MOF-based nanocomposites. Meanwhile, the integration of other metals and biomaterials into MOF-based nanocomposites has been explored to improve the stability and recyclability of these photocatalysts. This paper also highlights the existing gaps in the current research to direct future investigations on photocatalytic degradation using MOF-based nanocomposites.

sciforum-089549: A Systematic Review of Microplastic Detection in Water

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The need to detect and mitigate the presence of microplastics in water has been the focus of both researchers and scientists recently due to their impact on humans and the environment. Microplastics (MPs) are pervasive pollutants that are almost always found in environmental settings, particularly in water. These are small fragments of polymers utilized to produce abrasives and exfoliants, or that appear as fragmented pieces from larger manufactured plastic products such as bottles and bags. They have been proven to cause not only health but also environmental problems as they heavily disrupt marine life and the ecosystem. Detection of not only the presence of microplastics in water but also the type of polymers present in water will further improve understanding and allow the development of preventive measures against the contamination of water and improvements in overall water quality. This systematic review paper aims to provide further insight into the various developments in the detection of microplastics suspended in water, the mechanism of detection, and the potential integration of different analytical instruments. These include the recent development of new and novel methods of detection, type, and sampling collection requirements, and optimization approaches. In addition, research gaps are identified to open avenues for researchers who want to venture into extended works related to the subject. Finally, the information presented in this paper will be beneficial for the improvement of existing MP detector equipment design, leading to more efficient performance.

sciforum-087907: A Systematic Review on Water Hyacinth (*Eichhornia crassipes*) as a Biosorbent of Cadmium

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Water hyacinth (*Eichhornia crassipes*) has gained a noteworthy reputation as the worst invasive macrophyte for its alarming proliferation rates, which threaten transportation and irrigation systems and ecosystem biodiversity. Recently, researchers have focused their attention on developing novel materials that come from biomass such as water hyacinth capable of removing heavy metals in the water streams. In fact, sustainable efforts have found the plant to demonstrate efficiency as a biosorbent in sequestering toxic heavy metals such as cadmium from marine environments. Cadmium's presence in water, primarily brought about by anthropogenic sources, poses public health risks due to its toxicity. Consequently, studies on the applications of *Eichhornia crassipes* and the removal of cadmium have become active research areas in recent decades. This systematic review presents literature on the cadmium sorption capacity of various water hyacinth biosorbents. The effects and optimization of parameters including treatment, temperature, pH, and initial sorbate and sorbent concentration have been explored in classical and competitive models. Investigations on kinetics, equilibrium, and desorption studies have also been conducted. From the gathered literature, water hyacinth-derived biosorbents show considerable potential for industrial-scale applications, but their performance in multi-metal continuous adsorption systems and metal recovery require further evaluation. In addition, this study presented research gaps, trends, and developments that could set the tone of future works for the improvement of biosorbent materials for the removal of cadmium in the environment.

sciforum-090186: Adsorption of Methyl Orange onto Calcium Ferrite for Environmental Sustainability

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Wastewater poses public and environmental problems when discharged into aquatic systems due to industrial, agricultural, or domestic activities. Water pollutants commonly found in effluents include dyes, surfactants, phenolics, chlorides, heavy metals, etc., which are detrimental to plants, animals, and human lives. These effects are noticeable in the slow photosynthetic activity of aquatic plants, which also serve as a breeding ground for bacteria, viruses, and vectors, leading to waterborne diseases. Herein, the potential of calcium ferrite ($CaFe_2O_4$) as an adsorbent for the removal of methyl orange (MO) dye from wastewater was evaluated by studying the adsorption kinetics. Batch adsorption experiments were carried out after reacting calcium chloride ($CaCl_2$) with ferric nitrate ($Fe(NO_3)_2$), and the mixture was heated continuously at 90 °C for two hours to form the $CaFe_2O_4$ precipitate, which was then calcined for four hours at 600 °C in a furnace. The synthesized $CaFe_2O_4$ was found to have high adsorption capacity for MO, as evidenced by its ability to remove 80.02% of MO dye from wastewater within one hour. Furthermore, the adsorption capacity at equilibrium (q_e) and at variable time (q_t) for the kinetic model with a linear regression coefficient (R^2) value of 0.9979 signifies that the adsorption process is best described by pseudo-second-order kinetic models. Thus, $CaFe_2O_4$ can be effectively used for the removal of dyes such as MO from wastewater to ensure sustainability.

sciforum-088934: Adsorption Removal of Aromatic Compounds from Chemical Enterprise's Wastewater

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Wastewater from chemical enterprises is a complex multicomponent system that contains insoluble impurities, suspensions, and dissolved substances of mineral and organic nature (surfactants, oxidants, and dyes). Wastewater has a specific color and acidity (pH) from 4 to 12.5. Modern organic and organometallic dyes have a low capacity for biodegradation and resistance to chemical and temperature effects of the environment.

The concentration of colored organic substances in the highly mineralized wastewater of the storage facility "Rubizhansky", the chemical enterprise "Rubizhansky Krasitel", Ukraine many times exceeds the established norms. Polluted colored industrial wastewater contains aromatic sulfonic acids, nitrobenzene, chlorobenzene, phenol, and mineral salts.

The purification of acidic wastewater from the "Rubizhanskyi" storage facility by the sorption method with carbon adsorbents was carried out. The carbon adsorbent KARBON™ (ISPE, NAS of Ukraine) produced from commercial coconut charcoal AquaCarb 607C ("Chemviron Carbon", Belgium) by high-temperature steam-air activation as well as charcoal ZL-302 (Huzhou Beigang Imp. & Exp. Co. Ltd., China) were used.

The adsorbent morphology (porous structure and surface properties) by methods of low-temperature nitrogen adsorption and scanning electron microscopy was determined. It was found that KARBON™ and ZL-302 adsorbents are micro-mesoporous materials with specific surface areas of 1730 and 1523 m^2/g. It established the existence of aniline and phenol in wastewater by using the UV-spectroscopy method. The removal of aromatic compounds from wastewater by carbon adsorbents KARBON™ and ZL-302 consists of 99.99% and 94.4%, respectively.

It is shown that carbon adsorbent KARBON™ is effective adsorbent for the successful purification of chemical enterprises' wastewater from aromatic compounds.

sciforum-087174: Adsorption, Optimization, and Kinetic Modeling of Methyl Red Removal from Textile-Polluted Water Using Brewery Waste as an Adsorbent

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Environmental pollution, driven largely by industrial emissions, especially from the textile sector, is a pressing concern today. Inadequate treatment of global colored industrial effluents poses a significant environmental threat, leading to water pollution and potential risks to aquatic ecosystems and human health, further amplified by the mutagenic and carcinogenic effects of specific persistent dyes. In response, efforts have been directed towards investigating low-cost, easily accessible, and efficient bio-adsorbents to tackle the removal of dyes from wastewater. This study specifically aims to assess the efficacy of a particular industrial waste, namely Brewery waste, as an adsorbent for the elimination of methyl red dye. The results of the dye adsorption onto Brewery waste were analyzed using first- and second-order kinetics models. Various operational parameters, including the dye concentration, the pH of the dye solution, the mass of the adsorbent, and the reaction time, were scrutinized to optimize the operational aspects of the adsorption process. The kinetic results indicate the involvement of both internal and external diffusion processes in the adsorption mechanism. Brewery waste exhibited optimal performance in a weakly acidic medium with a pH of 4, and the Langmuir isotherm effectively characterizes the adsorption of the dye onto Brewery waste, with a coefficient of determination (R^2) of 1 and a maximal adsorption capacity (qemax) of 64.1 mg/g.

Brewery waste proves to be an effective and economical adsorbent with a substantial capacity for removing methyl red dye from aqueous solutions.

sciforum-084892: Advancement of Electrospun Carbon Nanofibers in Sensor Technology for Air Pollution Detection

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The use of electrospun carbon nanofibers (ECNs) has been the focus of considerable interest due to their potential implementation in sensing. These ECNs have unique structural and morphological features such as a high surface area to volume ratio, a cross-linked pore structure, and very good conductivity, making them well suited for sensing applications. Electrospinning technology, in which polymer solutions or melts are electrostatically deposited, allows the production of high-performance nanofibers with tailored properties, including fiber diameter, porosity, and composition. This controllability allows the use of ECNs in sensing applications to be optimized, resulting in improved sensor performance and sensitivity. While carbon nanofiber mats have potential for sensor applications, several challenges remain to improve selectivity, sensitivity, stability, and scalability. Sensor technologies play a critical role in the global sharing of environmental data, facilitating collaboration to address transboundary pollution issues and fostering international cooperation to find solutions to common environmental challenges. The use of carbon nanofibers for the detection of air pollutants offers a variety of possibilities for industrial applications in different sectors, ranging from healthcare to materials science. This brief review provides insights into the latest developments and findings in the fabrication, properties, and applications of ECNs in the field of sensing. The efficient utilization of these resources holds significant potential for meeting the evolving needs of sensing technologies in various fields, with a particular focus on air pollutant detection.

sciforum-086808: Application of Electrochemical Processes to Membrane Bioreactors for Sustainable Wastewater Treatment: A Short Review

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Membrane bioreactors (MBRs) are considered as innovative systems for wastewater treatment in line with sustainable development and the reuse of treated wastewater. One of the main problems of MBRs is the fouling of the membrane modules, defined as fouling, which affects both the stability and the effectiveness of the biological purification process. Among the many technologies developed by the scientific community for the mitigation of fouling, the application of electrochemical processes to MBRs has attracted considerable interest. It has been observed that these processes present greater simplicity from a management point of view and, at the same time, allow an improvement in the purification performance of the system, achieving greater purification efficiencies compared to conventional MBR systems. Unlike traditional chemical and physical cleaning methods, which cause a reduction in the useful life of the membranes and require higher operating costs, these systems, defined as membrane electrobioreactors (eMBRs), can prove economically advantageous. This technology does not involve the addition of chemical substances in the reactor, which can alter the characteristics of the wastewater. It is also simple from a management point of view and can be easily monitored in situ. The eMBR configurations used must be evaluated on the basis of different operating conditions, as a correct balance of parameters is essential for achieving the set objectives. This paper seeks to reviewtechnologies proposed for wastewater treatment using eMBRs. Finally, the challenges in applying these removal strategies are also highlighted in this brief review.

sciforum-087827: Application of Machine Learning for Methanolysis of Waste Cooking Oil Using Kaolinite Geopolymer Heterogeneous Catalyst

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With its ability to promote a more environmentally sustainable future, biodiesel, a renewable fuel made from plant oils and animal fats, shows great promise. However, costly, ineffective, and ecologically harmful homogenous catalysts are challenges that conventional production processes face. Geopolymer catalysts and machine learning approaches are starting to show promise as game-changers in the biodiesel industry. Three machine learning algorithms, response surface methodology (RSM), artificial neural network (ANN), and adaptive neuro-fuzzy inference system (ANFIS), were used to optimise and model biodiesel production from waste cooking oil using process parameters, such as methanol-to-oil ratio, catalyst loading, reaction temperature, and reaction time. RSM was used for process optimisation. The model construction of the ANN model used 70% of the data for training, 15% for testing, and 15% for validation. The network was trained using feed-forward propagation and the Levenberg–Marquardt algorithm. The ANFIS was generated using a grid partition and trained using a hybrid method. The effectiveness of the machine learning was assessed through error metrics, such as regression (R^2), root mean square errors (RMSE), mean absolute error (MAE), mean absolute percentage error (MAPE), average relative errors (AREs), and mean percent standard deviation (MPSD). The optimum yield was obtained witha methanol-to-oil ratio of 15 wt.%, a catalyst loading rate of 4 wt.%, a temperature of 120 °C, and a reaction time of 4 h, yielding 93.486%. The results have shown the promising use of machine learning potential methods for optimising, modelling, and predicting the methanolysis of waste cooking oil using geopolymers for eco-friendly biodiesel production.

sciforum-090395: Assessment of Preservation of Biodegradative Activity against Phenol by Immobilized and Non-Immobilized Resting Cells of the *Rhodococcus opacus* 1CP Strain

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The dangerous pollutant phenol and its derivatives can be found both in soil and in wastewater near industrial areas. The usage of biological preparations based on bacterial cultures may be the most effective way to remove phenolic contamination. However, there are some drawbacks to biological technologies, including a longer time required for degradation and the potential for certain toxicant to break down into more toxic by-products. Additionally, introducing enriched microbes to the contaminated soil can be challenging due to variations in environmental factors: pH, temperature, moisture content, nutrients. It was previously shown that cells of the *Rhodococcus opacus* 1CP strain have the ability to enter a dormant state under adverse conditions, and when re-introduced to a rich medium, they can quickly resume growth. Despite this, the preservation of destructive activity and the rate at which germinating cells of the *R. opacus* 1CP strain can decompose toxic substances remains poorly studied. The purpose of this work was to evaluate the viability and biodegradative activity against phenol of germinating immobilized and non-immobilized cells of the *R. opacus* 1CP strain after dormancy. Resting cells were obtained by simple cultivation in a rich medium followed by storage under static conditions. The induction of three phenol hydroxylases was detected by RT-PCR in cells germinated in a mineral medium with phenol as carbon source. The stability of the genome of cells germinating after dormancy is shown by box-PCR. Thus, dormant cells, both suspended and immobilized one, of *R. opacus* 1CP can be directly used for the decomposition of phenol after 4-12 months storage. In addition to phenol, germinating after 9 months of storage immobilized cells easily metabolized 4-chlorophenol and 2,4,6-trichlorophenol. The obtained data can be used to optimize bioremediation processes against phenolic pollutants.

sciforum-087576: Assessment of Rapeseed (*Brassica Napus* L.) Efficiency for Phytoremediation of Heavy Metal-Contaminated Soils

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Soil pollution with toxic pollutants, including heavy metals (HMs), has become a serious global problem. One of the most economically and environmentally feasible alternatives applied for the remediation of HM-polluted sites is the phytoremediation technique. Rapeseed (*Brassica Napus* L.) belongs to Brasicaceae, and was selected in this work as a model crop for the phytoremediation of pollutes soils, since it is a well-known metal-tolerant plant and widespread in Romania. Therefore, our paper investigated the tolerance and accumulation capacity of *Brassica Napus* L. for different heavy metals (Ni(II), Co(II), Cu(II) and Zn(II)) from polluted soils. The experiments were performed in greenhouse conditions for 41 days. The plants were grown in polyethylene pots containing 650 g of soil taken from the Dersca–Dorohoi peat field in the N-E part of Romania, which was artificially contaminated with different levels of metals. After 42 days of growth, the plants were sectioned into two parts (roots and stems with leaves), washed and dried at 105 °C and then subjected to wet mineralization. The samples were analyzed via flame atomic absorption spectrometry (AAS) in order to determine the quantity of metals accumulated in various parts of the plant. To assess the degree of accumulation of metals in plants, the bioconcentration factor (BCF), bioaccumulation coefficient (BAC) and translocation factor (TF) were considered. Our results revealed that *Brassica Napus* L. is not a heavy metal hyperaccumulator and is not suitable for phytoextraction at high metal ion concentrations, at least under the conditions tested and for the soil type considered. However, *Brassica Napus* L. has the potential for Ni, Co and Zn immobilization in roots, since BCF > 1 and TF 1 for some treatments tested (levels around 10 to 290 mg/kg of pollutant in soil). Since BAC1 for all treatments, the tested plant may be considered a metal shoot excluder.

sciforum-090088: Assessment of the Introduction of Microorganisms Capable of Destroying Toxic Compounds during Seed Germination

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The purpose of this work was to evaluate the introduction of microorganisms capable of destroying toxic compounds to seed germination. To develop methods for soil restoration using biological products, experiments were conducted on the introduction of isolated soil bacteria that exhibit the ability to grow on diesel fuel to cleanse the soil. The experimental design included the following: (1) control, (2) sterile soil + diesel fuel (DF), (3) sterile soil + DF + bacterial suspension (BS), (4) non-sterile soil + DF, (5) non-sterile soil + DF + BS.

From the soil sample, 45 microbial cultures were isolated, of which 13 can use diesel fuel as a carbon source. DF was added to the soil in an amount of 5% (w/w) and mixed with the soil until homogeneous. BS for soil treatment was prepared by mixing suspensions of each bacterial culture grown to 1.5 p.u. (600 nm), 1 mL each. In total, 13 mL of the resulting mixture was added to samples of sterile and non-sterile soils, and the soil was mixed again. The effectiveness of cleaning was assessed by the germination of wheat seeds and an assessment of the general toxicity of the soil using the recommendations of the Russian Federation, 1.39.2007.03223 [chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.gostrf.com/normadata/1/4293842/4293842245.pdf].

As a result, it was revealed that the soil with 5% (w/w) DF was characterized as slightly polluted throughout the experiment. The growth rates of wheat in DF-treated soil were 32% and 34% with sterile and non-sterile soil, respectively, while the growth rates in DF- and BS-treated soil were 86% and 88%, respectively. In the control sample, it was 82%. Thus, the introduction of a bacterial suspension of diesel-fuel-degrading strains, although it did not significantly reduce the toxicity of the soil, contributed to a significant increase in germinating wheat seeds.

sciforum-086465: Bagasse-Based Cellulose Nanocrystal—Magnetic Fe_3O_4 Nanocomposite for the Removal of Chromium (VI) from Aqua Media

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Large volumes of wastewater containing different contaminants, including harmful heavy metals, have been produced as a result of the fast growth of the human population and worldwide industrialization. Although effective for this purpose, the use of adsorption is constrained by the high cost of adsorbent materials, thus calling for the need to develop economical water purification materials. This research prepared a low-cost nano bio-adsorbent from SCB-based nanocrystals and incorporated MIONPs, for the adsorption of Cr(VI) ions from aqueous media. The prepared adsorbent cellulose nanocrystal—magnetic Fe_3O_4 nanocomposite (CNCs-MIONPs) exhibited excellent adsorption efficiency at an optimal pH of 2, a pollutant initial concentration of 0.5 mg/L, a contact time of 90 min, and a shaking rate of 250 rpm. The highest efficiency possible was 91.78%. The greater surface area of the nanocomposite, together with its smaller particle size and active sites, provided areas for chromium species immobilization linked to increased chromate ion removal. Furthermore, the CNCs-MIONPs have a surface charge that can interact with the chromium species via electrostatic interactions at lower pH levels, increasing removal effectiveness. The pseudo-second model was the rate-limiting phase, and chemisorption involving valence forces via electron sharing or exchange between the sorbet and adsorbate occurred, offering the best correlation of the data. The modification of CNCs with MIONPs improved the adsorbents' sorption efficiency. This offers great potential application in domestic and industrial water treatment plants.

sciforum-082724: Biochar Valorization from Oregano and Citronella Residues: Impacts on Radish Growth and Methylene Orange Dye Removal

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In recent years, the booming essential oil industry has produced residues that, if mismanaged, can harm ecosystems by contaminating soil and water. This study introduces a sustainable solution by transforming these residues into biochar using pyrolysis. Specifically, we evaluate the potential of oregano and citronella biochars to remove methylene orange dye and assess their safety for water treatment and soil improvement.

This study evaluated the impact of oregano and citronella biochars, produced at different temperatures, on radish seed germination and root development. The control group displayed strong performance with 90–100% germination and a 3.54 cm root length. Oregano biochar at 300 °C was toxic to seed growth, while oregano biochar at 400 °C improved germination but fell short of the control. Citronella biochar at 300 °C and 400 °C had better germination but still lagged behind the control group. Furthermore, our results demonstrate that Citronella biochar (BCR) at 400 °C effectively removed 88.8% of the methyl orange dye. Conversely, the combination of oregano biochar (BOR) and citronella biochar (BCR) at 300 °C did not substantially impact concentration reduction. In summary, applying BOR and BCR produced at 400 °C to soil appears to be environmentally safe but does not significantly enhance plant growth. These findings underscore the critical roles played by the biochar type and pyrolysis temperature in shaping the application process.

sciforum-090347: Biochar-Based Filter for Methylene Blue and Methyl Orange Adsorption

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Water, being essential for life, necessitates urgent protective measures, particularly in treating existing polluted water to safeguard public health and ecosystems. In Lebanon, water resources are suffering from urban and industrial pollution. Thus, the objectives of this work is to investigate the efficacy of biochar-based filter (prepared from a mixture of Lebanese organic waste and pyrolysed at 400 °C) in the adsorption of organic dyes such as Methyl Orange (MO) and Methylene Blue (MB). The biochar based filter prototype is composed of 3 consecutive layers: sand-biochar-sand. The effects of the initial concentrations of MO and MB and contact time are studied and tested in batch experiments tests.

Therefore, different concentrations of Methyl Orange (MO) and Methylene Blue (MB) ranged between 2.5 mg/L to 12.5 mg/L and 1 h. contact time are tested. The obtained results show varying rates of MO removal, reaching up to 37.9% at 15 ppm, while consistently high MB removal rates ranged between 99.2% and 99.8%. The addition of biochar notably improves efficiency when compared to filter composed only of sand.

The variation of contact time reveals its impact for MO adsorption, with optimal adsorption after 24 h, contrasting with rapid MB adsorption occurring within two hours. The biofilter's superior performance over sand alone underscores the effect of biochar.

The experimental results are fitted with Langmuir and Freundlich isotherm to predict the mechanisms of adsorption. It shows that the Freundlich model fits better the MO adsorption data, indicating multilayer adsorption, whereas the Langmuir model accurately describes MB adsorption, implying monolayer adsorption.

Our results highlight the complex nature of adsorption processes influenced by different parameters: dye concentration, contact time and adsorbent properties. This study gives valuable insights into biochar-enhanced biofilters for effective water treatment, emphasizing the importance of tailored approaches based on specific dye characteristics and environmental conditions.

sciforum-084957: Biodiesel Production via Microwave-Assisted Transesterification of Waste Canola Cooking Oil Using Mixed CaO, MgO, and Al_2O_3 as Heterogeneous Catalysts

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Recently, the increase in demand of non-fossil-based fuel for energy consumption has prompted researchers to look for ways to enhance transesterification yield. One particular technique is to speed up the biodiesel conversion with green technology incorporation like microwave-assisted operation and mixed heterogeneous catalysts. In this study, a novel approach of exploiting the synergy of microwave and mixed catalysts of Calcium Oxide (CaO), Magnesium Oxide (MgO), and Aluminum Oxide (Al_2O_3) was employed in the transesterification of waste cooking oil. The transesterification process was conducted with varying oil–methanol ratios and CaO-MgO-Al_2O_3 mixed catalysts of 0.5, 1.2, 1.95, 3.0, and 3.75 wt.%. Results showed that the highest biodiesel yield of 36.24% was obtained at a 1:6 oil–methanol ratio with 1.95 wt.% of mixed catalyst. The physico-chemical properties of the biodiesel produced a like density of 0.9155–1.0558 kg/L, kinematic viscosity of 19.960–23.041 mm^2/s and lower flash point of 35.6–39.0 °C. The GC-MS analysis results showed the prominent presence of 9-octadecenoic acid associated with the formation of fatty acid methyl esters. The study presented the potential of the proposed method in obtaining biodiesel fuel in a fast and sustainable way that could reduce reliance on non-renewable fossil fuels. Finally, the viability of using the mixed catalysts of CaO, MgO, and Al_2O_3 in a microwave-assisted transesterification process using waste cooking oil has been presented.

sciforum-089513: Biomass-Derived Hydrochar and Activated Carbon: Characterization and Water Remediation

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This study advocates the use of waste biomass to produce carbon-rich materials, such as activated carbon and hydrochar, aimed at water remediation due to their cost-effectiveness and broad utility. Hydrothermal carbonization transforms waste biomass into slurry-like substances, from which solid hydrochars are derived via filtration. These hydrochars are then further processed into activated carbons through physical activation methods. In our research, we utilized seeds of *Tectona grandis*, a type of waste biomass, for hydrochar production, which we subsequently converted into activated carbon. We characterized the hydrochar and the activated carbon using various techniques, revealing that the activated carbon possesses a high carbon content and surface area.

In contrast, the hydrochar displays limited porosity yet is enriched with oxygenated functional groups. The thermal stability of the hydrochar, as assessed by means of TGA/DTG analyses, proved to be high. Morphological examination disclosed that the hydrochars comprise structures with spherical elements, which are agglomerated following activation. When tested for the adsorption of 2-bromophenol, the activated carbon exhibited a notable adsorption capacity, reaching nearly 250 mg/g. The Langmuir and the pseudo-second-order models aligned well with the experimental data for isotherms and kinetics. Overall, this investigation underscores the potential of turning waste biomass into valuable materials for water treatment, showcasing a sustainable approach to waste management.

sciforum-090570: Bioremediation as an Agroecology Tool for the Elimination of Different Persistent Soil Pollutants

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The increasing development of urbanization and industrialization has released a plethora of different pollutants that end up being deposited in soils. Therefore, it is crucial to investigate cost-effective, feasible and environmentally friendly solutions to minimize the damage they cause. Bioremediation is a safe technique that has demonstrated satisfactory results and is easy to apply and maintain. This technique explores the degradation pathways of various biological agents (microorganisms, plants, algae, etc.) to neutralize contaminants. It is based on biodegradation and achieves the complete mineralization of organic pollutants into inorganic innocuous compounds such as carbon dioxide and water. Bioremediation, as a cleanup technology, is a widespread technique used for soils contaminated with pesticides, agrochemicals, chlorinated compounds, heavy metals, organic halogens, greenhouse gases, petroleum hydrocarbons and many others, either in situ (at the contaminated site) or ex situ (in excavated samples). Ex situ bioremediation techniques are usually more costly due to their required digging and transport from the polluted site. However, they can be used to treat a wider range of contaminants. Alternatively, in situ techniques do not have an extra cost for excavation; nonetheless, the cost of the in situ set-up of equipment, effective adhesion, and subsurface control of the contaminated site may render some in situ bioremediation methods ineffective. Some general limitations of the technique are, for example, its limitation to biodegradable compounds, its specificity and its limited scale-up. This study also addresses the economic and technical barriers to bioremediation, along with the outlook for the role of microorganisms in this process.

sciforum-090013: Biosorption Capacities of Natural Mushroom Stalk Wastes in Wastewaters Containing Toxic Nickel (II) Ions

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Today, the common problem of all countries in the world is the presence of heavy metals in water, air and soil environments. Ni(II) is a pollutant belonging to the group of primary toxic and bioaccumulative heavy metals commonly found in industrial wastewater. In addition, recycling food waste such as mushroom stalk wastes (MSWs), which are released as a result of domestic use, instead of throwing them into the garbage cycle, is of great importance for the minimization of environmental pollutants. Therefore, the main aim of the study is to determine Ni(II) biosorption capacity by applying natural MSW to wastewater. Within the scope of the study, the purification efficiency of Ni (II) was evaluated with laboratory-scale batch biosorption experiments under a different MSW dose, contact time and pH conditions. To reveal the biosorbent qualities of the MSW used in the study, its surface morphology and functional structure were determined using FT-IR and SEM. According to the experimental data, the suitability of Langmuir and Freundlich isotherms, and pseudo-second-order and pseudo-first-order kinetics, was calculated. According to the optimum adsorption factors, the maximum removal efficiency and adsorption capacity of Ni (II) for MSW were determined. Experimental results show that MSW is an economical and easily accessible biosorbent material.

sciforum-085064: Bryophytes as a Sustainable Alternative for Period Products

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Throughout history, bryophytes have been utilized in various contexts for their remarkable properties. Indigenous tribes, for example, recognized the absorbent nature of bryophytes and employed it as a diaper material to ensure cleanliness and comfort for infants. Similarly, during the Middle Ages and the First World War, bryophytes found application in toilet paper and wound dressings due to their absorbency and ability to control bleeding. In contemporary society, the environmental impact of traditional menstrual products, such as tampons, has become a growing concern. These products generate significant waste as they are designed for single use and often contain plastics and harmful chemicals. Tampons are often also flushed down the toilet with other hygiene products which are meant to be thrown away in a bin, thus causing blockages in sewers. The prevalent use of non-biodegradable single-use tampons in menstruation practices worldwide has prompted significant environmental concerns. Drawing from historical applications of bryophytes in the medical sphere, our initial experimentation aims to analyze their hygroscopic capabilities. Additionally, bryophytes exhibit a spectrum of advantageous properties, including antioxidative, antimicrobial, and anti-inflammatory properties, while retaining structural integrity during water absorption. This research aims to underscore the feasibility of bryophytes (*Sphagnum*) as viable materials for sustainable menstrual products, advocating for a reduction in the consumption of single-use menstrual items to address their adverse environmental repercussions. In addition, this research focuses on the investigation of two *Sphagnum* species as potential eco-friendly substitutes for the manufacturing of tampons and examines their mechanical and hygroscopic properties according to ISO 12571:2021. It also discusses the feasibility of using Sphagnum for menstrual products and highlights the urgent need for sustainable alternatives.

sciforum-090178: Carbon Capture and Utilization through Biofixation: A Techno-Economic Analysis for Natural Gas-Fired Power Plant

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With the increasing global concern regarding climate change and the need to reduce greenhouse gas emissions, carbon capture and utilization (CCU) technologies are seen as one of the primary steps toward large-scale decarbonization prospects. In this context, a thorough assessment of each CCU pathway is required from both techno-economic and environmental aspects. In this work, the potential of carbon biofixation through microalgae cultivation is evaluated by preliminary technical design and calculation of plant economics in the case of the Turakurgan natural gas-fired combined cycle power plant located in the eastern part of Uzbekistan. The primary data used in this study are obtained from the open access project report of the targeted power station along with recently published literature sources. According to the results, although the purchase and installation costs of photobioreactors require significant investments in the capital cost, the technology would still be cost competitive as long as there is a carbon tax imposition of around USD 50 per ton of CO_2 emissions. However, CO_2 biofixation can be relatively more suitable compared to benchmark absorption, particularly in low-CO_2-concentration conditions. Future research will involve a more comprehensive examination of CO_2-based microalgae cultivation, and its comparison with chemical absorption and membrane-assisted separation techniques.

sciforum-090272: Characterisation of Functional Biomaterials Obtained through the Immobilisation of Microorganisms by Means of the Sol–Gel Method Using Isobutyltriethoxysilane

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The use of biological agents in biotechnological processes is limited by the strict dependence of their biological activity on environmental conditions: pH, UV radiation, heavy metal salts, temperature, etc. Among the methods of protecting bioagents from negative conditions, the method of encapsulating living cells in a silicon matrix stands out. The cell is surrounded by a porous shell through which an effective exchange of substances between the cell and the environment can take place, but at the same time, the cell is not exposed to aggressive environmental factors. An important component in the sol–gel synthesis of biohybrids are alkylalkoxysilanes, which include tetraethoxysilane, dimethyldiethoxysilane and isobutyltriethoxysilane. The use of alkylalkoxysilanes allows the number of bonds formed between molecules to be varied. Isobutyltriethoxysilane is a substance in which there is a non-hydrolysable bond from an Si atom to a branched isobutyl radical. It is thought that a small amount of it will form a less rigid but stronger shell around microbial cells. In this work, we have characterised functional biomaterials obtained by immobilising microorganisms by means of the sol–gel method using isobutyltriethoxysilane. It is shown that the catalytic activity of the obtained hybrid material is not high, but the use of insignificant amounts of isobutyltriethoxysilane leads to the reliable encapsulation of microorganisms. Therefore, such a material can be used not only in environmental monitoring for the production of biofilters and biosensors, but also in the production of porous materials as carriers of substances.

sciforum-089904: Characterization of Potential Chalky Soil Bacteria Isolated from Rhizosphere of *Acacia* spp. Growing in Abardae, Maekel Region of Eritrea

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The expanding influence of disease-resistant microbes, pollution, and climate change on agriculture, the environment, and public health has increased the interest in soil microorganisms, particularly plant-growth-promoting rhizobacteria (PGPR). In today's world, discovering soil bacteria with potential for biotechnological advancements is highly significant. Therefore, the purpose of the current study was to characterize chalky soil bacteria that were isolated from the rhizosphere of *Acacia* spp. growing in the Maekel region of Eritrea. In this study, three chalky soil samples were taken from the rhizosphere of *Acacia ethibica*, *Acacia origena*, and non-rhizospheric soil. The number of culturable bacteria in the samples was found to be 1.42×10^{10}, 5.35×10^{9}, and 5.68×10^{7} cfu/g, respectively. In total, 80 bacterial strains were isolated, and 10 of them were chosen for further investigation based on their distinct morphology. The cell morphology of the strains was examined using a Nikon Eclipse Ci microscope. The results demonstrated that the aerial mycelium of strain EAE-1 exhibited a novel and previously undescribed organization of spore-bearing hyphae. The antimicrobial activity against phytopathogenic microbes was evaluated. The results revealed that EAE-1, EAE-3, EAE-14, EAE-15, EAE-40, and EAO-24 exhibited wide-ranging antimicrobial effects. Moreover, plant-growth-promoting activity was assessed using various growth parameters. Most of the strains exhibited significant effects on the growth of wheat. However, the bacterial strains EAE-40 and EAO-17 exhibited significant effects on the growth of maize. In conclusion, the current study probably found novel bacterial strains. Future research will be conducted on these strains, with a particular focus on strain EAE-1. Moreover, this study represents the first comprehensive analysis of the microbial composition of Eritrean soil.

sciforum-090559: Circularity in the Supply Chain

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The global economy is pivotal to its supply chains. The enormous waste generation, non-renewable resources, and product aftermarket converge in relation to the ecosystem and planet deterioration due to the traditional paradigm of take, make, and discard. Incorporating green actions, closed loops, and circular supply chains is critical for industrial applications because it decreases environmental load and imparts resource management from a raw material and product perspective. This study uses CE principles in the supply chain to turn it into a circular supply chain. The purpose is to discover the enablers that generate momentum gain to circular supply chains in the manufacturing organization. Several facilitators that promote circularity were identified through a literature search using the Scopus database over the past fifteen years. It was modified and concluded in consultation with case organization professionals. The framework aims to determine the cause and effect of the enablers developed through the Fuzzy DEMATEL technique. The findings emphasize the cause and effect of the 17 key enablers. One of the most important conclusions is that management is a tool for achieving sustainability through the use of enablers. This study is an important tool for scholars, practitioners, and policymakers. Few studies have implied that collaboration among stakeholders leads to a holistic approach in which consumers possess a direct influence.

sciforum-090219: Comparative Study of Titanium Dioxide and Lysozyme-Added Titanium Dioxide Nanoparticles for Enhanced Photocatalytic Degradation

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Titanium dioxide (TiO_2) and lysozyme-added titanium dioxide (L:TiO_2) nanoparticles were synthesized via a hydrothermal method and comprehensively characterized using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), UV-Vis spectroscopy, scanning electron microscopy (SEM), and transmission electron microscopy (TEM). The XRD analysis revealed the dominance of the anatase phase in L:TiO_2, while TiO_2 exhibited both anatase and rutile phases. FTIR spectroscopy identified specific chemical bonds or functional groups associated with lysozyme addition. UV-Vis spectroscopy indicated a decrease in the band gap energy from 3.2 to 2.9 eV upon the incorporation of lysozyme. The SEM/EDS analysis showed agglomerated fine particles with the presence of Ti, O, and C elements. The TEM analysis confirmed an average particle size of 12 nm for L:TiO_2 and 21 nm for TiO_2 nanoparticles, consistent with the XRD results. Furthermore, the photocatalytic activity of both TiO_2 and L:TiO_2 nanoparticles was evaluated for the degradation of methylene blue (MB) and methyl orange (MO) dye. L:TiO_2 nanoparticles exhibited superior photocatalytic performance, degrading MB dye to 97% and MO to 81% within a 90-min time interval under UV irradiation at 365 nm, compared to 90% and 76% degradation, respectively, using TiO_2 nanoparticles. Optimization studies revealed that the best degradation efficiency was achieved at a dosage of 0.1 gm. These results demonstrate the enhanced photocatalytic activity of lysozyme-added TiO_2 nanoparticles, underscoring their potential for environmental remediation and water purification applications.

sciforum-087246: Control of Wastewater Treatment Processes Using a Fuzzy Logic Approach

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The issue of pure water is currently one of the most critical concerns facing the global population. Wastewater treatment technologies are seen as one of the solutions to these water shortages. At present, despite the advancements in water treatment technology, there are still drawbacks in terms of energy consumption, the recovery ratio, and control. To solve the issues mentioned above, a proper control method for water treatment technology is also crucial. In this work, the development and implementation of a fuzzy logic approach to control industrial wastewater treatment technology using an ion-exchange resin are presented. Initially, ion-exchange resin technology was developed in the laboratory as a pilot device and tested to purify wastewater at the Kungrad Soda Plant in Uzbekistan. According to technical instructions, the hardness of purified water should not exceed 3 mEq/L, the total dissolved solids (TDSs) should not exceed 40 ppm, and the pH should remain below 7.5. Based on these data, the membership functions (MFs) of the parameters were formed, and the model of controlling the process through the fuzzy logic controller was developed. The developed fuzzy logic controller model was compared with the traditional controller (PID). The energy consumption ranged from 2 to 2.5 kJ/m^3, and the settling time was 46 s when the process was controlled by a PID controller. By implementing the developed fuzzy logic controller in the process, it is possible to decrease energy consumption by 1.8–2 kJ/m^3 and the settling time by 28 s.

sciforum-088506: Cultivating Sustainability: Extracting Curcuminoids from *Curcuma longa* Using a Green Approach

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Industries worldwide have a significant influence on the environment, affecting it through the consumption of resources and the generation of waste. The linear model, characterized by a take–make–dispose approach, has led to widespread waste accumulation. Data from The World Counts indicate that humanity requires 1.82 planets to effectively manage CO_2, waste, and resources effectively. This figure is projected to rise to two planets by 2030 if current trends persist. Addressing this pressing environmental challenge requires the adoption of nature-aligned technologies and processes. Given these circumstances, and with the ongoing evolution of technology and expansion of industries, transitioning from a linear to a circular economy emerges as a pivotal and crucial step. Industries can reinforce global circularity initiatives by adhering to green chemistry principles, which include the use of safer chemicals, recovery of by-products, and implementation of waste separation and recycling practices. Notably, a significant portion of operational costs, up to 80%, is attributed to downstream processes. Bearing this in mind, the present study focuses on a sustainable methodology for the extraction and purification of curcuminoids from *Curcuma longa*, employing aqueous micellar solutions. By integrating solid–liquid (SLE) and liquid–liquid extractions (LLE), this approach streamlines conventional procedures while utilizing environmentally friendly solvents. The SLE solvent is comprised of a buffer and a biodegradable surfactant, capable of forming an aqueous micellar two-phase system (AMTPS), a specific type of LLE. The successful optimization of both SLE and LLE parameters yielded curcuminoid recovery and selectivity exceeding 95% each. This optimized methodology demonstrates promising outcomes in curcuminoid isolation from *Curcuma longa*. Furthermore, an optimized HPLC method enhances the separation of individual curcuminoids.

sciforum-090153: Current Status of Enhanced Oil Recovery Projects Using Carbon Dioxide in Croatia

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The application of carbon dioxide (CO_2) in enhanced oil recovery (EOR) projects for partially depleted oil reservoirs is becoming increasingly more of interest in the petroleum industry because it can boost oil production rates while potentially reducing greenhouse gas emissions. This EOR technique uses a water-alternating-gas (WAG) process to displace and mobilize crude oil more efficiently than primary or secondary techniques. The injected CO_2 reduces the viscosity and density of crude oil, making it easier to flow from the reservoir rock fractures to the production wells. This article studies the performance of the first EOR-CO_2 project in Croatia, which started inoperation in 2014. The CO_2 is supplied via a DN500 88 km pipeline from a natural gas sweetening unit using an amine solution. The CO_2 that was previously discharged into the atmosphere is now compressed, liquefied, and pumped into the EOR fields of Ivanić and Žutica. These two oil reservoirs were discovered in 1963, and the primary recovery stage lasted until the mid-1970s, after which secondary recovery operations continued via water injection. The oil recovery factors after the primary and secondary stages were 9% and 38% in the Ivanić field, and 9% and 32% in the Žutica field. The tertiary (EOR) stage is expected to continue until 2040 and will increase the oil recovery factors to around 55%. Over the course of the project's lifetime of 25 years, the Ivanić and Žutica oil fields will produce an additional 3.4 million tonnes of oil and 600 million standard cubic meters of natural gas. Simultaneously, a total of 5000 million standard cubic meters of CO_2 in supercritical condition will be injected and stored into the reservoirs.

sciforum-088212: Custom-Made Sorbent-Based Sensors for Subsurface Microseepage of Volatile Organic Markers of Oil and Gas Fields

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The geochemical exploration of oil and gas fields offers a cost-efficient approach to reservoir prospecting through the remote and subsurface detection of volatile organic compounds (VOCs), which are markers of underlying fossil fuel deposits. Hydrocarbon indicators can manifest as surface seeps of visible oil and gas (macroseeps) or as traces detectable by sophisticated analytical methods (microseeps). An effective geochemical exploration method involves absorbing hydrocarbon molecules using specially developed materials buried up to a few meters deep, followed by gas chromatography/mass spectrometry (GC-MS) analysis of the accumulated VOCs. Given the variety of absorbents available, it is essential to identify the most effective material.

We developed a method to compare and test adsorbents for their affinity to mixed hydrocarbons and N,O,S-derivatives, evaluating them using natural oil samples in a laboratory microseepage setup. This approach enabled us to screen a library of commercial and custom-made sorbents to identify the best materials for absorbing oil markers. The adsorbate often consists of a complex mixture of components, making chemical analysis challenging. To address the difficulties of separating and identifying complex mixtures, we proposed using two-dimensional HR-GCxGC-TOF-MS. This technique involves first separating mixed analytes on a long polar column followed by a short non-polar one with consequent high-resolution TOF-MS analysis of resulted probes.

Thus, a variety of adsorbent types were screened for their affinity towards the accumulation of potential hydrocarbon markers. The most efficient sorbents were identified based on the maximum number and diversity of analytes detected through thermal desorption/HR-GCxGC-MS and Brunauer/Emmett/Teller (BET) surface area analysis. Two top-performing custom-made sorbents, composed of carbon nanomaterials, showed significantly higher adsorption capacity compared to a commercial reference sorbent, when exposed to model hydrocarbon mixtures, and were selected for further development.

sciforum-090690: Deep Learning System for e-Waste Management

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The deep learning system for e-waste management presented in this proposal is a transformative solution designed to address the escalating challenges of garbage collection and management in urban environments. Rapid urbanization has resulted in increased waste generation, necessitating a more intelligent and efficient approach to e-waste collection and disposal. This system integrates cutting-edge technologies, primarily Artificial Intelligence (AI), to improve e-waste management processes, enhance resource utilization, and contribute to the creation of cleaner and more sustainable urban spaces. Urban areas are experiencing unprecedented growth, leading to a surge in the volume of waste generated daily; as such, traditional waste management systems struggle to cope with this influx, resulting in environmental pollution, compromised public health, and inefficient resource utilization. The proposed deep learning system for e-waste management seeks to revolutionize existing practices by leveraging the capabilities of AI. The aim of this research is to develop a sequential deep neural network using a Keras and TensorFlow image analysis: a deep learning convolutional neural network (CNN) for e-waste management. The Python programming tool will be used to develop the deep learning model as well as a GUI that will facilitate human–computer interactions. The system will be tested and the result evaluated to assess the functionality and adequacy of the system.

sciforum-088101: Degradation of Crude Oil by Microbial Populations of Lagos Lagoon Water Microcosms

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Petroleum hydrocarbon pollution (PHP) poses a significant environmental threat and affects both marine and terrestrial ecosystems. This study focused on the isolation and screening of indigenous petroleum-degrading microorganisms from Mile 2 Lagoon, Lagos, Nigeria. This study aimed to investigate the biodegradability of crude oil and analyse the petroleum–hydrocarbon degradation characteristics of microbial consortia on a laboratory scale. Physicochemical analysis of the lagoon water revealed a neutral pH and high nitrate and phosphate concentrations, indicating minimal prior oil pollution. A continuous enrichment method was employed to cultivate microorganisms, using Ecravos light crude oil as the sole carbon and energy source. The enumeration of total heterotrophic microorganisms and hydrocarbon-utilising microorganisms, along with microbial characterisation, was conducted. This study identified three hydrocarbon-utilising bacteria (THUB-1-3) and two fungal strains (THUF-1-2), and demonstrated their ability to degrade crude oil. The growth profile of these isolates showed exponential growth, with the bacterial consortium achieving a maximum concentration of 9.9×10^6 cfu/mL on day 28. Petroleum degradation kinetics showed that the microbial consortium degraded 93% of the crude oil over 42 days, with variations observed in different hydrocarbon fractions. This study provides valuable insights into the potential of indigenous microbial strains to mitigate the ecological impact of oil spills on aquatic environments.

sciforum-090261: Deletion of the PHO91 Gene Leads to Impaired Ability to Consume Methanol in Cells of the Methylotrophic Yeast *Ogataea parapolymorpha*

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The PHO91 and PHO87 are parts of yeast's phosphate metabolism system. We investigated the influence of PHO91 deletion on the methanol utilization as a sole carbon source in *Ogataea parapolymorpha* through comparison of wet biomass, protein content, methanol oxidase (MOX) activity and acid-soluble and acid-insoluble inorganic polyphosphate (polyP) content, while growing on methanol and without any carbon source other than trace amounts from the yeast extract. The Δ*pho91* strain has a lack of wet biomass, protein content and MOX activity while grown on methanol (as a Δ*MOX* strain) and has the same numbers as a WT strain in media without methanol. We found two ways of recovering methanol utilizing capabilities for Δ*pho91* mutant—either adding MOX on plasmid under constitutive promoter control, or adding a Δ*pho87* mutation. Both Δ*pho91* + MOX and Δ*pho91*Δ*pho87* strains showed all the parameters as a WT strain on methanol as a sole carbon source and without methanol addition. Further, we compare the polyP content of the strains in methanol media, media without a sole carbon source and media with glucose. All of the WT, Δ*pho91* + MOX and Δ*pho91*Δ*pho87* strains, capable of utilizing methanol, have the P_i, acid-soluble and acid-insoluble polyP at the same levels with some variations. The Δ*MOX* and Δ*pho91* strains, despite both not being able to utilize methanol, showed very different levels of P_i and polyP's, which can be interpreted as different mechanisms of the inner cell, leading to a loss of capability utilizing methanol in both of these strains.

sciforum-087063: Determination of Heavy Metals in Fish–Fish Feed and Their Possible Human Health Risk in Khulna District, Bangladesh

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Due to the scarcity of natural sources of fish feed in Bangladesh, especially in the Khulna district, tannery and poultry byproducts are predominantly used as a cheap fish feed source in fish culture. The chemical composition of these byproducts may theoretically increase the accumulation of toxic contaminants such as lead, cadmium, and chromium in cultured fish, posing a potential risk to food safety. This study focuses on measuring heavy metal concentration in fish feed and fish to evaluate its possible health risks. Three heavy metals (Cr, Pb, Cd) were determined in nine fish feeds and three fish species (*Labeo rohita, Oreochromis mossambicus, and Pangasius pangasius*) that were collected from three local markets (Phultala, Daulatpur, and Rupsa) of Khulna, Bangladesh. Heavy metals were determined by acid digestion followed by graphite furnace atomic absorption spectrophotometry (GF-AAS). The concentration of Cr in fish is above the acceptable limit and the concentration of Pb, except in *Labeo rohita* of Daulatpur, is above the acceptable limit (1 mg/kg) according to WHO. The Cd concentration in fish feed was found in the range of 1.120 ± 0.006 to 3.520 ± 0.005 mg/kg, which exceeded the EU maximum permissible limit. The Target Hazard Quotient (THQ) value of *Pangasius pangasius* in Phultala is greater than 1, which indicates a significant health threat through long-term consumption. However, in most of the cases, the estimated daily intake (EDI) value for Cd is beyond the recommended value of 0.06, indicating a potential health risk. The Carcinogenic Risk (CR) values for Pb and Cr exceeded the unacceptable limit (10^{-4}), raising concerns about the potential cancer risk associated with the intake of Pb and Cr through the consumption of fish species. This study suggests implementing continuous monitoring of fish-feed-producing companies and local markets through an Environmental Management Framework (EMF) established by the government.

sciforum-090206: Development and Evaluation of a CO_2 Capture System Using Hollow Fiber Membranes for Industrial Emissions Applications

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Membrane technology has emerged as a selective and efficient option for carbon dioxide (CO_2) capture. However, challenges arise in processing high industrial flows with the same effectiveness as mature technologies. Therefore, studying the process efficiency under real conditions is essential. Membranes of a polymeric nature are promising candidates for implementation on industrial scales.

In this context, this study aims to assess a CO_2 capture system using synthetic and real gases from the textile and cement industry on an experimental scale using a polysulfone hollow fiber membrane contactor, with the goal of developing a pilot-scale system. The experiments were conducted by varying parameters such as the pressure, CO_2 concentration and flowrate. As a result, higher permeate flux values were obtained at the maximum experimental concentration of 12% CO_2 in the feed stream, with a value of 472.54 $cm^3\ cm^{-2}\ s^{-1}$. Additionally, a CO_2 permeance value of 90.98 GPU was achieved along with a CO_2/N_2 selectivity of 11.37; these values closely approach the Robeson upper bound.

Measurements conducted with gases from the textile industry with a CO_2 concentration of 0.5% reaffirmed the results obtained with synthetic gases of a low permeate flux. In contrast, measurements with gases from the cement plant showed promising results. Also, it was demonstrated that oxygen has a significant impact on the separation efficiency, as it competes with CO_2 for transport sites in the membrane, reaching concentrations of up to 40% compared to the 0.5% CO_2 concentrated in the permeate for textile gases.

In conclusion, tests conducted with gases at higher CO_2 concentrations, such as those from the cement industry, reaffirm the technical feasibility of CO_2 capture using commercial membranes. However, further research is recommended to explore alternative configurations and materials to improve the process purity and efficiency.

sciforum-089721: Development of a Wastewater Treatment Process Control System Based on Quantum Algorithms

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At present, the scarcity of fresh water is one of the biggest global problems. One of the solutions to the shortage of fresh water is the treatment of salt water and the recycling of used water. Although there are several advanced water treatment methods available, there are still certain deficiencies. The primary objective of effluent remediation on a global scale is to decrease energy consumption and resource depletion. Improving wastewater treatment technologies, reducing energy consumption, and increasing water purity also depend on the proper control of the process. One of the urgent issues is the creation of effective models of the synthesis of the control system, taking into account the complexity of the technological process and the non-linearity and uncertainty of data. This article discusses a control system referred to for developing intelligent control systems via quantum nondeterministic inference. This design strategy allows for the handling of unexpected situations when information about the structure of the object is incomplete. A new method has been created to use quantum algorithms to solve optimization and combinatorial logic problems (hybrid and parallel) in artificial intelligence. This method shows how well and efficiently the control process is working. A quantum system has been designed to regulate the wastewater treatment process under unknown external effects by utilizing quantum algorithms that can analyse vast amounts of data quickly and make rapid judgements. The implementation of this system made it possible to reduce the energy consumption of wastewater treatment by 1.5%.

sciforum-089957: Direct Comparison of Powdered Activated Carbon (PAC) and Natural Powder in Urban Waste Water Treatment

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Today's environmental issues related to wastewater are being tackled by growing public concern and tighter international regulation. Pollutant removal from wastewater is still a very challenging task. The removal of heavy metals from industrial and agricultural wastewater is a complex environmental issue due to its potential health hazards. There are different methods used for wastewater treatment. However, these technologies are either frequently ineffective or generate secondary metabolites. Adsorption, a physicochemical method, has proven effective in eliminating low-concentration inorganic pollutants. Powdered activated carbon and natural powders have emerged as potential solutions in urban wastewater treatment. This study provides an overview of their applications and effectiveness in removing contaminants from wastewater, thereby improving the overall treatment efficiency and water quality. For this purpose, experiments have been performed using three types of powders: *Saccharum officinarum* powder and its powdered activated carbon as an adsorbent, and Luffa aegyptiaca *Luffa aegyptiaca* powder. This study focused on the adsorption treatment of natural powders influenced by different parameters (pH, infrared spectroscopy, contact time, concentration, mass and particle size) during laboratory experiments. By maintaining a few parameters and using natural powders without carbonization or prior activation, this study demonstrated that powdered activated carbon remains more effective and shows better results than natural powders.

sciforum-088952: Direct Use of Agricultural Bio-Waste in Water Treatment

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The existence and maintenance of life are associated with the use of water. Water is used by all beings every day to meet their metabolic needs, as well as in various agricultural and industrial activities. Globally, there is growing concern about the low water quality that is available to consumers. In underdeveloped or developing countries, the lack of adequate treatments means that water of dubious quality is available to consumers [1]. This work presents some preliminary results on the direct use of untreated biomasses from agricultural activities as adsorbents for water treatment. The efficacy of agricultural wastes, such as stubble, sawdust from teak (*Tectona grandis*), fibres from Imbondeiro (*Adansonia digitata L.*), bamboo flowers, and other regional plants was tested using Methylene Blue (MB) removal from the aqueous phase. Adsorption studies were conducted in a batch system and the influence of solution pH, MB initial concentration, adsorbent granulometry, contact time and temperature was evaluated. The adsorption performance of the natural adsorbents was significantly high, and Imbondeiro presented a maximum removal capacity of 188.3 mg of MB per gram [2]. This amount is higher than published values obtained on diverse activated carbons considered excellent adsorbents for this purpose. Imbondeiro exists in rural areas of some poor countries. The possibility of using these natural adsorbents in the treatment of water before it is consumed is of particular importance. This study was finished by constructing filters containing natural adsorbents. The maximum amounts of MB removed on a continuous flux were lower than those obtained on a batch system. However, these quantities were in line with other results that have been published and were obtained in batch mode from a variety of untreated biomasses.

Reference

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sciforum-088217: Ecological Strategies of Decorative Invasive Tree and Shrub Plant Species in the City's Green Infrastructure

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The EU Green Infrastructure Strategy aims to help stop biodiversity loss and enable ecosystems to deliver their services to people. Natural and semi-natural areas of Chernihiv (Ukraine) represents the green infrastructure of an average-sized Eastern European city in the continental biogeographical region. In total, 93 decorative species and forms of tree and shrub plants are used for the city landscaping, and 18 of them are invasive. As such, there is a need to develop sustainable approaches to control the spread of alien plants. For this purpose, the invasive plant species' ecological strategies were investigated.

According to the classification of J.P. Grime (1988, 2006), the decorative cultivated plants of invasive species belong to three categories: competitors (C-strategists: *Robinia pseudoacacia*), stress tolerators (S-strategists: *Acer saccharinum*, *Caragana arborescens*, *Cotinus coggygria*, *Gleditsia triacanthos*, *Fraxinus pennsylvanica*, *Juglans mandshurica*, *Physocarpus opulifolius*, *Ptelea trifoliate*, *Quercus rubra*, *Rhus typhina*, *Sorbaria sorbifolia*) and ruderal plants (R-strategists: *Acer negundo*, *Amorpha fruticosa*, *Prunus virginiana*, *Prunus serotina*, *Robinia viscosa*, *Ulmus pumila*).

Robinia pseudoacacia causes the greatest danger to the phytodiversity of green infrastructure. Black locust–pine and black locust–birch phytocenoses are formed as a result of black locust's invasion in anthropogenically disturbed forests. They differ in structure and species composition. S-strategists do not pose a threat to the city's green infrastructure biodiversity. They play an important role in preventing erosion processes in sloping areas. R-strategists are pioneer species in anthropogenic areas (e.g., wastelands, roadsides and railroad tracks) and recreationally disturbed forest and grassland ecosystems. They are characterized by rapid growth, high generative and vegetative productivity, and the ability to spread over long distances.

Our research confirmed the results of previous studies that demonstrated that significant tolerance to the environmental gradients (temperature, soil moisture and salinity, light availability, resistance to pests), high reproductive ability, growth rate and native latitudinal range determine the ecological strategy of invasive plants.

sciforum-089071: Effect of a Beer Bagasse Dehydration Process on the Recovery of Ferulic Acid and Other Phenolic Compounds as an Alternative to Agroindustrial Waste Revalorization

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Beer is one of the oldest drinks consumed by humans. In 2023, a global production of 211.56 billion liters of this beverage was estimated. Beer production generates various wastes, bagasse being the most significant—equivalent to 31% of the raw material. The main waste is spent barley grains, which are used as animal feed ora soil improver or disposed of in landfills. An alternative for its revaluation is the recovery of compounds with biological activity from bagasse, such as ferulic acid; however, this type of compound can be thermolabile, and processes such as dehydration can affect the amount of bioactive compounds. Given the above, this work aims to compare the recovery of total phenolic compounds (TPCs), especially ferulic acid (FA), after applying different dehydration conditions on Stout-type and Session IPA-type brewing bagasse. TPCs and FA were determined via olin–Ciocalteu and HPLC methods, respectively. Drying by freeze-drying and by a convective process was evaluated. The results show that after increasing the temperature from 60 °C to 80 °C in the convective process, there are no significant differences in the presence of TPCs or AF for the Stout matter, with average values of 967 and 108 mg/100 g, respectively. In the case of the Session IPA bagasse, a decrease in the presence of AF is observed with increasing temperature. On the other hand, when comparing the results with the freeze-drying process, the latter produces raw materials with a lower amount of TPCs, but with higher levels of AF, with values of up to 210 mg/100 g of raw material. The results presented allow us to conclude that the recovery of FA from brewing bagasse is feasible, and that the process variables have an important effect on its recovery.

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sciforum-086238: Eggshell Waste Valorization into $CaO/CaCO_3$ Solid Base Catalysts

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One of the main challenges of a circular economy is the reuse of waste into value-added products. In this context, the large amounts of food waste generated globally have become a great renewable resource for recycling and transformation, increasing the sustainability of the supply chain. In particular, 7.2 million tons of hen eggshell waste are produced annually, which is converted into a source of environmental pollution. However, eggshell is a biodegradable residue composed of more than 90% $CaCO_3$ and thus can be exploited as a catalyst, adsorbent, composite, and functional material, among other uses. The aim of the present work is the valorization of eggshell waste to obtain $CaO/CaCO_3$ materials with applications as heterogeneous catalysts.

Domestic hen eggshells were first washed with tap water to eliminate impurities, and then the inner membrane was manually removed. Afterward, the eggshells were dried in an oven at 80 °C for 24 h under air. The dried eggshells were calcined in a muffle at different temperatures, times, and heating speeds to achieve diverse compositions. The crystalline structures achieved were characterized by X-ray diffraction (XRD), while their textural properties were obtained through N_2 adsorption–desorption (the BET method). Thermogravimetric analyses (TGA) were used to study the thermal stability of the obtained samples. The physicochemical changes and properties observed were correlated with the treatments applied, evidencing the transformation from $CaCO_3$ to CaO. Considering these preliminary results, the prepared solids could be useful as base catalysts in different heterogeneous reactions.

sciforum-089977: Empirical Modeling of the Carbonylation of Acetylene for the Synthesis of Succinic Anhydride Using Gas Ratio (CO/C_2H_2)

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Succinic anhydride, a crucial chemical intermediate, finds widespread applications in pharmaceuticals, polymers, and agrochemicals. The carbonylation of acetylene presents a promising route for succinic anhydride synthesis, offering environmental advantages and process efficiency. This study focuses on the empirical modeling of the carbonylation process to optimize the gas ratio of carbon monoxide (CO) to acetylene (C_2H_2), a critical parameter influencing product yield. Regression Analysis was applied to experimental data to develop a predictive model that can be used to predict the yield of succinic anhydride based on the ratio of carbon monoxide (CO) to acetylene (C_2H_2). The linearity connection between the analytical variables was determined by plotting the ($CO:C_2H_2$) ratio (independent variable) and the yield of the process (dependent variable) against each other. However, the plot's curvilinear form suggested polynomial regression, showing that the connection was not linear. The R^2 values were 0.9219, 0.9563, and 0.9874 for the data in quadratic, cubic, and quartic models. These findings with statistical tests showed that the quartic model is the best empirical model for explaining the observed data variance (by a margin of 98.74%). The verification of experimental data to validate model acceptability showed an error of less than 0.05. Thus, using this model and changing the ratio of ($CO:C_2H_2$) from 1.1 to 4.0, the yield of succinic anhydride increased. The insights of this study would contribute to the advancement of sustainable and efficient chemical processes with potential applications in various industries.

sciforum-088206: Employing Mechanochemistry in the Synthesis of N-Ibuprofen-Substituted 1,2,3,4-Tetrahydroisoquinolines

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Mechanochemistry has emerged as a potential alternative for organic transformations, leveraging substrate availability, stability, and reduced solvent use. Its high efficiency and eco-friendly profile have garnered significant attention, particularly in the pharmaceutical industry, where it is hailed as the most promising environmentally friendly method for organic synthesis. This approach harnesses mechanical energy to stimulate or accelerate chemical changes, offering a green and effective means to obtain organic molecules.

We employed an innovative green and eco-friendly approach—mechanochemical, solvent-free, and heterogeneously catalyzed—to synthesize a series of new biofunctional hybrid molecules, specifically derivatives of biologically active 1,2,3,4-tetrahydroisoquinoline alkaloids. Our method involves a mechanochemically driven intramolecular alpha-amidoalkylation reaction. To facilitate this reaction under acidic conditions, we successfully utilized polyphosphoric acid on silica as a heterogeneous catalyst. This approach enables the rapid and straightforward synthesis of novel compounds without the generation of byproducts or waste. All newly obtained bio-functional hybrid compounds were fully characterized via ^{1}H, ^{13}C NMR, UV, and mass spectral data.

In our quest for environmentally sustainable synthesis methods, we made a significant breakthrough by synthesizing a series of innovative N-ibuprofen-substituted 1,2,3,4-tetrahydroisoquinolines through solvent-free mechanosynthesis. These novel derivatives offer exciting prospects for studying their biological properties and investigating correlations between structure and activity.

sciforum-084909: Energetic Echoes: A Commencement into Exploring Building Materials and Their Embodied Energy in Old Downtown Amman with a Focus on Process System Engineering and Electronic Elements

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This research focuses on exploring the relationship between sustainable architecture and urban heritage, delving into the vitality of Amman's old downtown. With a firm focus on the intersection of process systems engineering and electronic components, our study amplifies the potential energy within the construction materials of ancient buildings. As the world grapples with environmental challenges, understanding the energy embodied in building materials is emerging as a pivotal step towards environmentally conscious design. We carefully examine the life cycle of materials, considering both operational and embodied energy. Recognizing the profound impact of material choice on a building's energy profile, our research calls for a measured approach before making design decisions.

The contextual background of Amman's old city center provides a unique setting, offering insight into the challenges and opportunities inherent in the preservation of ancient buildings. Through a hybrid output–input approach, we measure the embodied energy of old downtown's most prevalent building materials by using arithmetic matrices, ensuring a comprehensive understanding of their environmental footprint.

Our findings underscore the critical role of embodied energy in shaping buildings' overall consumption and environmental impact. The methodological rigor of our approach, leveraging energy flow diagrams to map the complex journey from raw material to construction site, establishes a reliable framework for proactive decision-making in sustainable design. In conclusion, this research calls for a paradigm shift in material selection and urges the implementation of a comprehensive code tailored to Jordan's unique energy scene.

sciforum-089760: Enhanced Photocatalytic Properties of a Novel Ag/TiO_2/Graphite Nanocomposite

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The present study investigates an innovative nanocomposite comprising Ag-doped TiO_2 supported on graphite sheets with enhanced photocatalytic properties when subjected to UV-A radiation. Ag-doped TiO_2 nanoparticles were produced via a cost-effective sol–gel method, employing polyethylene glycol 400 (PEG 400) as a reducing agent. A ratio of 1% Ag:Ti was selected. Meanwhile, graphite nano-sheets were fabricated in the laboratory through the chemical treatment of graphite flakes. The synthesis of the Ag/TiO_2/graphite nanocomposite involved a combination of the sol–gel method and microwave treatment. The photocatalytic properties of the nanocomposite were assessed using Rhodamine B (Rh B), revealing a photodegradation efficiency of 80% for Rh B within only a 30-min period. These hybrid structures underwent comprehensive characterization through various techniques, including Scanning Electron Microscopy (SEM), Fourier-Transform Infrared Spectroscopy (FTIR), Scanning Transmission Electron Microscopy (STEM), and X-ray Diffraction (XRD). The FTIR and XRD pattern displayed the presence of a highly pure anatase Titanium Dioxide. SEM analysis was conducted to examine the particle size and the morphology of the Ag/TiO_2/graphite nanocomposite. STEM images confirmed the presence of graphite layers and well-dispersed Ag/TiO_2 within the graphite nano-sheets. This study presents an economical and promising methodology for the development of a novel TiO_2-based photocatalyst with significant potential for application as an antiviral coating.

sciforum-090269: Enhancing Trench Stability: A Geogrid Reinforcement Approach

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This paper investigates trench stabilization using geogrid reinforcement, employing static analysis via the finite element numerical method through PLAXIS 2D. Focusing on the challenges associated with soil instability in construction projects, particularly earthen roofs and rocky formations, this study emphasizes the potential for structural compromise and fragmentation due to erosion and weathering. Geogrid polymer networks, strategically integrated with soil and stone, emerge as a preventive measure against such disasters. Notable advancements in geogrid-related research are surveyed, establishing the context for this study. The methodology encompasses a simulated trench environment, systematically reinforced with a geogrid in 10 layers, within an 8 × 35-m earthen area. The properties of soil materials and geogrid specifications are detailed, while standard boundary conditions emulate real-world scenarios. Fine meshing ensures result accuracy, and trench width reduction analysis reveals a crucial correlation between diminished dimensions, augmented displacement, and a decreased safety factor. The results highlight a heightened instability within the trench as it undergoes dimensional changes. The decrease in trench length directly correlates with a reduction in the safety factor, underscoring the risk of compromised structural integrity. Reducing the length of the trench from 15 m to 14 m is associated with an approximate 1% increase in displacement, concurrently accompanied by a 9% decrease in volume. This insight emphasizes the need for meticulous trench dimension considerations in construction practices. The findings contribute to the geotechnical engineering field, prompting a re-evaluation of design methodologies and offering empirical evidence for the development of robust guidelines in trenching projects.

sciforum-084806: Enhancing Water Purification Processes through Green Nanotechnology: A Sustainable Approach

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This abstract explores the application of green nanotechnology to improving water purification processes. With global concerns over water scarcity and pollution, sustainable methods that minimize environmental impact are imperative. This study aims to investigate the efficacy of utilizing green nanomaterials in water purification to address these pressing challenges.

The research employed a combination of experimental studies and theoretical frameworks to assess the effectiveness of green nanotechnology in water treatment. Synthesis of green nanomaterials derived from natural sources was achieved using a sol-gel method, with characterization conducted via techniques such as X-ray diffraction (XRD), scanning electron microscopy (SEM), and Fourier-transform infrared spectroscopy (FTIR).

These synthesized nanomaterials were then incorporated into filtration systems using techniques such as electrospinning or layer-by-layer assembly. Various characterization techniques, including dynamic light scattering (DLS) and zeta potential measurements, were employed to analyze the physicochemical properties of the developed materials.

Water quality analyses were conducted using standard methods such as turbidity measurements, chemical oxygen demand (COD) tests, and microbial enumeration techniques. Filtration efficiency was assessed by monitoring the removal of contaminants, pathogens, and heavy metals from water sources through techniques like atomic absorption spectroscopy (AAS) and polymerase chain reaction (PCR).

This study revealed promising results, showcasing the enhanced filtration capabilities of green nanomaterials. Significant improvements were observed in the removal efficiency of contaminants, pathogens, and heavy metals from water sources. Furthermore, the utilization of green nanotechnology exhibited reduced energy consumption and minimized waste generation compared to conventional methods.

The findings highlight the potential of green nanotechnology as a sustainable solution for water purification. Integrating these eco-friendly materials into filtration systems presents a viable approach to mitigating water pollution while ensuring resource efficiency. This study emphasizes the importance of further research and implementation of green nanotechnology in advancing environmentally friendly water treatment processes for a more sustainable future.

sciforum-084538: Environmental Friendly and Cost Effective Treatment of Textile Processing Wastewater: Employing Calcium Hypochlorite Oxidation Coupled with Sand Filtration Using Recycled Blast Furnace Iron Slag to Reuse Treated Effluent in Wet Processing

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The textile industry is a cornerstone of Bangladesh's economy, contributing significantly to its foreign exchange earnings and providing employment to over four million, predominantly female workers. However, the unplanned concentration of textile industries has led to adverse environmental impacts, particularly through the unregulated discharge of untreated wastewater. Compliance challenges arise due to the high costs linked to treating this wastewater using expensive imported chemicals and energy-intensive systems. To address this, a pilot project was launched at an operational textile wastewater treatment plant to develop a sustainable solution. This initiative focused on refining the effluent through a tertiary treatment process to meet discharge standards while producing reusable water for textile manufacturing. The method involved chemically treating the wastewater with calcium hypochlorite, followed by rapid sand filtration aided by waste blast furnace iron slag. This tertiary treatment achieved complete color removal and impressive reductions of 92% for Chemical Oxygen Demand, 82% for Total Dissolved Solids, and 85% for Total Suspended Solids. Denim fabrics dyed with the recycled water showed comparable results in color fastness to wash and rubbing. This innovative approach, utilizing local resources and technology within the regional supply chain, holds promise as a sustainable wastewater treatment option for textile industries facing resource constraints. This strategy is aligned with sustainable development goals, embracing principles of the circular economy.

sciforum-088293: Evaluating and Mitigating Risks to Crop Production under Extreme Weather Conditions: A Case Study in Rural Kashkadarya, Uzbekistan

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This work evaluates the impact of climate-induced damage to wheat production in Kashkadarya (Uzbekistan), was conducted in April and June of 2023, and examines the effectiveness of various management strategies to mitigate these risks. Based on a survey of 120 wheat growers, this study applies parametric and non-parametric econometric techniques to assess the production risks associated with extreme weather events and the role of innovative management strategies in reducing crop damage. The findings highlight the significant adverse effects of severe weather events, such as thunderstorms, windstorms, and hailstorms, on wheat yield, and demonstrate that the adoption of strategies like those for watercourse availability, shelterbelt plantation, and adjustments to irrigation schedules can significantly reduce wheat losses. This study underscores the importance of financial and technical support for farmers to adopt such strategies and suggests further research to explore effective adaptation measures to protect crops from weather shocks. By integrating empirical data with sophisticated econometric models, this study offers a comprehensive view on the adaptation processes necessary for sustaining agricultural productivity in the face of climatic uncertainties. In addition, this work serves as a call to action for policymakers, researchers, and practitioners to prioritize climate-smart agriculture practices to safeguard food security in rural Kashkadarya, Uzbekistan, and similar agro-ecological zones.

sciforum-087564: Evaluation of Natural Radioactivity in a Cultivated Area: El Jadida, Morocco

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Radioactive elements are present everywhere in the environment. Detectable amounts are naturally found in soil, rocks, water, air, and vegetation and can be ingested if they enter the food chain or are inhaled. The primordial radionuclides ^{238}U, ^{232}Th, and ^{40}K are the main sources of external radiation exposure for the general public. Exposure to high levels of radiation over long periods can lead to health problems such as cancer. The uptake of natural radioactive elements by plants grown in contaminated soil can play a substantial role in exposing the population to radiation. Therefore, this study assesses the annual effective dose of naturally occurring radionuclides and ^{137}Cs in soil samples collected from agricultural areas in the El-Jadida region, Morocco. Radionuclide concentrations in soil samples were measured using a High-Purity Germanium (HPGe) gamma spectrometer system. The annual effective dose rates of El-Jadida agricultural area soil samples were estimated and compared to internationally recommended values. The results revealed significant variations in specific activities among different sampling points. Recorded concentrations for ^{226}Ra, ^{210}Pb, ^{137}Cs, ^{232}Th, ^{234}Th, ^{235}U, and ^{40}K ranged from 20.35 ± 1.1 to 78.95 ± 4.05 Bq·kg^{-1}, 49.7 ± 4.4 to 269.0 ± 15.7 Bq·kg^{-1}, 1.0 ± 0.1 to 6.5 ± 0.4 Bq·kg^{-1}, 6.0 ± 0.8 to 19.6 ± 1.6 Bq·kg^{-1}, 25.8 ± 3.9 to 184.5 ± 11.9 Bq·kg^{-1}, 1.2 ± 0.2 to 8.5 ± 0.5 Bq·kg^{-1}, and 94.1 ± 6.5 to 286.1 ± 15.3 Bq·kg^{-1}. This study provides essential baseline data for evaluating hazard indices related to natural radiation in the examined region, offering insights into potential environmental and health risks associated with radionuclide concentrations in agricultural soils.

sciforum-089862: Evaluation of the Properties and Degradative Potential of Soil Isolates

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Microorganisms from various taxonomic groups play a crucial role in environmental cleanup, specifically in the bioremediaton of contaminated soils and aquatic ecosystems by decomposing toxic pollutants or transforming them into less toxic substrates that can be easily recycled. The purpose of this study was to characterize soil isolates for their potential application in biotechnologies for environmental remediation. Bacteria that can degrade phenol, petroleum hydrocarbons, pesticides, toluene, isoprene, and organochlorine compounds were isolated from both polluted and unpolluted soils using the enrichment cultivation method. Over 150 cultures were examined for their capability to utilize these substances as the only source of growth in a mineral medium, with phenol concentrations in the medium varying from 0.1 g/L to 3.0 g/L, oil at 1–2%, pinoxaden and toluene up to 0.5%, and carbon tetrachloride up to 10%. It was found that the isolated bacteria belonged to the genera *Rhodococcus*, *Pseudomonas*, *Peribacillus*, *Microbacterium*, and *Bacillus*. Some isolates were found to be able to thrive at temperatures ranging from +3 to +55 °C, at pH levels between 5 and 11, and in salinity levels of up to 14%. On average, the concentration of petroleum products decreased by 29% and 46% under these circumstances. *Rhodococcus* and *Pseudomonas* isolates are known for their ability to promote growth in plants like rye and wheat. Isolates from the genera *Peribacillus* and *Bacillus* have also been identified as antagonists of pathogenic microorganisms. Therefore, the research conducted successfully identified potent strains that can efficiently eliminate various pollutants. Additionally, the study also involved analyzing their characteristics and exploring the potential strains for producing biological products for agriculture and bioremediation.

sciforum-085471: Evaluation of Water Quality Influence on Water Discharge of Nuclear Power Plant (Non-Radiation Impact Factor)

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The main function of the nuclear power plant (NPP) cooling circuit system (CCS) is to remove heat from the power plant equipment. The purpose of this study is to analyze the quality of the make-up, cooling, and return water of the NPP CCS and the surface water of the water body into which the plant discharges water. This study was conducted for the Rivne NPP CCS and the Styr River (Ukraine). Physical and chemical parameters of the water such as temperature, total dissolved solids, total alkalinity, total hardness, Cl^-, $SO_4{}^{2-}$, TSS, dissolved oxygen, chemical oxygen demand, biological oxygen demand over 5 days, $NO_3{}^-$, Na^+, K^+, ammonia nitrogen, $NO_2{}^-$, and $PO_4{}^{3-}$ were measured weekly and evaluated during 2019–2022. Consequently, each component was analyzed separately to determine the possible impact of the concentration on the maintenance of the water chemistry regime and water discharge. Meanwhile, selected water quality parameters were correlated using Pearson's correlation coefficient to relate the impact of the recharge water to the water parameter in the system, and the water parameter was related to the component content in the water body. Regarding the assessment of compliance with the operational standards and according to the maximum permissible concentration (MPC), discharges of polluting chemicals were investigated according to the maximum permissible discharge (MPD). Discharges of pollutants from the Rivne NPP do not cause the MPC to be exceeded in the Styr River. The estimated discharges of pollutants, their distribution by components, and the actual water discharge of pollutant components of the Rivne NPP do not exceed 50% of the MPD. Overall, this study indicates that there is no negative non-radiological impact of water discharge of polluting chemicals with the effluent of the Rivne NPP CCS on the surface waters of the Styr River.

sciforum-089411: Exploring the Reaction Mechanism and Electronic, Thermodynamic, and Kinetic Parameters of Electrochemical CO_2 Reduction to CO on a Copper Electrocatalyst using First-Principle Calculations: Density Function Theory Simulations

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Introduction

The electrochemical reduction of carbon dioxide (CO_2) to carbon monoxide (CO) is a promising approach to mitigate greenhouse gas emissions and produce valuable chemicals. In this work, we investigate the reaction mechanism and kinetics of electrochemical CO_2 reduction on Cu(100) using density functional theory (DFT) calculations.

Methods

We constructed a four-layer slab of Cu(100) and placed CO_2, H_2O, CO, H, OH, and H_2 as adsorbates on the surface. We calculated the Gibbs free energies, adsorption energies, activation barriers, and reaction rates of all the elementary reactions using DFT and transition state theory. We also modeled the solvation effect by placing a monolayer of H_2O molecules on the catalyst surface.

Results

We found that the most favorable pathway for the electrochemical reduction of CO_2 to CO on Cu(100) involves the transformation of *trans*-COOH* and its isomerization to *cis*-COOH*, followed by CO* + OH $\rightarrow$ CO and CO* + H $\rightarrow$ CO + H_2O. The calculated rate constants show that CO_2* + H $\rightarrow$ *trans*-COOH is the predominant form of CO_2 activation. We also investigated the effects of a water layer on the CO_2RR-to-CO kinetics. Our results showed that the majority of elementary reactions exhibited altered reaction barriers, emphasizing the profound influence of the water environment on the reaction mechanism. Furthermore, our study on the effects of introducing a layer of water molecules on the CO_2RR-to-CO kinetics showed significant changes in the rates of most elementary reactions, indicating a nuanced interaction between the water molecules and the catalyst surface.

Conclusions

Our DFT calculations provide insights into the reaction mechanism and kinetics of electrochemical CO_2 reduction on Cu(100). The results indicate that copper is a promising electrocatalyst for transforming CO_2RR to CO and highlight the importance of considering solvation effects when modeling electrochemical reactions.

sciforum-090282: Exploring Leaf Date Palm Fibers as a Reinforcement for Geopolymer Composites made from Mining Waste

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Ensuring the sustainability of geopolymer composites is essential for promoting global sustainable development and eco-friendly objectives. To achieve this, incorporating natural fibers such as palm fibers into geopolymer matrices offers a potential sustainable solution for geopolymer composite applications by reducing the environmental impacts. This study investigates the impact of incorporating leaf date palm fibers (LDPFs) at varying concentrations (0.5%, 1%, 2%, 3%, and 4% by weight) into a geopolymer matrix derived from mining waste on the resulting composites' mechanical, physical, and morphological properties. The geopolymer matrix was synthetized by activating mining waste with a highly concentrated sodium hydroxide solution. Subsequently, the fibers were blended in until homogenous geopolymer composite pastes were achieved. After a curing period of 28 days, the geopolymer composites underwent a comprehensive analysis to assess their mechanical and physical properties in terms of the modulus of rupture (MOR), modulus of elasticity (MOE), thickness swelling (TS), and water absorption (WA), and their morphological properties (XRD, FTIR, and SEM-EDX spectroscopies).

The study's findings demonstrate that the incorporation of LDPFs led to improvements in both the studied mechanical and physical properties of the formulated composites. Specifically, the MOR reached a peak of 12.51 MPa, while the MOE attained 3.4 GPa at a fiber content of approximately 2%. These two mechanical properties nearly doubled in value compared to the pure geopolymer. The achieved physical properties did not align with those reported for other composite materials discussed in the literature. Structural and morphological analyses of the geopolymer composites revealed a satisfactory degree of geopolymerization, and the fibers exhibited strong interfacial bonding with the geopolymer matrix.

The findings suggest that LDPFs are highly efficient in reinforcing the geopolymer matrix derived from mining waste, providing a cost-efficient alternative for improving construction materials.

sciforum-090289: Exploring Scenarios of Eco-Innovation in the Industry: A Prospective Approach

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With the increasing urgency to address global environmental challenges, the pursuit of sustainable solutions has become a priority across various sectors, including engineering. Eco-innovation, aiming to integrate environmentally responsible and economically viable practices in industrial processes, is fundamental within this context. Industrial eco-innovation is crucial for addressing contemporary environmental and economic challenges, promoting a transition to a more sustainable production model. Decision support systems based on fuzzy logic emerge as promising tools to assist in selecting and implementing eco-innovation strategies due to their ability to handle uncertainty and imprecision, addressing the complexities of sustainability. This research aims to explore the application of fuzzy decision support systems in promoting eco-innovation strategies within Sustainable Systems Engineering. Through this approach, we seek to advance more sustainable practices and construct environmentally responsible and economically viable engineering systems. To measure the level of eco-innovation, an index has been created with the following terms: Alarming [0, 1.5], Insignificant [1.5, 3.5], Moderate [3.5, 6.3], Adequate [6.3, 8.5], and Promising [8.5, 10]. This scale allows for a comprehensive evaluation, reflecting on the worst-case scenarios to the most promising ones, in terms of environmental impact and sustainability. The analysis of the eco-innovation index reveals a deeper understanding of the different levels of environmental impact and sustainability in various industrial contexts, from "Alarming" to "Promising". This enables the identification of critical areas that require immediate interventions and recognition of strengths and opportunities for improvement in existing processes. Incorporating fuzzy logic into decision support systems for eco-innovation is a notable leap in research in Sustainable Systems Engineering. This flexible method enhances the management of sustainability challenges by addressing complexity and uncertainty, fostering informed decision-making and streamlined eco-innovation strategies.

sciforum-084520: Exploring the Dynamics of Natural Sodium Bicarbonate, Sodium Carbonate, and Black Ash in Spray-Dry SO_2 Capture

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The viability of spray-dry desulphurisation relative to wet flue gas desulphurisation (FGD) systems is determined by selecting a highly reactive scrubbing reagent. This research evaluated sodium-based reagents from natural and waste by-product sources for treating sulphur dioxide (SO_2). Sodium carbonate (Na_2CO_3) and sodium bicarbonate ($NaHCO_3$) were obtained from mineral sources, whereas the black ash (BA) ($Na_2CO_3 \cdot NaHCO_3$) was sourced from the pulp and paper industry. The sorbents introduced in slurry form were subject to SO_2 absorption conditions in a lab-scale spray dryer, including an inlet gas phase temperature of 120 to 180 °C, a flue gas flow rate of 21 to 34 m^3/h, and a sodium-to-sulphur stoichiometric ratio (SR) (Na:S) of 0.5 to 2. The performance comparison was assessed based on %SO_2 removal efficiency (%η_{DeSOx}) and revealed that $NaHCO_3$ exhibited the highest overall effectiveness of 62% at saturation. BA was the second-best-performing reagent, achieving a removal efficiency of 56%, and Na_2CO_3 demonstrated the lowest efficiency of 53%. The maximum SO_2 reduction of $NaHCO_3$ at individual operating conditions was seen at an SR of 1.75 (69%), a reaction temperature of 120 °C (73%), and a gas inlet flow rate of 34 m^3/h (80%). In summary, the sodium reagents produced a notable SO_2 neutralisation of over 50% in their unprocessed state, which is within permissible bounds in small- to medium-sized coal-fired power plants considering retrofitting pollution mitigation systems.

sciforum-083632: FCP: From Biomass Waste to Activated Carbon for the Removal of Methylene Blue from the Aqueous Environment

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Adsorption of organic pollutants onto activated carbons, especially those based on plant waste, has received interest from scientists due to its low cost and energy consumption. This study deals with the development of activated carbon based on FCP powder by phosphoric acid (H_3PO_4) activation, named AC-FCP, and its application as an adsorbent of methylene blue dye. Due to its high toxicity, the dye content in wastewater must be within tolerable limits before its discharge into the aquatic environment. With a small quantity, these dyes can diffuse over a large area of aquatic environments, causing inhibition of photosynthesis by depriving light penetration into the water. The activated carbon obtained was characterized by physicochemical methods like Brunauer–Emmett–Teller (BET) theory, morphological studies (SEM), energy-dispersive X-ray (EDX), X-ray Diffraction (XRD), Fourier-Transform Infrared Spectroscopy (FTIR), complementary analyses and thermodynamics. The effects of various parameters on the removal efficiency and adsorption capacity of methylene blue onto AC-FCP were studied by testing the effect of the mass, initial concentration, contact time, pH, and temperature. The characterization of AC-FCP shows that our activated carbon has a high surface area, a negative charge, a microporous and mesoporous structure, and an amorphous structure. The removal efficiency is at 99.28% with an adsorption capacity of 72.58 mg·g^{-1} in a contact time of 110 min. The adsorption mechanism is favorable and reversible, forming a monolayer with a chemosorption mechanism which is defined by the Langmuir isotherm and pseudo-second-order kinetics. Our activated carbon AC-FCP has the best characteristics for the high removal of toxic dyes like methylene blue in aqueous environments with low cost and less energy.

sciforum-090258: Features of the Cell Wall, Extracellular Matrix and Extracellular Vesicles of *Candida* Yeast during the Utilization of Hexadecane in a Liquid Medium

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Elucidating the mechanisms allowing microorganisms to utilize xenobiotics is one of the most important fundamental tasks of modern microbiology and molecular biology. This task is of particular relevance in the context of environmental pollution by hydrocarbons and surfactants. Yeast, utilizing diesel fuel, is a promising study subject. The cell wall is the most important cellular compartment directly in contact with hydrophobic substrates. Electron microscopic and cytobiochemical research enabled us to study the features of the Candida yeast function during the utilization of a hydrophobic substrate, hexadecane. Different strategies for building colonies in a liquid medium were observed. *C. albicans* produced a thick layer of biofilm in the form of a ring along the edge of the flask at the phase interface. *C. tropicalis* formed a biofilm over the entire surface of the phase interface. *C. maltosa* had microspheres with neutral buoyancy measuring about 1.5 mm in size. The transfer of these cells to a medium with glucose as a carbon source led to the disintegration of the colony into single cells and the release of the extracellular matrix into the external environment. Channels, part of the complex formation of the cell wall associated with exocellular fibrillary structures, trophosomes, have been discovered. Polyphosphatase treatment and fluorescence microscopy with DAPI have shown that polyphosphates are discretely distributed in the cell wall in correlation with the location of modified sections of the cell wall in *Candida*, when growing on hexadecane. The content of high-molecular-weight polyphosphates in comparison with the growth on glucose has increased in *C. tropicalis* and *C. maltosa* and *C. albicans*. Fluorescence microscopy with DAPI showed the unusual localization of polyphosphates on the cell surface and in the composition of exovesicles in three yeast species growing on hexadecane. Electron scanning analysis has presented that exovesicles are connected to the cell wall and are arranged in chains on the cell surface and in the external environment. EDS microanalysis has displayed that the phosphorus content in vesicles is twice as high as the nitrogen content. The study of structural and functional changes in the yeast cell wall makes it possible to reveal the phenotypic potential of these eukaryotes. This is necessary for the development of biotechnologies for the disposal of various environmental pollutants.

sciforum-089745: First-Principles Prediction of Enhanced Photocatalytic Activity in Cu-Doped $ZnTiO_3$ by Replacing Zinc and Titanium

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The most abundant, clean, renewable, and environmentally friendly energy source is sunlight. In numerous environmental applications, the photocatalytic activity of oxide-based semiconductor particles has been proven. Adding new energy levels between and modifying the conduction band minima (CBM) and valence band maxima (VBM) is an efficient way of elemental doping to adjust the band gap of TiO_2. Cu doping in $ZnTiO_3$ is anticipated to alter absorbance, as well as other physical or chemical characteristics of the material, due to the altered electronic shell structure. The impact of Cu doping on the $ZnTiO_3$ system's electronic structure and photocatalytic activity was examined through the utilization of the density-functional-theory-based open-source software Quantum Espresso.

In this work, the effects of copper doping on the properties of zinc titanate were studied. The optoelectronic characteristics of pure and doped $ZnTiO_3$ with copper and the compatibility of Cu to replace Ti or Zn in doping were the main focuses of this research. The formation energies of Cu-doped $ZnTiO_3$, in which Cu substitutes Zn and Ti, were found to be −188.3019486 eV and −177.7992517 eV, respectively. Studies found that replacing Zn with Cu is more practical than replacing Ti with Cu. Band gaps were 2.92 eV for $ZnTiO_3$, 2.44 eV for Cu-substituted Zn, and 1.68 eV for Cu-substituted Ti from the band structures of $ZnTiO_3$ and Cu-doped $ZnTiO_3$. By generating an accepter level in $ZnTiO_3$, copper increases the feasibility of $ZnTiO_3$ for photocatalysis under visible light.

When compared to pure $ZnTiO_3$, the Cu-doped system shows light absorption activity in the visible range. Cu-doped $ZnTiO_3$ demonstrated higher photo-catalytic potential because they showed intermediate states in the band structure and density of states, which is better suited to the particular requirements for photocatalysis powered by solar radiation.

sciforum-089625: Forecasting Trona Product Quality in Spray Drying Using Reactive Engineering Approach (REA)

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This study presents the formulation and development of a Reactive Engineering Approach (REA) kinetic model to characterize the drying kinetics of Trona across diverse experimental scenarios. By integrating fundamental reaction principles with experimental data, the REA model aimed at offering predictive capabilities to forecast trona drying behaviours. The model formulation involved solving both heat and mass transfer models to predict the drying behaviour and product quality such as temperature distribution and moisture content and along the spray dryer. The model equations were solved using finite difference method to develop a one-dimensional model. The validity of the developed REA kinetic model was assessed by comparing its predictions against the experimental data from diverse drying conditions. Experimentation involved drying Trona slurry under varying experimental condition such as slurry flowrate (12–28 mL/min), solid concentration (5–15%), inlet gas flowrate (40–80 m^3/h) and inlet gas temperature (120–200 °C). This was carried out using a laboratory scale spray dryer while observing the spray characteristics including exit temperature and moisture content. The model simulation results presented close alignment with the experimental data indicating effective representation of the moisture loss behaviour under different operating conditions. Specifically, the model predicted higher rates of moisture loss at higher inlet gas temperatures (200 °C), consistent with experimental observations. Additionally, it indicated a decreasing rate of moisture loss along the chamber height (0–0.5 m) due to decreasing temperatures. Moreover, the model predicted a decreasing rate of moisture loss with increasing slurry concentration, consistent with final moisture content measurements.

sciforum-086404: Future Trends of Natural Refrigerants: Selection, Preparation and Evaluation

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The field of refrigeration technology has played a pivotal role in modern society, providing essential cooling solutions for various industries, including food preservation, healthcare, and manufacturing. However, the conventional refrigerants used in these systems, such as hydrofluorocarbons (HFCs) and chlorofluorocarbons (CFCs), have been identified as major contributors to climate change and ozone depletion. Recently, the heightened environmental consciousness of the refrigeration industry has paved the way for searching for a natural refrigerant (NR) as an alternative to the usual commercial and synthetic refrigerant (SR). Natural refrigerants are known to be substances that occur naturally in the earth's surroundings and were commonly used; however, synthetic refrigerants took their place because of their known better thermal performance durability and safety. Despite challenges such as flammability and toxicity, these NR substitutes demonstrate competitive performance, urging a transition from traditional SR. In this review paper, commonly known NRs, such as ammonia, carbon dioxide, air, and hydrocarbons, were presented in terms of their sustainable characteristics, historical origins, selection criteria, preparation techniques, evaluations, and impacts. To provide a sustainable and eco-friendly guideline for the advancement of refrigeration technology, this analysis examines the trends, selection criteria, preparation processes, and evaluation procedures of different NRs. Finally, the results presented in this paper will provide useful baseline information for both researchers and scientists for the development of a refrigeration system.

sciforum-089609: Green Synthesis, Properties and Application of Silver Nanoparticles of Eggplant

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Nanoparticles and their synthesis and application have been widely studied in recent years. Silver nanoparticles are one of the most fully studied materials. Nanoparticles are produced in many ways, including physical and chemical methods such as microwave treatment, chemical reduction, photochemical methods, and biological synthesis methods. Silver nanoparticles have a significant effect on the living cells of both prokaryotes and eukaryotes. The technology for biological production of nanoparticles is simple and effective. The aim of this study was to develop a method for producing green nanoparticles using eggplant extract. UV-Visible spectral analysis and the X-ray diffraction (XRD) assay were used for the characterization of nanoparticles. The size of the nanoparticles was calculated based on the Debye–Scherrer equation. It was determined that a silver nitrate concentration of 1 mM was the most effective for the green synthesis of nanoparticles using eggplant extract. The resulting particles were optimized and the phytochemical properties of eggplant silver nanoparticles and the effectiveness of their use in therapy were assessed. The ability of the synthesized nanoparticles to remove free radicals was assessed and the most effective concentration of antioxidants was determined. It was found that the most effective concentration was 200 ppm when using the method of inhibiting DPPH oxidation in comparison with such a widely used antioxidant as ascorbic acid. Thus, silver nanoparticles were synthesized from eggplant extract, which effectively prevented oxidation, which can be considered as a simple, inexpensive and effective way to obtain green nanoparticles. The study showed that eggplants are a cheap raw material for producing silver nanoparticles using green synthesis, which have the function of antioxidant protection and are able to remove free radicals. The work carried out shows the advantages of green synthesis of nanoparticles for a clean and lower cost production of food additives to improve the quality of life of people.

sciforum-089106: Identification of Value-Added Phenolic Compounds in Olive Stones Extracted Using Microwave-Assisted Extraction

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Nowadays, the most common use of olive stones, after being removed from olive mill solid waste, is for combustion to generate heat or electric energy. So, this lignocellulosic by-product is underused when it is burnt, because of its high content in phenolic compounds. Those might be regarded as high-value-added products not only in the food industry, but also in the chemical and construction industries because they could be chemical building-blocks in the synthesis of compounds with interesting physicochemical properties (i.e., resin). The type and the concentration of these phenolic compounds vary depending on the extraction technique, since they can easily degrade and pass from a compound to another when using high temperatures during extraction.

A Green Chemistry approach was followed in this work. It means that an optimization was made by designing the experiments of the extraction process based on response surface methodology. This extraction was carried out using an unconventional method, namely, microwave-assisted extraction. As extraction solvent, aqueous acetone was used since it is environmentally safe and easy to recover. The principal phenolic compounds identified in the extracts were protocatechuic acid and hydroxytyrosol, and their optimal extraction conditions were 45 °C, 20 min and 90% (v/v) acetone for the former, and 74.7 °C, 19.37 min and 90% (v/v) acetone for the latter.

sciforum-086320: Impact of Plastic Cells and Fly Ash on the Compressive Strength of Concrete: An Empirical Investigation

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Plastic-cell-filled concrete, an innovative construction material, harnesses the strength of traditional concrete while incorporating recycled plastic cells for improved performance. This research endeavor involved a series of experiments designed to scrutinize the influence of plastic cells (specifically, the effect of confinement due to plastic cells) and fly ash on the compressive strength of concrete. Specifically, the laboratory investigation involves evaluating the compressive strength of concrete grades M20 and M25 at three specific time intervals: 3 days, 7 days, and 28 days, under conditions with and without the incorporation of plastic cell confinement. Furthermore, the study extends to comprehending the impact of replacing cement with fly ash on strength characteristics using the same intervals and conditions. The plastic cell unit had dimensions of 150 mm $\times$ 150 mm $\times$ 150 mm, and the composition of fly ash in the concrete was systematically altered within the range of 0% to 50%. For both concrete grades and across all variations of fly ash content, it was observed that the inclusion of plastic cell confinement led to superior compressive strength compared to conventional concrete without plastic cells at each time interval. Additionally, the outcomes of this experiment revealed that the 3-day and 7-day compressive strength of concrete, whether with or without plastic cells, declined with an increase in fly ash content. Conversely, in the range of 0% to 30% replacement of cement with fly ash, the 28-day compressive strength of both the conventional and plastic-cell-filled concrete increased with the fly ash content, peaked at 30%, but decreased with further additions of fly ash. Therefore, replacing 30% of the cement with fly ash is deemed the optimal fly ash content to attain the highest level of compressive strength. Moreover, by introducing a 30% replacement of cement with fly ash, the compressive strength of the plastic-cell-filled concrete was enhanced by approximately 10% compared to conventional concrete.

sciforum-090407: Improvement of Structural, Morphological and Mechanical Properties by Reinforcing Sisal Fibers in a Reinforced Concrete Slab

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Concrete, a widely utilized construction material, is prone to sudden failure and has limited energy absorption upon yielding. The incorporation of short discrete fibers has shown significant promise in addressing these challenges. Fiber-reinforced concrete finds application in various scenarios. Fibers are added to concrete to reduce cracking, enhance physical properties, reduce drying shrinkage, improve strength and toughness, extend service life, decrease water bleeding, reduce concrete permeability, and enhance construction value. Sisal, a natural fiber known for its high mechanical efficiency, is used as reinforcement in a cement-based matrix. This research focuses on the structural, morphological, and mechanical aspects of reinforced concrete slabs containing varying proportions of sisal fibers, ranging from 1 to 2% by weight of cement. The inclusion of sisal fibers alters the concrete flow, aligning with findings from prior studies. Notably, an alkaline treatment using NaOH was conducted, removing impurities and reducing lignin and cellulose content. This treatment, as observed in SEM images, enhanced the surface morphology of the coarser sisal fibers, leading to increased tensile strength in the samples. Additionally, the mechanical properties, including strength parameters and tensile stress, exhibited improvements with the incorporation of sisal fibers. These findings highlight the potential benefits of sisal fibers in enhancing concrete strength and mitigating brittle fractures.

sciforum-087887: Influence of the Interaction between Fiber Hemp Residues and Soil on the Mechanical Characteristics of Residues

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The increasing global population and consumption levels necessitate an exploration into alternative agricultural practices, such as the cultivation of fiber hemp (*Cannabis sativa L.*), which offers versatile product applications. This study aimed to evaluate the impact of fibrous hemp residue interaction with soil on its mechanical properties, focusing on moisture content and the mechanical characteristics of rolled versus unrolled hemp residues after harvest. The field of experimental research was divided into two parts. Cannabis residues after harvesting were processed with a shredding roller, and for the other part, cannabis residues were left on the soil surface. Using the test machine "Instron 5960" and the parameter registration software system "Bluehill", we assessed the mechanical properties of hemp residues in spring following their post-harvest treatment in September. Results indicated that rolled hemp exhibited a significantly higher moisture content (73%) and required approximately 53% more energy to break than unrolled hemp. Additionally, rolled hemp showed a 39% greater extension and took 39% longer to break. These findings suggest that rolling hemp residues before overwintering could strengthen their mechanical properties, enhancing their utility in no-tillage agricultural practices by facilitating their integration into seedbeds, even in conditions unfavourable for seed growth. This research informs the selection of technological processes in hemp cultivation, indicating the potential benefits of no-tillage practices.

sciforum-087882: Leaching Kinetics of Ironmaking Blast Furnace Slag as a Source of Calcium for CO_2 Sequestration

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The study demonstrated that increasing the concentration of the solvent enhances the efficiency of calcium extraction; however, it also causes the leaching of other elements, such as magnesium, which can impede the carbonation stage. The research also revealed that the extraction of calcium from the largest particles is constrained by mass transfer and the accessibility of calcium from the particle. A portable laboratory orbital shaking incubator was used for the leaching experiments. In addition, XRF and AAS were utilized for the sample characterization of solid residues and leach liquor, respectively. The authors hypothesize that the reaction products build up and hinder the reaction on the surface layer of the particles. On the other hand, with the smallest particle size, more calcium can be extracted before the surface is obstructed, and the maximum extraction efficiency has not been achieved yet. Based on the activation energy value of 70.51 kJ/mol, it is less likely that the leaching of blast furnace slag in ammonium nitrate is a product-layer-diffusion-controlled process, as the activation energy for this type of process is usually below 20 kJ/mol. Instead, the higher activation energy suggests that the leaching process may be controlled by surface chemical reactions or a mixed mechanism. However, more detailed analysis and experimental data would be required to confirm the reaction mechanism.

sciforum-090337: Levels of Arsenic in Soil and Vegetables in Sites of Delhi Nearby Yamuna Region

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Population growth has led to increased urbanisation, industry, and agricultural operations to supply food demand and these anthropogenic activities causes environmental stress. Using wastewater for irrigation due to lack of fresh water is a major source of heavy metal. This study examined the levels of arsenic in soil and vegetables samples from agricultural areas in Delhi-NCR, India.

The soil and vegetable samples were collected from Okhla region of Delhi. 7 types of different vegetables were collected which includes brinjal, fenugreek leaf, coriander leaf, sem bean, spinach, mustard leaves, chick-pea leaves. The soil samples were collected separately for each vegetable then further analysed. The materials were digested using wet digestion techniques on a hot plate before being analysed for arsenic by hydride generating atomic absorption spectrometry.

The concentration of Arsenic in soil exceeds 20 mg/kg above the permissible limit of World Health Organization (WHO) which may lead to a detrimental effect on soil quality, leading to food contamination. Leafy vegetables shows higher concentration of arsenic when compared with tubers and roots. Mean concentration of arsenic in soil is 24.50 mg/kg. The concentration of arsenic were highest in dhaniya and methi samples. It is found that crops with higher water absorption rates accumulate more arsenic. Hazard Quotient based on estimated daily intake was found >1 for arsenic. Hazard quotient due to intake of arsenic in vegetables was >1 with high values of 7.205 mg/kg, 15.078 mg/kg in methi and dhaniya samples, respectively.

To minimise future health hazards, it is advised to monitor heavy metal concentrations in soil and crops in the research region frequently. Secondly, usage of wastewater should be reduced for vegetation. The study implies that continuing the current trend of atmospheric deposition might destabilise sustainable agriculture practices and increase harmful metal consumption in diet.

sciforum-089336: Managing Dynamic Product Recovery of Electronic Goods in Wake of Reverse Logistics

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This research delves into the imperative of employing reverse logistics (RL) to manage the dynamic product recovery of electronic goods. Disposing of electrical items correctly is challenging due to their complexity, cost, and hazardous components. The study underscores the necessity of an efficient RL system to safely and effectively recover and reuse outdated electronic equipment. It explores the complexities associated with managing dynamic product recovery post-RL, particularly focusing on the lack of standardization in electronic design and production. Through a survey-based approach involving 400 participants, the study employs statistical analysis and Cronbach's alpha to validate the collected data. Findings emphasize the crucial role of a dependable RL system in mitigating the adverse environmental impact of electronic waste while enhancing the economic value of recycled materials. The abstract further discusses the evolving landscape of consumer preferences, regulatory frameworks, and technological advancements shaping the RL ecosystem. Key factors such as product design for disassembly, efficient collection and transportation networks, and refurbishment processes are highlighted. By embracing innovative strategies and fostering collaboration among stakeholders, businesses can effectively navigate challenges, reduce environmental footprints, and harness opportunities for sustainable growth in the electronic goods sector. Moreover, the study stresses the importance of continuous adaptation to evolving market demands and emerging technologies within the RL framework. It advocates for proactive measures to address future challenges and optimize resource utilization.

sciforum-087071: Mechanisms of Biodeterioration of Structural Materials by *Streptomyces* spp.: A Review

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Processes of microbial damage to materials lead to a number of environmental problems. Along with this, technogenic influence on the environment can contribute to the preferential development of certain eco-trophic, corrosively active groups of microorganisms, with a subsequent intensification of biodamage. To prevent their development, "green" biocides-inhibitors are being developed. Actinobacteria of the genus *Streptomyces* are actively studied from the point of view of usefulness/harmfulness in relation to human activity, in particular in processes of microbial damage to materials. To summarize the results of available scientific research and reviews devoted to the participation and supposed mechanisms of structural material damage caused by streptomycetes, the presented study was performed. It was speculated about the possible role of streptomycetes in the biodeterioration of structural materials:biofilm formation, the impact on electrochemical reactions during the corrosion process, the effect of corrosion inhibitors, and the production of various substances that can change the corrosion process. It is emphasized that the mechanisms of *Streptomyces* influence microbial damage to metals, and the consequences (intensification or weakening of corrosion) are ambiguous, species-, and strain-specific, depending on other microorganisms involved. The obtained data indicate the need for further studies on streptomycetes as participants in the corrosion process, with special attention to their production of secondary metabolites and nanoparticles of metal and metal oxides with antimicrobial and inhibitory properties, which will contribute to the expansion of the list of "green" biocides/inhibitors.

sciforum-082684: Microplastics and Their Impact on Moss Ecosystem Functions: A Comprehensive Review

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Microplastic pollution has become a global environmental concern due to its pervasive presence in terrestrial and aquatic ecosystems. While the impact of microplastics on larger organisms is increasingly understood, their potential consequences for lower trophic levels, such as mosses, have garnered less attention. This review examines the current state of knowledge regarding the role of microplastics in altering moss ecosystem functions, shedding light on this understudied aspect of microplastic pollution. Mosses, as ubiquitous components of many ecosystems, play critical roles in nutrient cycling, carbon sequestration, and habitat provision. Microplastics, which are small plastic particles less than 5 mm in size, have been documented in moss tissues and surrounding environments. We explore the mechanisms of microplastic–moss interactions, including uptake, accumulation, and potential adverse effects. Evidence suggests that microplastics can disrupt moss physiology, affecting photosynthesis, nutrient uptake, and water retention capabilities. The review also discusses how alterations in moss ecosystem functions can have cascading effects on higher trophic levels and overall ecosystem health. Furthermore, we highlight the potential for mosses to act as bioindicators for microplastic pollution, offering a valuable tool for monitoring and assessing the extent of contamination in various ecosystems. In conclusion, this review underscores the need for a deeper understanding of the intricate relationship between microplastics and moss ecosystem functions. It emphasizes the ecological significance of mosses and the importance of considering lower trophic levels in the context of microplastic pollution, ultimately contributing to the development of more holistic strategies for mitigating the impact of microplastics on terrestrial ecosystems.

sciforum-085954: Modelling and Optimisation of Biodiesel Production from Margarine Waste Oil Using a Three-Dimensional Machine Learning Approach

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The development of low-carbon and environmentally friendly energy sources has led to much research on the production and optimisation of biodiesel. This work presents the use of three-dimensional machine learning approaches, namely response surface methodology (RSM), an artificial neural network (ANN), and an adaptive neuro-fuzzy inference system (ANFIS) to optimise and model biodiesel production from margarine waste oil. The effect of process parameters, e.g., the methanol to oil ratio (3–15 mole), catalyst ratio (0.3–1.5 wt.%), reaction time (30–90 min), and reaction temperature (30–70 °C), was studied. RSM was used for process optimisation. Model construction of the ANN model used 70% of the data for training, 15% for testing, and 15% for validation. The network was trained using feed-forward propagation and the Levenberg–Marquardt algorithm. The ANFIS was generated using a grid partition and trained using a hybrid method. The effectiveness of the machine learning was assessed through error metrics such as regression (R^2), root mean square error (RMSE), mean absolute error (MAE), mean absolute percentage error (MAPE), average relative error (ARE), and mean percent standard deviation (MPSD). The optimum yield was obtained with a 9 mole ratio, 0.9 wt.% catalyst ratio, 60 min reaction time, and 50 °C reaction temperature, with 89.09%. According to the results, the developed three-dimensional machine learning approach—the RSM, ANN, and ANFIS models—is a potential method for optimising and modelling the production of biodiesel from waste margarine oil. The study results may be used to create sustainable, efficient, and economical solutions for recycling waste margarine oil.

sciforum-090339: Modelling and Simulation of the Pyrolysis Distillate Recycling Process

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The global chemical sector has seen substantial changes in recent years. In particular, gas processing and fractionation remain one of the most important parts of the industry. Recycling waste products from gas processing is one of today's urgent problems. In this regard, the development of new, import-substituting chemical products based on the processing of hydrocarbon raw materials is of particular importance. Pyrolysis distillate and pyrolysis oil are secondary raw materials for the production of naphthalene and aromatics. Hydrocarbons, indene, phthalic anhydride, and other valuable chemical products are necessary for industry. Therefore, research aimed at improving the complex technology of the waste processing of gas–chemical complexes is an urgent task and requires an optimal solution. In this paper, the model of the pyrolysis process is simulated in the Aspen Plus modelling package. The developed model was also used to study the effect of temperature on the pyrolysis process and showed that there is an optimal temperature for chain fractions. To evaluate the technical efficiency of the process, the Aspen Plus simulation model was developed, and the model made it possible to accurately predict the mass shares of the hydrocarbon product. The analysis of the calculated data shows that as the pressure in the technological process is increased from 0.1 to 3.0 MPa, the vapor density of pyrolysis distillate increases up to 30 times. When the temperature rises to 350 °C, the density of distillate vapor decreases by an average of 1.51 times.

sciforum-084539: Modelling for Zinc (II) Adsorption Using Green and Recyclable Adsorbent: Ann and Anfis

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The current study aims to determine how well an adsorption approach in a laboratory-scale reactor removes zinc (II) from an aqueous solution. In this work, ANFIS and the ANN were used to predict the green adsorbents' adsorption capacity in removing zinc (II). Four operational variables were studied: the contact time in minutes, the dosage of the green adsorbent in mg/100 mL, the initial concentration of the Zinc (II) solution in mg/L, and pH. The outputs were the removal percentage (%) and adsorption capacity (mg/g). The ANN and ANFIS approaches were built using 60% of the data for training, with the remaining 40% being used for validation and testing. According to the findings, the adaptive neuro fuzzy interference system models are a potential method for making predictions about the adsorption of Zinc (II). Based on this result, the training dataset's (RMSE) root-mean-square error, (AARE) Average Absolute Relative Error, (ARE) Absolute Relative Error, (MSE) Mean-Squared Error, and R^2 for the ANFIS model were found to be 0.021, 0.048, 0.012, 0.015, and 0.988, respectively. For the ANN model, the AARE, RMSE, ARE, MSE, and R^2 were found to be 0.013, 0.020, 0.021, 0.032, and 0.997, respectively. The Langmuir model best fitted the adsorption, whereas the pseudo-second order model governed the adsorption mechanism. The green adsorbent was studied for morphology, functional groups, thermal properties, and crystallinity. Although the functional groups of the adsorbent were similar to the CNCs, the TGA analysis showed that the adsorbent exhibited more excellent heat stability. The nanocomposites' needle-like shape, tiny particle size, and porous structure were all visible in the SEM.

sciforum-090115: Molten Base Carbonisation and Activation of Bamboo Shoots to Generate Capacitive Carbon

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Porous carbon with hierarchical pores has been produced from wet bamboo shoots via molten base carbonization and activation at 700 °C, with a short residence time of 1 h, using two different reactor configurations. The produced carbon exhibited a notable specific surface area (SSA) of 1198.47 $m^2\ g^{-1}$ from the vertical reactor (V-1) and a surface area of 1190.51 $m^2\ g^{-1}$ from the horizontal reactor (H-1), approaching that of the commercial YP50F (1425.89 $m^2\ g^{-1}$). The SSA of derived carbon material is linked to abundant micropores developed during in situ carbon activation at elevated temperatures facilitated by KOH and the interaction of biomass components at room temperature. Also, elemental analysis revealed increased oxygen and nitrogen content in V-1 (27.04% and 2.74%, respectively) compared to H-1 (25.88% and 1.65%, respectively), and XPS analysis revealed different bond states for oxygen and nitrogen in V-1 compared to H-1. These differences in chemical composition were possibly influenced by reaction environments, compounds, and gases released during carbonisation, possibly affecting their behaviour towards eletrolytes. The urther testing of derived carbons in an electrochemical double-layer capacitor showed that V-1 exhibited the highest specific capacitance (164.75 F g^{-1}) compared to H-1 (160.26 F g^{-1}) in an organic electrolyte (1 M $TEABF_4$/AN). This increased capacitance is attributed to its larger SSA, hierarchical hierachical pores, and increased oxygen and nitrogen content that enhances capacitance resulting from some reversible electro-adsorption processes that do not require electron transfer (pseudo-capacitive mechanism). Both H-1 and V-1 carbons exhibited better capacitance compared to YP50F (143.08 F g^{-1}) and demonstrated cycling stability of 10,000 cycles with a capacity retention ability of 98% at a specific current of 0.1 A g^{-1}, demonstrating their potential as an alternative electrode material. These results highlight the potential for achieving hierarchical porous carbon from wet biomass via a process route that saves both time and energy towards biomass to carbon conversion.

sciforum-090402: Municipal Solid Waste Biogas Production Enhancement Using a Hybrid Landfill Bioreactor: A Case Study

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This study aimed to investigate the application of hybrid bioreactor technology for biogas production enhancement from a municipal solid waste organic fraction (OFMSW). Two bioreactor (Br) columns were operated for up to seven (7) months to simulate a typical (Br-1) and a hybrid (Br-2) landfill bioreactor, respectively. The OFMSW used included kitchen, garden, and paper waste at a ratio of 16:3:1. Partial aeration during the first stage was practiced, and diluted leachate with water was recirculated throughout the operation in Br-2 while tap water was added in Br-1 for humidification. The results showed that partial aeration and diluted leachate recirculation led to greater performance in terms of accelerated methanogenesis onset and biogas production enhancement. Methanogenesis onset occurred after 90 days for Br-2, while it was realized after 143 days for Br-1. A biogas accumulation of 21.52 L at an average rate of 0.12 L/day was produced from Br-2, which was higher than the volume of accumulated biogas produced in Br-1 of 8.75 L, averaging 0.05 L/day for 7 months. The leachate pH slowly increased and fluctuated around 7 in Br-1, while in Br-2, it quickly increased from 5.24 to 8.2 during the methanation phase. The reduction in TOC (260 mg/L) and COD (4000 mg/L) indicated the maturation phase of the leachate in Br-2, while Br-1 had high values of TOC (461.1 mg/L) and COD (10,000 mg/L) ranging within the methanation phase after 6 months of operation. The TOC/COD ratio of 0.63 was also indicative of a stabilized leachate in Br-2, while Br-1 had a lower ratio than 0.5. The results indicated that diluted leachate recirculation and partial aeration had a considerable effect on biogas production and the onset of methanogenesis. Partial aeration introduced oxygen into the process, while leachate recirculation re-introduced the discharged nutrients with water, diluting the high concentration of leachate pollutants.

sciforum-087674: Novel Photocatalytic Reduction of CO_2 into Solar Fuel under a Continuous Flow Photoreactor Using Nano-Engineered Slag Catalyst

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The biggest contribution to the global warming phenomenon is a rise in carbon dioxide, which causes climate change. The need for a novel and low-cost composite catalyst to capture and convert CO_2 from the atmosphere into solar fuel is in high demand. Slag waste from a steel-making company is one of the low-cost raw materials. This slag was synthesized in this study using a solvothermal preparation technique to produce a steel slag nanocomposite catalyst. The chemical and elemental composition, morphology, crystallographic structure, and band gap were evaluated using EDX, SEM, TEM, FTIR, XRD, and UV-vis spectroscopy, respectively. The result reveals that the EAF-SSNC exhibited nanocomposite behavior with a band gap of 1.67 eV. The prepared slag nanocomposite was utilized under a continuous flow photo-reactor for CO_2 reduction with water for the first time. The resulting product was analyzed using total organic carbon (TOC) analyzer and gas chromatography–mass spectrometry (GC-MS). Based on the gas chromatography analysis of the liquid products, it was revealed that CH_3OH was the predominant product, whereas HCHO was the minor one. EAF-SSNC achieved 37 mg/L TOC concentration in CO_2 reduction. This work showed that steel slag nanocomposites might be effectively used for CO_2 reduction and will reduce the overall cost of using pure chemicals.

sciforum-090179: Optimal Backstepping Control for Nonlinear Morphing Quadcopter System

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It is acknowledged that quadcopters, because of their low cost and flexibility, play a vital role in many areas of applications such as smart farming, natural disasters, package delivery, etc. It has been established that conventional quadcopters can perform various manipulations and control functions such as obstacle avoidance, terrain following, environmental navigation, and autonomous landing. Interestingly, flying insects can perform all those functions and far beyond, using ingenious strategies for perception and navigation. Additionally, flying insects can reconfigure their shapes to achieve desired goals such as accessing a tight space, landing and taking off in densely populated farmland for food foraging, and accessing indoor environments from outside. These bring up a new research topic, called self-arm management or morphing quadcopters. However, existing morphing quadcopters have been determined to have the following challenges: an increased weight budget and energy consumption, which translate to limited flight time, a loss of stability and controllability during morphing because of variation in the center of gravity, inertias, and the system dynamics. This research aimed at the mathematical modeling and design of backstepping control for morphing quadcopter application taking into consideration X, Y, T, H, and O morphing configurations. The choice of this control approach is due to its capability in ensuring Lyapunov stability robustness of the desired dynamics and handling all forms of nonlinearities. Simulation results obtained showed the effectiveness of the proposed control approach to adapt parameter variations in the model dynamics because of geometric reconfiguration. Furthermore, the control approach was investigated under instant changes in configurations every 15 s. Analyzing the control error performance, the controllers exhibit a maximum overshot of 0.015 (7.5%) and a settling time of 10 s. Finally, a PID controller was designed for servo control of the arm, and a good tracking performance with minimum error was achieved.

sciforum-090340: Optimization of Phenolic Compounds from Oregano by Accelerated Solvent Extraction Using Response Surface Methodology

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Accelerated solvent extraction (ASE) has been considered as a potential alternative to conventional solvent extraction for the isolation of phenolic compounds from plants. New "green" extraction techniques that provide higher efficiency, lower energy, and solvent consumption than conventional extraction processes have already been utilized in extracting antioxidants from aromatic plants and essential oils' solid residues in order to improve extraction efficiency and product quality. The current small scale research focuses on the optimization of accelerated solvent extraction (ASE) for the extraction of phenolics from Greek oregano (*Origanum vulgare* L. *subsp. Hirtum)*. The response surface methodology (RSM) based on Central Composite Design was used to optimize methanol concentration (X1, 40–80%), extraction time (X2, 3–9 min, 3 cycles), and extraction temperature (X3, 60–140 °C). The responses for the ASE method were estimated as yield (%), total phenolic (TPC) and flavonoid content (TFC), and antioxidant capacity measured by DPPH (2,2-diphenyl-1-picrylhydrazyl), and ABTS (2′-azino-bis-3-ethylbenzthiazoline-6-sulphonic acid), aiming to obtain maximum yields. The optimal extraction conditions for oregano were defined as follows: methanol concentration of 74%, extraction time of 9 min, and extraction temperature of 140 °C. Under these conditions, experimental values for extract yield, TPC, DPPH, and ABTS matched those predicted, therefore validating the model adequately. The phenolic profile was analyzed by HPLC/PDA/MS. The oregano extracts were rich in phenolic compounds, with rosmarinic acid, salvianolic acid B, and carvacrol being the most prevalent phenolic components. The results obtained revealed that ASE can be utilized for the extraction of bioactive compounds, and there are advantages to preserving phenolic content if optimization is applied.

sciforum-087629: Optimization of Processes for Eco-Friendly Fabrication and Analysis of MnO_2 Nanoparticles Utilizing Botanical Extract from *Alternanthera sessilis*

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The green synthesis of nanoparticles using environmentally conscious procedures is vital due to its eco-friendly characteristics, diminished energy requirements, and the avoidance of perilous chemicals. Manganese di oxide (MnO_2) nanoparticles have widespread applications in diverse fields such as electronics, catalysis, environmental remediation, drug delivery, ceramics, material science, and sensors. Typically, MnO_2 nanoparticles are produced through physical, chemical, and biological methodologies. A freshly extracted botanical solution from *Alternanthera sessilis* is employed in nanoparticle synthesis owing to its economical nature and easy accessibility, serving as both a reducing and stabilizing agent. The biosynthesized MnO_2 nanoparticles underwent comprehensive characterization through distinct techniques, including X-ray Diffraction (XRD) studies, Fourier Transform Infrared Spectroscopy (FTIR) studies, Ultra Violet Visible (UV) Spectroscopy, and Transmission Electron Microscopy (TEM) studies. The XRD analysis facilitated the identification of crystal phases in the Manganese di oxide (MnO_2) nanoparticles. Additionally, the Debye–Scherrer equation was utilized for determining the crystallite size of the nanoparticles based on X-ray diffraction findings. Diverse functional groups present in Manganese di oxide (MnO_2) nanoparticles were confirmed through Fourier Transform Infrared Spectroscopy results, while Ultra Violet Visible absorption spectra were indicative of the energy band-gap value of the MnO_2 nanoparticles, and Transmission Electron Microscopy observations depicted the spherical morphology of the synthesized nanoparticles.

sciforum-090009: Photocatalytic Degradation of Anionic and Cationic Dyes by Bi_2WO_6/ZnO Nanocomposite under Visible Light Irradiation and Study of Its Antimicrobial Activity

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This study investigates the synthesis and performance evaluation of a visible light-driven photocatalyst, Bi_2WO_6/ZnO, for degrading industrial sewage dyes and its antimicrobial activity. The novel Bi_2WO_6/ZnO composite was synthesized via a hydrothermal method and characterized using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), and transmission electron microscopy (TEM). XRD analysis confirmed the presence of diffraction peaks corresponding to Bi_2WO_6 and ZnO, indicating high purity and crystallinity. FTIR analysis validated the chemical bonds of Bi_2WO_6 and ZnO in the composite material. TEM analysis revealed nanoparticle sizes of approximately 46 nm, corroborating the XRD results. Additionally, selected-area electron diffraction (SAED) patterns supported the crystalline nature of the composite.

The photocatalytic efficiency of Bi_2WO_6/ZnO was evaluated by degrading cationic (RhB, MB, CV) and anionic (EY, EB) dyes under visible light exposure for 90 min. Kinetic studies demonstrated high degradation efficiencies for cationic dyes, achieving impressive removal rates of RhB (97%), MB (96%), and CV (88%) within the specified timeframe. Anionic dyes exhibited slightly lower degradation percentages, with EY and EB being degraded by 62% and 69%, respectively. Moreover, the composite showed significant antimicrobial activity against Escherichia coli, Staphylococcus aureus, and Candida albicans, highlighting its potential for antimicrobial applications.

Further investigations were conducted to assess the effect of varying the dosage of Bi_2WO_6/ZnO photocatalyst on degradation efficiency, focusing on RhB and MB dyes. Experiments ranging from 0.1 g/L to 0.5 g/L determined the optimal dosage for degradation to be 0.4 g/L for both dyes. Remarkably, the photocatalyst maintained high efficiency even after five cycles, showcasing its structural stability and reusability.

In conclusion, the synthesized Bi_2WO_6/ZnO composite demonstrates promising potential as an effective photocatalyst for dye degradation as well as antimicrobial activity.

sciforum-084248: Photocatalytic Degradation of Methylene Blue (MB) Using Tilapia (*Oreochromis niloticus*) Fishbone-Derived Hydroxyapatite (HAp)

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The impact of the excessive accumulation of dyes like methylene blue (MB) in the environment has posed a challenge to both researchers and scientists. Due to the recalcitrant nature of the dye, the implementation of an advanced oxidation process in wastewater paves the way for the development of a sustainable photocatalyst. Here, the photocatalytic degradation of MB using hydroxyapatite (HAp) from Tilapia *(Oreochromis niloticus)* fish bone as a photocatalyst was investigated. The Hap was synthesized via calcination under simple heat treatment at 900 °C with 5/min heating rate. The physicochemical properties of the synthesized HAp were characterized using Fourier Transform–Infrared Spectroscopy (FTIR), Scanning Electron Microscope (SEM), and X-ray Diffractometer (XRD). The photocatalytic degradation of MB was conducted at varying initial pollutant concentrations (8 and 12 ppm), catalyst loadings (500 and 1000 mg), and time exposures (1 and 2 h). Results showed that the HAP exhibited an agglomerated formation of a non-uniform nano-spherical crystal powder. FTIR confirmed the presence of functional groups associated with Hap, while the XRD spectra demonstrated peaks at 31.70°, 32.84°, and 32.12°, confirming the formation of Hap. Finally, the highest photocatalytic degradation of 84.75% was obtained with 12 ppm initial concentration and 1000 mg catalyst loading subjected to a 2 h UV irradiation time, showing the potential of mitigating the impact of MB dye in the environment.

sciforum-089851: Physicochemical Characterization and Computational Studies of Tilapia Fish Scales as a Green Inhibitor for Steel Corrosion

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The effect of increased corrosion in re-enforcement structures has led to the need to identify and develop more inexpensive, non-toxic, eco-friendly and readily available inhibitors from natural resources. Extensive research and development have led to the discovery of new classes of green corrosion inhibitors. In this work, Tilapia fish scales (FS) were used as a green corrosion inhibitor as they is abundant in both organic components, such as collagen ($C_{12}H_{19}N_3O_5$), and inorganic components, such as hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$). The FS were subjected to a maceration process to extract all the inorganic and organic compounds. The FS extract was then characterised using an X-ray diffractometer (XRD), a scanning electron microscope (SEM) and Fourier transform infra-red (FTIR). Quantum computational studies were conducted in order to determine parameters such as the energy of the highest occupied molecular orbital (EHOMO) and the energy of the lowest occupied molecular orbital (ELUMO). The Gaussian 09 program density functional theory at the 6-311++(d,p) basis set was used to investigate the interaction between the organic and inorganic molecules, therefore examining both interaction energies. The XRD results confirmed that a large amount of hydroxyapatite was present in the extract, with a high diffractive peak at 32θ and small amounts of collagen picked up between 13θ and 25θ. SEM results showed the percentage weight of atoms, such as carbon (19.8%), calcium (27%), oxygen (41.3%) and phosphate (11.9%), which were found to be present in both the organic and inorganic part of the FS sample. FTIR results confirmed the presence of hydroxyl (3200–3500 cm^{-1}), carbonate (1620–1700 cm^{-1}) and phosphate groups (1200–800 cm^{-1}). The computation studies showed that hydroxyapatite was the most reactive molecule as it had the highest EHOMO of −0.2076 eV compared with that of collagen at −0.2470 eV. The interaction energy of the FS molecule was −615 kJ/mol.

sciforum-089665: Physiology and Cell Viability of New Strains of Destructors of Organic Pollutants

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Every year, people cause more and more harm to the environment as a result of their activities, so the search for new strains of pollutant destructors remains an urgent task. Microbial destructors are the inhabitants of various natural sources: soil, water, etc. We isolated four strains from soil (designated SL-1, 2, 3 and SL-4) and two from river sludge (designated IL-1 and IL-2). The isolation was carried out by the enrichment culture method on a mineral medium containing phenol at a concentration of 0.5 g/L as the sole source of energy and carbon. The pure cultures obtained were tested for their ability to grow on phenol at a concentration of 0.5–2 g/L. The studies showed that strain SL-4 was able to grow on phenol at concentrations of up to 2 g/L, while strains IL-1, SL-1, SL-2 and SL-3 were able to grow on phenol up to 1.5 g/L, and IL-1 was able to grow on phenol up to 0.5 g/L. The new isolates were further tested for their ability to degrade toluene (50 g/L), pinoxaden (50 g/L), a diesel + gasoline mixture, biphenyl and oil. The isolates showed growth on all the substrates used as sole carbon and an energy source, except for strains IL-1, IL-2, SL-1 and SL-3, which are incapable of toluene utilization. The strains were tested for their ability to grow at high salinity. Studies have shown that strain SL-4 is able to grow on a medium with up to 120 g/L of NaCl and the other isolates with up to 100 g/L. The studied strains were also tested for cell viability when growing at high concentrations of phenol and its chlorinated derivatives. The peculiarities of the physiology of isolates and the maintenance of cell viability in unfavorable conditions are important for their further use as a basis for biological products.

sciforum-085934: Plant-Based Adsorbents for Caffeine Removal: Current Research and Future Outlook

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Pharmaceutical wastes, due to their recalcitrant nature, are emerging contaminants in wastewater that have been the focus of researchers and scientists. One pollutant of interest is caffeine, which is one of the most detected contaminants in a global context. Although commonly present in beverages such as coffee, caffeine can be harmful to both humans and animals when disposed of in bodies of water. Current wastewater treatment approaches not only display ineffective results in removing the mentioned stimulant but also entail high financial costs in applying the treatment technology. Recent studies have revealed the potential of adsorbents derived from plant sources such as husks, fruit peels, and other plant fibers from biomass to effectively reduce caffeine concentrations in wastewater, with a removal efficiency in the range of 8.04 to 171.23 mg/g. Moreover, the adsorption phenomena exhibited a Langmuir isotherm model and pseudo-second-order kinetics. This review paper study aims to comprehensively present and analyze the current literature and prospects of utilizing plant-based adsorbents in addressing the impact of caffeine on the environment. Specifically, the review will focus on the efficiency of said adsorbents in removing caffeine, considering the specific surface area, adsorbent dosage, pH level, maximum adsorption capacity, adsorption isotherms and kinetics, and the predicted optimum conditions for adsorption using RSM. The objective is to identify the most suitable adsorbents to be used in wastewater treatment plants. This study will serve as a valuable reference for future research.

sciforum-090384: Potential Role of Nanoparticles For the Development of Plants

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Nanotechnology has facilitated various applications in food and agricultural industries due to the unique characteristics of nanoparticles, such as their large surface area, reactivity, tendency to agglomerate, ability to penetrate, and specific size and structure. The exploration of nanoparticles in agriculture is gaining interest because of their ability to minimize the use of chemical fertilizer and significantly enhance plant growth. Nanoparticles have proven to be highly beneficial for plant development. Nanotechnology plays a vital role in improving methods for monitoring ecological conditions, managing pathogenicity, managing crop capacity for photosynthetic respiration, increasing nutrient or pesticide absorption and accelerating seed germination. The effects of NPs on plants depend on their size, shape, concentration, coatings, self-aggregate tendency, and stability. Several studies have demonstrated that controlled concentrations of nanoparticles significantly promote seed germination and facilitate robust plant growth. A clear understanding of the physiological, biochemical, and molecular mechanisms of nanoparticles in plants can lead to enhanced plant growth and development. Here, we provide an overview of the applications of recently developed nanoparticles, including metallic and non-metallic NPs and carbon-based nanomaterials (CNMs). These NPs have been explored for their potential in mitigating crop diseases, leading to improved seed germination, vigor, enhanced plant growth, flowering and seed production.

sciforum-090374: Property-Specific Biopolymer Production in Electroactive Biofilms

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Although the biology- and yield-improving potentials of a few industrially relevant electroactive biofilms have been investigated to a minimal extent, an efficient bioprocess system control for biofilm-based bioproduction is yet to be reported. However, the controlled application of electrical potential could be employed to modulate biofilm metabolism (respiration) in a manner that favors the secretion of the target EPS component. In this study, various regimes of electrochemical techniques are employed to produce polyglutamic acid (PGA) with specific molecular weights and stereoisomeric properties over a period of 48 h. In the first stage, biofilm formation and electroactivity are enhanced via specific stressors, followed by varied potentiostat-controlled biocatalyst respiration and its influence on specific product formation in the matrix. Lastly, the key molecular genes encoding the proteins facilitating the electroactive bioprocess in tandem with specific properties of PGA will be characterized for further process improvement. The biofilm produced by *Bacillus subtilis* PB5760 was enhanced in the presence of 17 mM choline chloride-based deep eutectic solvent from 0.23 to 1.44 as measured using a crystal violet assay. Also, the molecular weights of the polyglutamic acid (PGA) content of the matrix obtained under an applied potential of 0.4 V and open circuit potentiometry (OCP) were 2.168×10^6 and 3.986×10^6 Daltons, respectively. Under the stated experimental conditions, polydispersity indexes (Mz/Mn) of 1.957 and 2.310 were obtained at 0.4 V and OCP, respectively, which are key factors that determine the usefulness of PGA in the food, cosmetic, pharmaceutical, and biomedical sectors. This platform potentially offers a non-invasive, real-time monitoring and control system of microbial redox states by channeling electron flux without having to produce undesired by-products in the form of reduced organic compounds during fermentation.

sciforum-084491: Reducing Pressure on Aquifers: Examining Rainwater Use as an Alternative in Denim Wet Processing in Narayanganj, Bangladesh

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Bangladesh's economy heavily relies on its textile industry, contributing a substantial 83.4% to the nation's export revenue. Within this sector, wet processes consume significant amounts of water, often leading to a heavy dependence on easily accessible groundwater. However, this reliance poses a threat to local communities' access to safe potable water, particularly in Narayanganj, located to the southeast of Dhaka, where numerous textile factories are located. The excessive use of groundwater has caused a rapid decline in the water table, amounting to a 1 to 2 m drop annually. This study aims to explore the feasibility of using rainwater as an alternative water source for textile wet processes in Narayanganj, where the yearly average rainfall reaches 2047 mm and meets the necessary water quality standards for textile processing. The research emphasizes integrating rainwater with groundwater for these processes, aligning with Sustainable Development Goals (SDGs) 6, 9, and 12. Denim fabrics underwent dyeing and washing procedures using harvested rainwater, after which the samples underwent evaluation through tests for color fastness during washing and rubbing (under both dry and wet conditions). The obtained results, falling within the 4–5 Grade range, unequivocally affirm the viability and efficiency of rainwater harvesting as a water resource for textile wet processing in denim manufacturing. This confirms the effectiveness of rainwater harvesting for textile processing, potentially meeting 40–60% of the industry's water demands. Embracing this alternative source can ease pressure on groundwater reserves and offer a sustainable solution to address their depletion. These findings are expected to benefit inhabitants of Greater Dhaka, water management authorities, and register a positive impact on the environment.

sciforum-083377: Removal of Cadmium (II) from Acid Mine Drainage Using Biodegradable Adsorbent Using Response Surface Methodology

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To eliminate Cd^{2+}, an adsorbent derived from cellulose nanocrystals (CNCs) was effectively produced. The FTIR, SEM, TGA and BET pecific surface area were used to ascertain the properties of CNCs. In addition to how well they predicted reaction (adsorption capacity), the response Surface Methodology modeling was used. The process was further understood by applying the kinetic models and the adsorption isotherm. The response surface model method performs well, according to statistical data. After 240 min of contact, a beginning concentration of 300 mg/L, an adsorbent dosage of 12 mg, and a pH of 6 initially, the adsorption capacity was 400.01 mg/g. The FTIR examination revealed that the functional groups of the nanocomposites were equivalent to those of CNCs and chitosan; however, the nanocomposites were more thermally stable than CNCs and chitosan. The SEM images of the nanocomposites showed a needle-like form, thin particle size, and porous structure. The adsorption process is spontaneous, explained by the Langmuir model; chemisorption was the main controlling factor. The Dubinin-Radushkevich Model indicates that chemisorption was likely involved since it takes more energy than 8 kJ mol^{-1} to adsorb Cd^{2+}. With the use of the pseudo-second-order rate model, the adsorption kinetics were determined. H_{OMO}–L_{UMO} energy binding differences were used to find the best locations for adsorption.

sciforum-087367: Removal of Micropollutant by Using Hydrocavitation/Ozone

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Organic micropollutants (OMPs) have been found in water bodies all over the world, and they have the potential to impact the environment. OMPs can enter water bodies from a variety of sources and flow routes. One significant source is effluent from conventional wastewater treatment plants, where many OMPs are not completely removed. Therefore, advanced oxidation processes (AOPs) have been extensively explored and executed to degrade refractory OMPs. The AOPs involve the generation of hydroxyl radicals ($HO^{\bullet}$), which are powerful oxidants capable of destroying a wide range of OMPs in water. The purpose of this study is to investigate the use of hydrodynamic cavitation in combination with ozone ($HC + O_3$) to degrade succinic acid (the emerging contaminant). Cavitation is a process that involves the formation and collapse of bubbles as a result of a local pressure drop, which can produce strong reactive species ($HO^{\bullet}$) in liquid. The combination of HC and O_3 speeds up the formation of $HO^{\bullet}$ in liquid. The treatment was carried out with varied nozzle pressures and O_3 concentrations at a nozzle office diameter of 300 μm. The results demonstrated that $HC + O_3$ could efficiently remove SA, with around 41% removal observed at a nozzle pressure of 48 bar, at an O_3 concentration of 7.4 mg/L and at an initial concentration of 100 mg/L.

sciforum-089813: Review Green Extraction of Manganese from Leach Solutions in Hydrometallurgy Process of Nickel Laterite Ore

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The increasing need for nickel, due to the necessity of producing eco-friendly electric vehicles, highlights the importance of obtaining nickel from nickel laterite ore, which is the main source of this essential commodity. Hydrometallurgy is the favored technique for extracting nickel from minerals with a low nickel content. The leach solution in the hydrometallurgy process contains several minerals such as nickel, cobalt, iron, zinc, chromium, aluminum, and manganese. Manganese plays a crucial role in battery manufacturing, and extracting manganese in the hydrometallurgical process of nickel laterite greatly enhances the economic value of this process. This paper explores the current technologies in use, including Mixed Sulfide Precipitation (MSP), Mixed Hydroxide Precipitation (MHP), and Direct Solvent Extraction. Although MSP and Direct Solvent Extraction exhibit good selectivity, they have environmental downsides, including the excessive use of organic solvents and the release of harmful pollutants. Therefore, the search for more environmentally sustainable options has become more important. Various eco-friendly techniques have been studied, including the oxidative precipitation of manganese utilizing ozone, oxygen, and hydrogen peroxide. This paper provides a detailed review of the complexities involved in the green extraction process, highlighting the various factors that affect its results. The goal is to offer valuable insights for practical use in industries and set the foundation for future research, specifically focusing on promoting sustainable methods and addressing challenges related to removing manganese during the preparation of nickel products.

sciforum-090367: Robust Zinc Metal–Organic Framework-5 for Selective Landfill Methane Capture: Synthesis and Physicochemical Property Analysis

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Landfills are the third leading source of methane (CH_4) emissions. Engineering controls aim to capture methane and utilize it as an energy source using metal–organic framework systems during active periods or in abandoned landfills. Due to its exceptional physical features and tunable nature, adsorption on metal–organic frameworks (MOFs) presents itself as a potentially viable alternative for methane-selective separation/adsorption. As a result of some complex inherent features, it has proven challenging to comprehensively synthesize MOFs for methane capture and to evaluate their physicochemical properties using conventional techniques.

The aim of this study is to synthesize and optimize a zinc metal–organic framework (Zn-MOF-5) under various conditions of temperature, ranging from 85 °C to 90 °C, as well as a reaction time from 24 h to 48 h, and test its suitability for selectively capturing landfill methane through comprehensively exploring its physicochemical properties, including the functional groups, crystallinity and thermal stability using Fourier Transform Infrared (FTIR), X-ray Diffraction (XRD) and Thermogravimetric Analysis (TGA). The Zn-MOF-5 material revealed broad bands at 2980 and 2871 cm^{-1}, which are attributed to the C-H stretching vibrations of the methylene–alkane groups in the DEF molecule and the asymmetric stretching vibration of the C=O group linked to Zn at 1658 cm^{-1}. The XRD obtained broad peaks, which indicated an increasing regularity of the crystalline structure and better alignment layers with 0.92–1.04 cm^3/g micropores, and the material was proven through TGA to be thermally stable up to a temperature of 500 °C.

sciforum-090554: Selected Aspects of the Antibacterial Use of Lactic Acid in Food Processing

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Lactic acid is well known in food technology as a preservative in naturally fermented products or as a technological additive E (270) without quantity restriction. L(+)-lactic acid is authorised as an active substance for biocidal products, with applications in the fields of veterinary hygiene, food, and animal feed. Several factors can influence the antimicrobial effect of lactic acid, including the applied concentration of lactic acid, the contact time, and the organic soling of the surface to which it was applied.

The aim of this study was to evaluate the bactericidal activity of 5% (*v*/*v*) and 1% (*v*/*v*) lactic acid solutions on test bacteria: the Gram-negative strain Salmonella *enterica* subsp. *enterica* serovar Typhimurium (ATCC 14028) and the Gram-positive *Staphylococcus aureus* subsp. *aureus* (ATCC 33592), which is a strain that is resistant to gentamicin and methicillin (MRSA). A dilution–naturalization method was used, based on EN 1276, a quantitative suspension test for the evaluation of the bactericidal activity of chemical disinfectants and antiseptics used in the food, industrial, domestic, and institutional areas, with the bacterial activity being modified in part of the obligatory test organisms.

The obtained results showed no difference in the results of the tests under simulated clean and dirty conditions. Both tested concentrations of lactic acid showed a 5 lg reduction in *Salmonella* Typhimurium. For the tested strain *Staphylococcus aureus*, the required reduction of 5 lg was not achieved. These results contribute to a better understanding and rational use of lactic acid for antibacterial purposes.

sciforum-089691: Snamboo: Handmade Bag from Natural Fibers of Snake Plant *(Dracaena trifasciata)* Leaves and Bamboo *(Bambusa vulgaris)* Sheaths

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This study aimed to produce a handmade paper bag from natural sources of fiber, namely snake plant *(Dracaena trifasciata)* leaves and bamboo *(Bambusa vulgaris)* sheaths. The researchers successfully developed and produced the product, noting significant contributions in the field of environmental and green processes, ultimately leading toward solutions to major problems on Earth. Specifically, this study determined the quality of the produced bag in terms of weight, durability, and reusability. The findings of the tests conducted showed that the handmade paper bag with dimensions of $7.5'' \times 4'' \times 10''$ has an average weight of 78.33 g, which means that it is slightly heavier than commercial bags. Thickness is a big factor that can affect the weight of the paper bag, which means that the thicker the paper, the heavier the basic weight, which results in a greater load-carrying capacity. As such, the durability test conducted revealed the strength of the produced bag, represented by a weight-carrying capacity of 5.05 kg. It also can endure heavy weights for an extended period of time, which implies that it is capable of carrying even more than 5.05 kg. Meanwhile, a real-word usage simulation was also conducted to determine the reusability of the bag. This was conducted by walking with each bag with the full weight in a 50-m distance per walk cycle. Based on the test, it is concluded that the bag can be reused 20 times on average, which exceeded the standard of only 3 reuses. In conclusion, the paper bags produced from snake plant and bamboo sheath fibers exhibit good quality for usage, and thus, these have the potentiality to create sustainable and organic paper bags.

sciforum-089844: Solar-Enhanced Photocatalytic Decontamination of Water from Tetracycline Antibiotics and Its Application in Aquaculture

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The occurrence of emerging pharmaceutical contaminants, especially antibiotics in water systems, is an alarming issue and is addressed using advanced oxidation processes (AOPs). In this study, the degradation of tetracycline hydrochloride (TCT) is evaluated and compared using UV and solar light as the source of energy in the presence of semiconductor oxide catalyst ZnO. Further, the effective solar photocatalytic degradation of TCT in distilled water and aquaculture wastewater was deeply investigated. TCT showed a 62% degradation efficiency in deionized water at the laboratory scale, while aquaculture effluent exhibited 87% degradation efficiency with the ZnO catalyst after 60 min of solar irradiation. The effect of multiple contaminants such as chloroquine (CLQ) and sulphamethoxazole (SMX) on TCT degradation was also investigated. CLQ inhibited the degradation of TCT, whereas SMX did not. The effective operational parameters, such as pH, irradiation time, photocatalyst dosage, the effect of oxidants, the effect of anions, and TCT concentration, were studied consecutively. The pseudo-first-order kinetic model best fit the experimental results (different tetracycline concentrations). Complete COD removal of TCT concentrations was achieved in deionized (up to 90 mg/L) and aquaculture wastewater. The catalyst was characterized using SEM, TEM, and XRD images. LC-QTOF analysis was used to identify the intermediates formed during the degradation using a mechanistic pathway. The results suggest the possibility of using inexpensive natural, non-renewable solar energy to purify TCT-contaminated real wastewater, thereby enabling the reuse of scarce water resources.

sciforum-090379: Some Characteristics of Actinomycetes Isolated from the Soil of the Belgorod Region

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Microorganisms of various systematic groups, such as fungi, bacteria and actinomycetes, represent an inexhaustible source of biologically active substances that can be used in various fields of human activity. Among them, actinomycetes of the genus *Streptomyces* stand out as producers of many promising metabolites. These gram-positive filamentous bacteria are widespread in soil and marine sediments, and synthesize most clinically important antibiotics, attracting high interest in the pharmaceutical and industrial fields. It is important to note that not all *Streptomyces* strains have been fully studied, which opens up additional prospects for their study.

The purpose of this work was to characterize pigment synthesizing actinobacterial isolates.

A soil sample from the Belgorod region, Russia, was taken for the study. The isolation of the bacterium was carried out by serial dilution on LB nutrient medium (composition g/L: Peptone-10, Yeast extract-5, NaCl-5, agar-agar-20). The isolates were characterized using standard biochemical, morphometric and genetic tests.

12 bacterial strains were isolated, the morphometrical characteristics of which allowed them to be presumably attributed to the order actinomycetes. One of the strains, GB43 was capable of synthesizing pink pigment. On solid LB medium, strain GB43 formed convex, round pink colonies with an uneven edge growing into the nutrient medium. This strain was tentatively identified as *Streptomyces griseoaurantiacus* based on phylogenetic analysis of the 16S rRNA gene. Isolate BG43 showed pronounced antimicrobial activity against phytopathogenic fungi and bacteria, which makes it promising for plant protection biotechnologies.

sciforum-089163: Spent Tea Biochar Production: Characterization and Environmental Applications

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The world is suffering from a myriad of environmental issues, including but not restricted to solid wastes management, water scarcity and water and soil pollution and governance. In Lebanon, most rural municipalities dump waste into valleys or leave ituntreated until people burn it themselves. Simultaneously, water resources in Lebanon are suffering from pollution induced by urban as well as industrial wastewater, which includes pharmaceutical compounds. The polluted water has resulted in disease outbreaks and has also affected the daily lives and the overall health of people.

In this study, we intend to turn a common form of waste into value through its conversion into biochar for subsequent use as an efficient material for industrial wastewater treatment. To this end, spent tea leaves were dried, ground and pyrolyzed at 350, 450, 550 and 650 °C in a muffle furnace in a total absence of oxygen. The biochar production yields ranged from 48% at 350 °C to only 30% at 650 °C. The pH and electrical conductivity values of the synthesized biochars increased with the increase in the pyrolysis temperature. The highest obtained pH was 10.45 and the highest electrical conductivity was 13.6 mS/cm, both assessed at 650 °C. Preliminary batch adsorption tests showed that biochars efficiently removed methylene blue, amoxicillin and diclofenac at percentages of 100%, 80% and 51%, respectively.

sciforum-090469: Stability Assessment of Resveratrol Tablets Stored under Stress Conditions via Directional-Hemispherical Reflectance

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Resveratrol is a natural polyphenol found in many vegetables and fruits. Scientific reports have demonstrated its broad pharmacological activity, including cardioprotective, anti-cancer, anti-microbial, anti-ageing, antioxidant, immunomodulatory and neuroprotective effects. However, due to its low solubility, as well as its sensitivity to light and elevated temperature, it is susceptible to configuration transformation and rapid degradation. Various analytical techniques are used to assess the stability of solid drug forms. The aim of this work was to assess the stability of tablets containing this natural polyphenol, after storage under stress conditions, using hyperspectral analysis (THR). To test the suitability of THR to monitor the stability of the tablets under study, the formulations were stored in a Solarbox 1500 chamber (COFOMEGRA s.r.l., Milan, Italy) for different periods of time (1 day, 5 days) at two different temperatures (20 °C, 45 °C), yielding four storage conditions. The photostability test was performed in accordance with ICHQ1B guidelines. SOC-410 Directional Hemispherical Reflectometer (Surface Optics Corporation, San Diego, CA, USA) was used to determine the total reflectance of tested tablets bands in the spectral range of 335–2500 nm. Twenty tablets were tested at each time point, and the results obtained were subjected to statistical analysis. Irrespective of storage conditions, significantly lower mean directional reflectance was observed for tablets stored under stress conditions compared with the values determined at the beginning of the experiment (0 day). Furthermore, the highest total directional reflectance was observed for the two near-infrared spectral ranges (700–1100 nm and 1000–1700 nm), while the lowest was observed for the near-ultraviolet range (335–380 nm). The present study showed that during storage under stressful conditions (heat and UV radiation), more light was transferred to the interior of the tablet matrix, which may have been due to changes in its physico-chemical parameters.

sciforum-082959: Structural Comparison of Sodium Bicarbonate and Hydrated Lime for Dry SO_2 Removal

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In dry flue gas treatment systems, gas–solid interactions are modulated by the reagent's molecular composition and physical attributes. In the present investigation, sodium- and calcium-based sorbents were screened for structural and compositional variations for subsequent application in sulphur dioxide capture. Mined sodium bicarbonate ($NaHCO_3$) in an unprocessed form and commercial-grade hydrated lime ($Ca(OH)_2$) were subjected to morphological analysis employing scanning electron microscopy (SEM), particle size distribution (PSD), Brunauer–Emmett–Teller surface area evaluation and Barrett–Joyner–Halenda (BJH) pore structure classification. Fourier Transform Infrared Spectroscopy (FTIR) was used for surface elemental chemical assessment. Pursuant to the BET report, $Ca(OH)_2$ presented a larger specific surface area (4.2360 m^2/g) compared with $NaHCO_3$ (0.2303 m^2/g), which was supported by the weighted mean value (D43) from the PSD analysis. Although $Ca(OH)_2$ had a higher pore volume (0.089822 cm^3/g), the totality of the $NaHCO_3$ pore size (117.312 Å) was classified as mesoporous. The SEM assessment suggested that the lower $NaHCO_3$ surface area stems from larger particle sizes. The FTIR spectrum indicated a greater carbonate concentration in the $NaHCO_3$ sorbent material, which also determines the pore morphology of the reagent. These findings offer critical information that is pertinent to the intricate dry flue gas desulphurisation process. The generated data will be the basis of fixed-bed experiments in a subsequent study.

sciforum-090393: Structural, Morphological, Thermal and Mechanical Study of a Geopolymer Based on Metakaolin Mixed with Oujda Clay

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Geopolymers, typically, are created by blending aluminosilicate with a concentrated alkali hydroxide or an alkaline silicate medium, and then undergo a curing process at room temperature or slightly higher. The formation of geopolymers includes a combination of solid and liquid components. The solid part comprises aluminosilicate sources in powder form, containing a proper ratio of highly reactive silica and alumina. This study investigated a metakaolin-based geopolymer blended with Oujda clay, replacing 5–15 wt.% of MK. The research delved into the structural, thermal stability, and microstructural changes in the geopolymer pre- and post high-temperature exposure, using X-ray diffraction (XRD), thermogravimetric analysis (TGA), Fourier-transform infrared spectroscopy (FTIR), and scanning electron microscopy (SEM). Thermal treatment of Oujda clay was conducted, and the optimal conditions were determined as calcination at 800 °C for 3 h. It was observed that the addition of Oujda clay enhanced the compressive strength of the geopolymer by expediting the reaction process activated by the alkalis. After 28 days of curing, the compressive strength increased by 31% with 15% by weight of Oujda clay. The high chemical activity of Oujda clay accelerated the geopolymerization process at high temperatures and facilitated the healing of microcracks. Moreover, Oujda clay improved the formation of a compact ceramic protective layer, thereby preventing the geopolymer from disintegrating at elevated temperatures.

sciforum-084598: Synthesis and Characterization of Superabsorbent Polymer (SAP) from Cotton Waste Cellulose

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A super absorbent polymer (SAP) is a class of polymers that absorb large quantities of water more than a typical absorbent material. Recently, research on the use of waste raw materials has extensively been studied. One particular waste material of interest is cotton waste, which is known to be a good source of cellulose. In this study, a sustainable SAP from carboxymethylcellulose sodium (CMC) and extracted cellulose from cotton waste material at varying weight ratios of CMC to cellulose (7:3, 2:1, and 5:5) crosslinked with citric acid was proposed. The produced SAP samples were then characterized by Scanning Electron Microscopy (SEM) for morphological properties and a Fourier Transform Infrared Spectroscopy (FTIR) analysis for the functional groups' identification. In addition, the swelling rate, absorptivity, and water retention were investigated to evaluate the performance of the prepared SAP. The SEM results showed that there is an increasing porosity of the surface of SAP as the concentration of CMC increases. FTIR results indicate that the cross-linking formation of the carboxylic group was visible at the band range from 1640 to 1600 cm^{-1} and the presence of the OH^{-1} bond was found at the band range from 3500 to 3000 cm^{-1}, which is essential in water absorption. For the swelling rate of the SAP samples, it took 45 to 50 min to reach swelling equilibrium while the maximum swelling capacity was found to be 68 and 55 g H_2O per g dry sample for the 7:3 and 2:1 ratio of CMC–cellulose solution samples. Water retention results showed that 13.8 and 15.9% of water was lost, respectively. The results of this study showed the potential of cotton waste as a sustainable source of cellulose for the production of SAP.

sciforum-085453: Synthesis of Biocompatible Bacterial Cellulose–Chitosan Composite from Nata de Coco and Squid Gladius

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Recently, studies have been conducted utilizing the pellicle of Nata de Coco (NC) as a sustainable source of bacterial cellulose (BC) and Squid Gladius (SG) for chitosan. In this work, the synthesis of a biocompatible bacterial cellulose–chitosan composite (BCC) from NC and SG was conducted. In addition, the effects of varying chitosan concentrations (2%, 5%, 8% w/v) on the physicochemical properties (morphology, water holding capacity, and tensile strength) and biocompatibility were investigated using Simulated Body Fluid (SBF). The BCC composite showed a denser and more homogenized structure compared to the BC pellicle, as was seen from the scanning electron microscopy (SEM). The Fourier Transform–infrared spectroscopy (FTIR) results demonstrated that the spectra of the pellicles were in the 2800 to 1200 cm^{-1} wave range, while the bands for the amide groups were observed at peaks at 1613, 1550, and 1337 cm^{-1}, which were associated with the presence of chitosan. The highest water holding capacity of 581% was achieved by 8% w/v chitosan containing BCC, while the 5% w/v chitosan containing BCC tended to endure more tensile force. The SEM images of the BCC pellicles that had undergone the SBF process showed the gradual progress of the formation of the hydroxyapatite (HaP) crystals with a Ca-P ratio of 1.67 on the third day, as revealed by the X-ray Fluorescence (XRF) indicating a biocompatible property. The FTIR analysis showed all the typical absorption characteristics of HaP, ranging from bands observed at 3555 and 622 cm^{-1} due to the stretching mode of hydrogen-bonded ions and liberational mode of hydrogen-bonded ions, respectively. The results of this study showed the potential of producing biopolymers from biomass for possible wound dressing products for biomedical applications.

sciforum-086902: Synthesis, Characterization and Photocatalytic Activity of Sb_2O_3 Nanoparticles: A Step towards Environmental Sustainability

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Introduction

Numerous nano-photocatalysts have been used to degrade toxic dyes for the wastewater remediation process. This paper focuses on characterizing Sb_2O_3 nanoparticles (NPs) synthesized via the solvothermal process. Ball-shaped morphology was obtained for the NPs, which is not usually reported. The photocatalytic activity was tested against Methylene Blue (MB) dye, which is associated with potential toxicity when used in high concentrations. Therefore, the purpose of the synthesis of the NPs was to know their role in environmental remediation.

Material and Methods

The fabrication of Sb_2O_3 NPs was carried out using the solvothermal process. All the chemicals used were of analytical grade.

Major Results

Different analytical techniques were used for the characterization of the NPs. The NPs were found to be round. XRD (X-ray diffraction) patterns were recorded to measure the size and phase of the Sb_2O_3 NPs. The size of the NPs was around 20 nm as calculated using the Sherrer equation. Using the JCPDS data card (card number 00-003-0530), the sample was found to have an alpha phase of Sb_2O_3, indicating high purity. The NPs caused a 60% degradation of MB in 60 min under ultra-violet (UV) light irradiation. The dye was found to be adsorbed on the surface of the NPs.

Conclusions

The dye degradation activity of the NPs may be attributed to the high surface area and effective charge conversion ability along with their unique morphology. Therefore, the synthesized NPs could be used as nano-photocatalysts in wastewater treatment.

sciforum-089850: Synthesizing Cadmium Oxide (CdO) Nanoparticles Using Leaf Extract of *Amaranthus dubius*

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Biologically fabricated nanoparticles have several applications in numerous fields where bio-mediated nanoparticles emerged as having a major role in green synthesis. In this study, cadmium oxide (CdO) nanoparticles were synthesized using *Amaranthus dubius* leaf extract as a reducing and stabilizing agent. Generally, cadmium oxide (CdO) nanoparticles have wide applications as pigments in paints, semiconductors, plastics, the production of batteries and other electronic applications, and also exhibit excellent magnetic, optical and structural properties. Furthermore, in the present investigation, the synthesized samples were characterized using methods such as X-ray Diffraction (XRD), Fourier-Transform Infrared Spectroscopy (FTIR), UV-Visible Absorption Spectroscopy (UV) and Transmission Electron Microscopy (TEM). Using X-ray Diffraction, the crystalline structure of cadmium oxide (CdO) nanoparticles is identified whereas Fourier-Transform Infrared Spectroscopy is used to identify the molecular interactions taking place in the sample. A reduction in cadmium (Cd^{2+}) ions and the optical band gap value is recognized using UV-Visible Absorption Spectroscopy, while Transmission Electron Microscopy shows the spherical nature of cadmium oxide (CdO) nanoparticles. Thus, the present study concludes that the biologically synthesized cadmium oxide (CdO) nanoparticles exhibit enhanced morphology and are non-toxic to the environment. This synthesis method ensures the rapid production of metallic nanoparticles which is environmentally friendly, simple and economical in nature.

sciforum-082804: Terbium Iodide-Filled Single-Walled Carbon Nanotubes: Microscopy and Spectroscopy Investigations

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Terbium (III) iodide is an interesting chemical compound with unique chemical properties. The introduction of terbium iodide into single-walled carbon nanotubes (SWCNTs) is an environment-friendly process, and it leads to the development of new nanocomposites with improved properties. The embedded terbium iodide forms new one-dimensional atomic structures inside the SWCNTs. Moreover, the electronic properties of filled SWCNTs are modified. Here, the atomic structures of terbium iodide-filled SWCNTs are investigated using high-resolution transmission electron microscopy, and their microstructure, morphology, and filling degrees are studied. The electronic properties of filled SWCNTs are investigated using spectroscopy. Raman spectroscopy provides information on the charge transfer inside filled SWCNTs. The number of transferred electrons and the charge transfer density along the SWCNT axis are estimated from the Raman spectra. These data on charge transfer are required for the application of terbium iodide-filled SWCNTs in nanoelectronics, thermoelectric power generation, and sensors. The obtained quantitative data reveal the high doping efficiencies of SWCNTs with terbium iodide. This is one of the most effective dopants for SWCNTs. The data show a strong p-doping of SWCNTs with the charge transfer from SWCNTs to terbium iodide. The data from Raman spectroscopy testify to the shift of the Fermi level to the valence band of the SWCNTs. The Fermi level shifts are estimated from these data. They are in the range of 0.3–0.4 eV and are comparable to the values for SWCNTs filled with other rare earth metals using environment-friendly processes.

sciforum-090058: The Biodegradation Behavior of a Siloxane/Polycaprolactone Composite

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Due to their high biocompatibilities and simple modifications, polymers have attracted a lot of attention for use in biomedical applications. Nevertheless, a large number of polymers are not ecologically friendly or biodegradable. It is well recognized that natural polymers are environmentally friendly and biodegradable, whereas synthetic polymers offer better mechanical and thermal properties. Thus, the resulting hybrid materials have the potential for environmental and biomedical applications by combining the benefits of synthetic and natural polymers. In this work, ε-caprolactone (CL) was polymerized utilizing an aminopropyl polydimethylsiloxane (APDMS) oligomer to generate a siloxane/polycaprolactone hybrid copolymer. Energy dispersion spectroscopy (EDX), NMR spectroscopy, FTIR spectroscopy, gel permeation chromatography (GPC), scanning electron microscopy (SEM) and AFM (atomic force microscopy) were used to evaluate the siloxane/polycaprolactone composite material. The effects of this compound on the evolution of tomato plants (*Lypercosium esculentum*) were investigated, but also on their biological stability by identifying some microorganisms developed on the surface, given its susceptibility to biodegradation. The development of microorganisms, specifically *Lypercosium esculentum*, which was originally found on polycaprolactone-based hybrid polymeric materials, demonstrates that these products exhibit appropriate environmental susceptibility and do not significantly alter soil composition or plant evolution. Furthermore, without impairing soil bioremediation, the investigated hybrid could be a solution in the future because of its better performances when compared to the individual materials and its ability to model properties according to the field of usage.

sciforum-085857: The Design and Fabrication of a 3D-Printed Electrolyzer with Membrane-Less Technology for Green H_2 Production

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Hydrogen production through water splitting is a popular technology. The reaction takes place in an electrolyzer unit. There are different types of electrolyzers available, including proton exchange membranes (PEMs), anion exchange membranes (AEMs), and alkaline and solid oxide electrolyzers. Although PEMs are a widely used commercial electrolyzer, they are very sensitive, not very durable, and have a high cost due to the membrane. To eliminate the cost of the membrane, the concept of membrane-less electrolysis technology was developed.

In this study, a new membrane-less electrolyzer design was proposed with a flow-through electrolyzer, as shown in Figure 1. The design was manufactured with the help of 3D printing technology with acrylonitrile butadiene styrene (ABS) polymer material that is more stable in basic media. To increase the conductivity of water, a 4M KOH solution was provided for electrolysis. In this design, electrodes were placed at an angle of 30° to each other. The generated hydrogen and oxygen gases were separated from each other using the effect of the flow of water between the electrodes. The tapered inlet was provided to maintain a proper laminar flow through the inlet. In the middle of the electrolyzer, a divider was also provided for separating the generated hydrogen and oxygen gas. A Ni mesh with an 80 grit size was used in the place of electrodes. The purity of the generated gas was measured via a gas chromatography instrument. A H_2 purity of about 99.85% was achieved by using a Ni mesh as an electrode at normal temperature and pressure.

sciforum-090423: The Physicochemical Properties of Metal–Organic Frameworks Suitable for CO_2 Capture: A Comparative Study of Magnesium- and Zinc-Based Materials

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Carbon capture and storage (CCS) is a climate change mitigation technique in which CO_2 is captured from a point source, including coal-fired power plants and other industrial activities, rather than released into the atmosphere. The utilization of metal–organic frameworks (MOFs) is one of the most promising approaches for post-combustion carbon capture due to their unique properties including high porosity, surface area, crystallinity, stability, and selectivity, and their wide range of applications, which include gas separation and storage. This paper presents a study on a unique approach to the synthesis of magnesium (Mg)- and zinc (Zn)-MOF-74 materials under varied reaction temperatures and times using the solvothermal technique. This study further explores the physicochemical properties of the materials to evaluate their suitability for selectively capturing CO_2 from flue gas produced by typical coal-fired power plants.

The MOF crystals were synthesized at 100, 110, and 125 °C for 6, 12, 24, and 48 h. The physical characteristic were examined using BET analysis, while the surface chemistry, crystallinity, and morphology were investigated using Fourier-transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), and scanning electron microscopy equipped with energy-dispersive X-ray (SEM-EDX), while the thermal stability was evaluated using thermogravimetric analysis (TGA). The FTIR results showed the presence of carboxyl (C=O) and hydroxyl (-OH) functional groups that demonstrate high affinity potential for CO_2 adsorption in Zn-MOF-74, whereas only a -OH group was present in Mg-MOF-74. The TGA results showed that the Mg-MOF-74 samples were more stable up to 580 °C whereas the Zn-MOF-74 samples were stable up to 430 °C. The highest surface area and pore volume of Zn-MOF-74 synthesized at 125 °C for 24 h were 826 m^2/g and 0.344 cm^3/g, whereas those of Mg-MOF-74 synthesized at 110 °C for 8 h were 24.73 m^2/g and 101.34 cm^3/g. Thus, the physical and chemical properties of the crystalline material prepared at high temperatures were suitable for carbon capture.

sciforum-088576: The Prediction of Road Traffic Congestion Patterns: An Optimized YOLOv8-Based Approach

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This research presents a new approach for Video Content Analysis (VCA) with a specific focus on detecting and analyzing road traffic congestion patterns. The implemented methodology deploys the YOLOv8 (You Only Look Once version 8) object detection framework, which has been optimized to accurately and efficiently identify road traffic objects within video streams. The primary objective is to enhance the capabilities of traditional VCA systems by capturing and understanding complex road congestion scenarios. This research develops a customized YOLOv8 model optimized specifically for road traffic analysis. The optimization process addresses the challenges inherent in real-world traffic scenarios, including variations in lighting conditions, diverse vehicle types, and dynamic traffic flow patterns. The developed model seeks to enable the robust and real-time detection of congestion-related events, such as heavy congestion and normal congestion, thereby contributing to improved traffic management and overall road safety. Moreover, the study explores the integration of advanced techniques for congestion pattern analysis, including vehicle detection, tracking, and counting. The combination of these features facilitates a comprehensive understanding of traffic dynamics and congestion evolution over time. The proposed approach is trained and evaluated on benchmark datasets and real-world video footage to assess its performance. Experimental results demonstrate the effectiveness of the optimized YOLOv8-based approach in accurately detecting and analyzing road traffic congestion patterns. The system exhibits promising capabilities in handling diverse and challenging scenarios, thereby serving as a valuable tool for intelligent transportation systems, urban planning, clean environment, and traffic management. This research significantly contributes to the advancement of video-based traffic analysis, providing a robust solution for monitoring and mitigating congestion-related challenges on road networks.

sciforum-084384: The Prospects of Acetogenic Pretreatment for Energy Conservation in Textile Processing Wastewater in Resource-Constrained Economies

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The textile sector holds a pivotal role in Bangladesh's economy, being its primary source of foreign exchange (84%) and employing around four million individuals, primarily women. However, the rapid and unregulated expansion of these industries has resulted in significant environmental repercussions. The uncontrolled discharge of untreated textile wastewater has emerged as a pressing concern, causing pollution in water bodies. Compliance challenges stem from the elevated treatment costs, driven by the usage of costly imported treatment chemicals and reliance on energy-intensive systems. Textile processing generates substantial wastewater volumes, often necessitating extended aerobic treatment to mitigate biochemical oxygen demand (BOD), which substantially consumes energy. This paper introduces a pioneering approach involving microbial acetogenic pre-treatment of textile wastewater, focusing on a practical case study within a textile processing industry. The outcomes highlight a remarkable 95% efficiency in reducing biodegradable organic matter through acetogenic pre-treatment, accompanied by further reductions in chemical oxygen demand and total dissolved solids. The kinetics of degradation adhere to well-defined first-order kinetics, with a first-order rate constant "k" for the degradation of textile dyeing wastewater measured at 0.048 hr^{-1} (95% confidence bound: 0.030, 0.064). By reducing the BOD_5/day loading to the extended aeration treatment system by 143 kg, a substantial potential energy saving of 574 KWh/day in aeration requirements is projected.

sciforum-081137: The Use of a Sonoplasma Discharge for the Prevention of Biocorrosion in Oil Wells

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Nowadays, the problem of the biocorrosion of equipment placed inside oil wells due to the injection of unprepared water into oil reservoirs in order to increase the reservoir pressure is becoming more and more urgent. This has led to an adjustment of r water requirements for this purpose. According to the new standard that has been adopted in Russia, water for injection into reservoirs should contain no microorganisms.

Technologies which can be used for the sterilization of water are often costly and require the use of chemicals or membranes, which need to be periodically replaced. During the preparation of water for injection wells, the use of chemicals is very limited since aspects such as the deposition of reaction products inside the formation and environmental damage should be prevented.

A method for water sterilization based on the use of so-called sonoplasma discharge, an electrical discharge induced inside a cavitation zone, has been developed. In water flows, a cavitation zone may be created using hydrodynamic emitters. The initiation of such a discharge in water leads to a number of effects, including high local pressures and temperatures, UV radiation, and the formation of radicals.

Research on the effect of sonoplasma discharge on microorganisms was carried out. Sonoplasma discharge reduced E. coli by 98% (and by more than 99.99% after a second cycle) and Saccharomyces cerevisiae by 84%, showcasing the method's effectiveness.

The number of sonoplasma cycles required to reach the necessary suppression level is determined experimentally.

The proposed method is reagentless and wasteless. The equipment, which consists of a reactor equipped with electrodes and a hydrodynamic emitter, a pump, and a power source, is simple and can treat up to 20 m^3/h, but it can be easily upscaled to 100 m^3/h and more.

sciforum-089733: Ultrasonic Irradiation as an Energy Source to Catalyze the Formation of a New Bioactive Sulfonylphthalimide

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The use of ultrasonic irradiation as an energy source to catalyze the formation of new biomolecules represents an innovative approach in the field of organic synthesis and green chemistry. This method harnesses ultrasonic waves, high-frequency sound waves, to induce chemical reactions efficiently and rapidly.

When ultrasonic waves are applied to a chemical reaction, they generate pressure waves and local turbulence in the reaction medium. These extreme conditions promote the breaking of chemical bonds and the formation of reaction products at accelerated rates compared with conventional methods. Consequently, ultrasonic irradiation accelerates the synthesis process and enhances reaction yields.

In the specific case of forming a bioactive sulfonylphthalimide, using ultrasonic irradiation offers several advantages. Firstly, it reduces the reaction times required to obtain the desired product, contributing to an overall increase in synthesis efficiency. Additionally, the intensity of ultrasonic waves can be adjusted to selectively control the formation of specific products and minimize the generation of undesirable by-products. This technique can often be performed at room temperature or slightly elevated temperatures, avoiding the need for more energy-intensive reaction conditions.

Furthermore, ultrasound can facilitate the activation of reagents that are difficult to react under conventional conditions, making it an attractive technique in the fields of organic chemistry, especially in the synthesis of pharmaceutical and biologically relevant chemical compounds. This offers advantages such as improved productivity, energy savings, and the opportunity to explore new synthetic pathways in biology and industry.

sciforum-090274: Ultrasonic Synthesis for the Efficient Zr^{4+} Modification of Hydrotalcite Adsorbents for Fluoride Removal

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Fluoride (F^-) that is found in water (used and consumed by humans) is also widely present in the subsoil due to the composition of the Earth's crust in several regions of the world. In Mexico, the problem predominates in the north of the Mexican Republic, causing a potential threat to health, since it exceeds the maximum permissible limit of 1 mg/L, established by the World Health Organization. This work focuses on studying the effect of the molar proportion of zirconium (Zr) on the modification of the structural properties and adsorption mechanisms of lamellar double hydroxide adsorbents (LDHs), obtained by ultrasound-assisted coprecipitation methods and constant pH. Three materials were synthesized with the following molar fractions of Zr: Zr 0.1, Zr 0.075, and Zr 0.05, which were used to remove F^- from an aqueous solution. The structural, morphological, and physicochemical properties were characterized by XRD, SEM, EDS, elemental mapping, N_2 physisorption (BET), and FTIR. Adsorption tests were carried out, in which the molar fraction of Zr 0.05 showed the best behavior in the removal of F^-. Subsequently, an experimental design was applied using the response surface method (RSM), in which the optimal conditions for F^- removal were obtained: an initial concentration of F^- 12 mg/L, an adsorbent dose of 1 mg/L, and a pH of 5. The maximum adsorption capacity was determined as qt: 12.58 mg/g for 180 min. The adsorption kinetics were fitted to the Pseudo-second-order model with an R^2 0.99, indicating chemisorption in the F^- adsorption process. In conclusion, the Zr 0.05 material is considered potentially efficient by removing 99.9% of the F^- present in the solution.

sciforum-090146: Unlocking Bioethanol Production Potential: A Computational Exploration of Agri-Food Waste Valorization in Circular Bioeconomy Using Metagenomic Mining and Process Prediction Tools

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In the pursuit of a sustainable approach to agri-food waste valorization, this paper delves into the realm of computational techniques to enhance our understanding and harness the potential for bioethanol production in a circular bioeconomy. Leveraging the power of metagenomic mining, we employed MG-RAST and MetaPhlAn to unravel the functional and taxonomic intricacies of environmental microbial communities, shedding light on their roles in waste conversion. Complementing this exploration, we delved into the predictive realm with process prediction tools. Pathway Tools emerges as a key player, utilizing genomic information to forecast metabolic pathways and providing valuable insights into the metabolic potential of microorganisms involved in the waste valorization process. The RAVEN Toolbox joins the ensemble, offering a robust platform for the reconstruction and analysis of genome-scale metabolic models, further enhancing our ability to predict and optimize bioethanol production.

In conclusion, our exploration of the sustainable valorization of agri-food waste for bioethanol production within the circular bioeconomy has been significantly enriched by the integration of cutting-edge computational tools. As we chart the course towards a circular bioeconomy, these computational tools emerge as indispensable allies, offering a data-driven and systematic approach to address the challenges of agri-food waste valorization. The convergence of metagenomic insights and predictive modeling marks a paradigm shift in our ability to harness the untapped potential of waste streams for bioethanol production, contributing to a more sustainable and eco-friendly future.

sciforum-085956: Unveiled Sustainability: Beyond Carbon and Towards a Holistic Analysis of Industrial Processes

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The concept of sustainability has gained significant traction in recent times, permeating not only academic but also industrial fields. Unfortunately, the use of this term is often confined to carbon dioxide emissions associated with specific manufacturing processes, leading to a simplistic or partial comprehension. A deeper definition of sustainability transcends a narrow focus on carbon emissions, embracing a harmonious synthesis of economic, social, and environmental considerations. A sustainable process enhances profitability, minimizes environmental impact, and fosters positive social implications.

In the contemporary landscape, processes are commonly evaluated using conventional life cycle assessment analysis. However, sustainability indicators provide an alternative and more comprehensive perspective. These indicators, expressed as percentages, find visual representation through one-shot spider diagrams. The primary objective of such analyses is to maximize the area enclosed within the spider diagram, serving as the objective function for developing a specific product. This analytical tool facilitates the evaluation of process sustainability, enabling comparisons with competitors and aiding decisions regarding the selection of raw materials based on customer needs.

The integration of cutting-edge technologies like artificial intelligence (AI) and machine learning (ML) into sustainability assessments has the potential to significantly improve the precision and efficiency of evaluating complex systems. AI's ability to process large datasets and identify intricate patterns enhances the understanding of the multifaceted dynamics in sustainability, revealing subtle correlations within economic, social, and environmental factors. Meanwhile, machine learning continuously refines its models, ensuring adaptability to emerging trends and real-time changes. This technological amalgamation not only promises more accurate assessments but also signifies a shift toward informed, data-driven decision-making for a sustainable future.

sciforum-089876: Use of Biomass Residues in MB Removal from the Aqueous Phase

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Each day, abundant agricultural and agro-industrial wastes are generated to fulfil the growing population's increasing demand. Preliminary results concerning the valorization of biomass waste through its use for water treatment are presented in this work. The efficacy of biomass residues, such as coconut shells and cork residues, was tested in the removal of methylene blue (MB) from the aqueous phase. The study of MB adsorption was conducted using a batch-based approach, and the effects of pH, the initial concentration of MB, adsorbent granulometry, contact time and temperature were evaluated. The MB adsorption was more effective at a pH > 7. Temperature seems to have no significant effect on MB adsorption on coconut shells but the rising temperature promotes an increase in the amount of MB adsorbed on cork residues.

Adsorption isotherms were obtained at 298 K, after a contact time of 24 h. The adsorption performance of the natural adsorbents was significantly high in coconut shells, with a granulometry lower than 0.63 mm, revealing a maximum removal capacity of 143.7 mg of MB per gram. With cork, using the same experimental conditions, the maximum amount of MB adsorbed reaches 102 mg of MB per gram, but with cork, the granulometry seems less relevant. These results are very similar to those obtained with Imbondeiro, which were considered to be extremely promising [1].

The possibility of using agricultural wastes as adsorbents in water treatment is becoming of great importance. These wastes can successfully replace adsorbents, such as activated carbons, which are currently used in water treatment but have a relatively high cost.

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sciforum-090452: Using Activated Carbon Adsorbents Obtained from Plastic Wastes from the Tunisian Beverage Industry

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In this study, we investigated the preparation of char and activated carbon (AC) materials derived from water bottles and bottle waste collected at a waste collection point in Tunisia. The materials were synthesized using a rotary horizontal tubular furnace on a lab/pilot scale and through chemical activation. Characterization of the carbon materials was performed using nitrogen adsorption isotherms at 77K and SEM-EDX analysis.

Furthermore, we examined the effectiveness of the ACs in removing the antibiotics 4-amino-N-(5-methyl-1,2-oxazol-3-yl)benzenesulfonamide (sulfamethoxazole-$C_{10}H_{11}N_3O_3S$) and 5-(3,4,5-trimethoxybenzyl)pyrimidine-2,4-diamine (trimethoprim) from aqueous solutions. The results revealed a maximum adsorption capacity of 108.17 mg g^{-1} (85.34%) for sulfamethoxazole and 98.11 mg g^{-1} (89.73%) for trimethoprim on the PET-KOH-1:1–800 °C sample.

Additionally, we analyzed the adsorption kinetics, fitting the data to pseudo-first and -second-order models, and studied the equilibrium isotherms using the Langmuir and Freundlich equation models. These findings suggest significant potential for the application of ACs derived from plastic bottle waste in the treatment of wastewater containing antibiotics.

Overall, our study highlights the feasibility of utilizing waste materials for the synthesis of valuable carbon-based adsorbents with promising adsorption capabilities. This research contributes to the ongoing efforts towards sustainable waste management and environmental remediation.

sciforum-085323: Utilizing Fish Scale *Catla catla* for Removing Heavy Metal Cr (III) and Co (II) in Wastewater Treatment

Samiha Sultana and Nafisa Maliat

Graduate

This comprehensive research focuses on the potential of *Catla catla* fish scales as a bio-adsorbent for the removal of heavy metals, particularly Cr(III) and Co(II), from wastewater. Different salt solutions including hydrated cobalt nitrate [$Co(NO_3)2.6H_2O$] and chromium sulfate [$Cr_2(SO_4)_3$] with varying concentrations of metal ions are utilized to evaluate adsorption efficiency, and the effect of parameters like initial metal ion concentration, chemical treatment of the adsorbent, and contact time are systematically examined using UV-Vis Spectrophotometry. It was found that the initial metal ion concentration influenced the adsorption efficiency, with higher concentrations leading to reduced adsorption capacity, and with longer durations resulting in increased metal removal until equilibrium was reached. Acid-treated fish scales showed superior adsorption performance compared to the raw ones. The augmentation in efficiency magnitude exhibited a notable elevation of 50.2% with acid-treated fish scales. Characterization of the bioadsorbent is performed using advanced analytical techniques, including Fourier-Transform Infrared Spectroscopy (FTIR), Scanning Electron Microscopy (SEM), and Energy Dispersive X-ray Spectroscopy (EDS), revealing changes in structural and chemical properties post-metal adsorption. The adsorption equilibrium data are fitted to the Langmuir and Freundlich isotherm models, with Langmuir being more suitable for cobalt adsorption and Freundlich for chromium adsorption. The significance of Langmuir and Freundlich isotherms lies in their capacity to elucidate the exponential distribution of active sites and energy, interpreting the adsorption process on heterogeneous solids. It has been reported that in commercializing biosorption, the extraction of heavy metals from industrial waters, employing reactors equipped with innovative biosorbents in the form of granules, is available at a cost approximately one-tenth that of ion exchange resins. This research highlights the cost-effective and sustainable potential of *Catla catla*, making a significant contribution to the domains of water purification and heavy metal pollution mitigation.

sciforum-087461: Waste Management System: Sustainability Design and Economic Approach of Bioconversion Food Waste from Hospital Using Black Soldier Fly (BSF)

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Health service providers such as hospitals have their own challenges in keeping their environment safe for the community. Therefore, waste processing units require a capable management system. Apart from medical waste, food waste from nutritional installation also needs to be carried out. Black Soldier Fly (BSF) larvae which have the ability to transform waste without carrying pathogens and dangerous compounds are a wise choice. Composting is a self-sustaining and cost-effective method that promotes high resource recovery and produces value-added products thereby developing new economic opportunities for hospitals. Here, we reviewed the sustainability design and economic of BSF organics waste processing unit within hospital environments. Through a literature review and some supporting data available at this hospital the author also attempts to evaluate opportunities and future directions regarding this technology. As a result, to fulfil the capacity of ~100 kg per day of food waste, we designed an effective, simple 4×4 m spatial layout. A sales price of IDR 50,000.00 per kg of dried larvae, it will produce a profit within 2 years. The construction of a bioconversion installation with BSF larvae can increase the efficiency of a low-cost food waste management system in hospitals. As well as producing equivalent value to reduce costs, which is suitable for developing country hospitals.

sciforum-089952: Water Quality Assessment of Kashkadarya Springs: Implications for Human Health and Water Resource Management

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Direct access to good-quality drinking water in Uzbekistan is becoming a major issue. This challenge is exacerbated by growing demands, driven by population growth, industrial development, and desert land cultivation. In this regard, there is a significant need for a thorough analysis of the existing water resources. This study aims to identify the chemical composition of springs' water in the Kashkadarya region of Uzbekistan and to assess their suitability as drinking water sources. To analyze the water quality, three springs were selected, which are the most used springs by the population of this region, "Hazrat Bashir", "Boshmanbulak", "Chillabulak", and the artesian waters of the city of Shakhrisabz were also included in the study. The quality of the spring water was evaluated based on the primary water quality indicators, including salt composition, heavy metals, and some essential trace elements such as iron (Fe), chromium (Cr), and selenium (Se) in the selected samples. According to the results, the spring water in Chillabulak was found to be relatively harder than the other samples, with magnesium and calcium concentrations of 28 and 390 mg/L, respectively. However, the study also revealed that the water from the other three examined samples meets sanitary norms and water quality standards, confirming their suitability for human consumption. The results can be used to develop water quality management strategies and environmental protection, as well as to inform the population about the ecological safety of regional aquatic reserves.

sciforum-089934: Approaches to Improve the Efficient Bioleaching of Arsenopyrite Flotation Concentrate

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Bacterial leaching is known as a green technology for the recovery of valuable metals. However, it has some "bottle neck" problems too. Arsenopyrite, a gold-bearing ore, is a refractory mineral material which is hardly soluble and contains toxic arsenic compounds which worsen bioleaching results. The most common biotechnology used for this process includes the bacteria Acidithiobacillus ferrooxidans, which are autotrophic, acidophilic and resistant to inorganic arsenic compounds. Attempts to dissolve arsenopyrite with increasing volumes of sulfuric acid and supplements of iron, as an energy source for the leaching bacteria, provoke the following: an acidification of the environment and its pollution with excess of iron. We simplified this procedure by (i) exchanging the sulfuric acid for HCl, (ii) the use of a new active strain of A. ferrooxidans: AA-ZhNR. Bench scale experiments of the bioleaching of arsenopyrite flotation concentrate were produced to compare it with (i) the common (classical) medium 9K based on sulfuric acid and iron and a known leaching strain, A. ferrooxidans TFbk, and (ii) our HCl medium without iron supplements and with our strain. The degradation of the flotation concentrate was evaluated by the accumulation of dissolved sulfate. The experiments showed that the application of A. ferrooxidans AA-ZhNR, with the arsenopyrite flotation concentrate as a single source of energy, resulted in 4-fold higher production of dissolved sulfate. On the whole, the bioleching of arsenopyrite concentrates may be increased by the selection of new strains and their orientation towards the raw material as a single energy source.

Abstracts

Session B. Energy Systems

sciforum-088874: Comparative Simulation of Maximum Power Point Tracking Algorithms for Optimal Power Tracking

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A photovoltaic generator (PVG) is a sophisticated integration of multiple photovoltaic (PV) cells designed to harness solar energy efficiently. In essence, it serves as a pivotal component in solar energy systems, converting sunlight into electricity. The power output of a PV module is intricately tied to various environmental and electrical factors, such as irradiation levels and ambient temperature. These factors contribute to the fluctuations observed in the maximum Power Point (MPP), which is the optimal operating point of the photovoltaic generator (PVG), representing the point at which the generator achieves its highest efficiency and power output.

Efficiently extracting the maximum energy from a PV system requires precise control mechanisms, and one of the key strategies employed for this purpose is Maximum Power Point Tracking (MPPT). MPPT algorithms play a crucial role in continuously adjusting the operating point of the PVG to ensure that it operates at or near its MPP under varying environmental conditions.

The primary focus of this study is to develop and evaluate control mechanisms aimed at consistently extracting the maximum energy from the PV system. Specifically, attention is directed towards enhancing the performance of the DC/DC converter and the PV generator within the system. To achieve this objective, a comparative analysis of various MPPT algorithms is conducted. The algorithms under investigation include Incremental Conductance (INC), a Fuzzy Logic Controller (FLC), Particle Swarm Optimization (P&O), and Neural Networks (ANNs).

Through extensive simulations performed using the MATLAB Simulink software, the efficacy and robustness of each MPPT algorithm are thoroughly assessed. The simulation results provide valuable insights into the performance of the proposed system under different operating conditions and help identify the most suitable MPPT algorithm for maximizing energy extraction from the PV system.

sciforum-089978: NVPE: An FPGA-Based Non-Volatile Processor Emulator for Intermittent Computing

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Research on novel memory storage devices that occupy less physical area and are compatible with CMOS processes, such as resistive RAM, has led to the interesting study of non-volatile compute memories and devices. The advent of these low-compromise non-volatile cells invites the opportunity for fully non-volatile microprocessors that are capable of rapid shutdown and startup. This class of microprocessors would be beneficial to intermittent computing systems applications that wait until an energy-harvesting device has sufficient energy available before they do some useful work due to requiring less energy to power down safely. Prior work has demonstrated the emulation of these non-volatile memories that enable the rapid testing of non-volatile memory systems. In this work, we expand on these ideas by introducing a framework that is capable of emulating fully functional non-volatile microprocessors based on individual non-volatile flip-flops, rather than larger addressable non-volatile memory blocks. Our proposed system enables the conversion and emulation of conventional systems into non-volatile equivalents. The proposed architecture is integrated into the open-source RISC-V microprocessor implementation 'Potato' and synthesized on a Xilinx Ultrascale + XCZU5EV FPGA. The area overhead for the proposed emulator is 22 slice registers and 17 LUTs per emulated non-volatile flip-flop. As a case study, an AES block cipher is executed throughout power-down and power-up sequences. The system is shown to properly emulate the complex overhead operations resulting from sensitive power-down and power-up sequences in power-intermittent systems, providing a vital metric for the non-volatile microprocessor's fidelity.

sciforum-089344: Quadrotor UAV Altitude Control Using FOPID, PID and Integral State Feedback Controller

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This research presents the development of an altitude control for a quadrotor unmanned aerial vehicle (UAV) using a fractional-order proportional–integral–derivative (FOPID) controller, a proportional–integral–derivative (PID) controller, and an integral state feedback (ISF) controller. The quadrotor UAV, which is a nonlinear, multiple-input, multiple-output, and underactuated system, was modelled using the Newton–Euler modelling system, in which the UAV's translational and angular velocity was derived mathematically. The quadrotor UAV was then linearized for easy analysis and modelled in MATLAB/Simulink. The simulation was carried out in the MATLAB/Simulink 2022b environment. Two cases were considered: the open-loop and closed-loop responses. The two cases were simulated, and the system performed satisfactorily in both open-loop and closed-loop scenarios. Also, FOPID, PID, and ISF controllers were applied on the closed-loop scenario for the altitude control of the UAV. From the simulation results, it can be deduced that FOPID outperformed PID and ISF controllers in terms of settling time and rise time, with values of 0.008 secs and 0.0236 secs, respectively. Also, the ISF controller had a better overshoot of 0%, while the PID controller had a better steady-state error (SSE) of 7.1524×10^{-10}, which were all obtained from the simulations. The contribution of this work is the application of FOPID with respect to the altitude control of quadrotor UAV. This shows the advantages of the FOPID controller regarding the altitude control of the quadrotor UAV in terms of robustness and reliability.

sciforum-090406: Sliding Mode Control of a Photovoltaic Water Pumping System

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This paper aimed to evaluate the performance of a three-phase double-stage photovoltaic water pumping system. Ours is composed of several components. These include a photovoltaic array; a boost DC-DC converter with a maximum power point tracking algorithm based on the Perturb and Observe technique; a three-level neutral-point-clamped inverter, which is controlled using simplified space vector pulse width modulation; and a moto-pump group based on an induction motor and tank. The induction motor is distinguished by its rigidness, reliability and relatively low cost. However, the difficulty of controlling the induction motor is related to the fact that its mathematical model in Park configuration is nonlinear and highly coupled. The regulation of the speed, rotor flux and d-q axis currents of the Field-Oriented Control is achieved through the use of sliding-mode-control-based regulators. To evaluate the performance of the proposed control strategy, simulations were conducted using the Matlab/Simulink platform while considering varying levels of irradiation and temperature. The simulation outcomes conclusively demonstrate that the proposed system control has good performance with regard to dynamic responses, control robustness and power quality, thus affirming its efficacy. A solar water pumping system that uses photovoltaic energy has the potential to be a dependable and effective way to pump water while using sustainable energy sources.

sciforum-089818: A High-Performance Single-Stage Photovoltaic Solar Pumping System under Partial Shading Conditions (PCS) Using a Horse Herd Optimization Algorithm (HOA)

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This paper introduces a high-performance, single-stage photovoltaic solar pumping system that operates without a battery. Its primary focus is on the design and control of a low-voltage squirrel cage asynchronous motor powered by renewable photovoltaic energy. The system employs the Hill-Of-the-Abscissa (HOA)-based Maximum Power Point Tracking (MPPT) technique to optimize the power balance between the motor and the solar panels, ensuring its operation at the global maximum power point (GMPP). Additionally, the rotational speed of the motor is controlled using Predictive Torque Control (PTC), which is based on torque and flux. The control scheme proposed in this paper is thoroughly modeled and simulated using MATLAB/Simulink software. The simulations aim to evaluate the system's performance under variations in irradiance and partial shading. The obtained results from the simulations run using the suggested control strategies are then compared to other methods found in the literature, such as the Grey Wolf Optimizer (GWO), Flower Pollination Algorithm (FPA), Cuckoo Search Algorithm (CSA), and Perturb and Observe (P&O). The simulation results indicate that the proposed system performs satisfactorily, as the HOA outperforms all MPPT in terms of speed and stability at the access GMPP. The combination of a single-stage design, enhanced power extraction, and precise motor speed control positions the system as a promising solution both technically and economically. Overall, our findings suggest that the presented photovoltaic solar pumping system has the potential to be a reliable and efficient solution for pumping water using renewable energy sources.

sciforum-084933: A Novel Emission Tester for Diesel Vehicles

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Vehicle emissions remain the major source of human health issues. Several mechanisms have been developed to mitigate emissions from the automotive industry; thus, emission testers are a prominent means to measure and control vehicle emissions. Though emission testing started decades ago, Sri Lanka has imposed taxation policies based on vehicle emissions since 2003. This research aims to develop a portable emission tester that can update the emission status of diesel vehicles rather than obtaining the reports annually. The basic procedure of the experiment is to check the average K-factor value of the vehicle by conducting three snap acceleration procedures. The K-factor value must be less than 4 (as new rules and regulations are updated), and the variation must be less than 1 from one to another procedure. The K-factor calculation is derived from SAE-J1667, which is a universal document that is used to identify rules and regulations of automobile diesel emission tests. The components, namely Arduino nano, Arduino Mega, a wireless transmitter, a magnetic pickup sensor, a piezo sensor, an optical dust sensor, a buck converter, a battery management system, and a display were used to build the system. The results were compared with the test results obtained from the localized emission test centers. This developed module provided a more detailed description of vehicles with in-depth analysis. Moreover, the system suggested the improvements required for diesel vehicles with higher emissions. Feedback model analysis was performed to understand the market expectations with this novel solution. Briefly, 75% of targeted population of 253 were positive on the developed solution. On average, the developed device indicated values around 0.79, whereas the emission report provided a value of 0.675. It can be concluded that both results are comparable and beneficial for remote usage in terms of diesel vehicles.

sciforum-089725: A Novel Optimal Power Management and Control Strategy for Marine Microgrids Integrated with Renewable Energy Sources and Hybrid Energy Storage Devices

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An advanced strategy for optimizing power management and frequency control in marine microgrids is introduced in this paper. The investigated system incorporates a mix of renewable energy sources and hybrid energy storage devices. A robust optimal PID controllerwas employed to tackle the intermittency challenges associated with wind and marine energy sources, ensuring precise frequency control via time-domain simulations. A hybrid energy storage system, which includes SMES/Battery/Ultra-Capacitors (UCs) and Fuel Cells (FCs), was implemented to manage frequency variations and optimize the charge/discharge cycles of batteries. To further mitigate power fluctuations and extend the life of batteries, a low-pass filter was applied, inspired by optimization techniques for hybrid storage systems. A notable innovation in this study is the introduction of a photovoltaic (PV) energy source into the system, enhancing the diversity and capacity for renewable energy production in the microgrid. A comprehensive comparative study is conducted, exploring a range of scenarios: with and without energy storage, with the integration of PV energy, excluding the use of diesel, and implementing battery filtering. This approach allows for an evaluation of the impact of each configuration on the overall performance of the microgrid, underscoring significant enhancements in sustainability, efficiency, and a reduction in dependence on fossil fuels. The preliminary results point to a considerable improvement in energy management in isolated marine environments, showcasing the potential of this strategy for future marine microgrid applications. This research makes a significant contribution to the advancement of renewable energy management systems, presenting a viable and sustainable option for the powering of marine microgrids.

sciforum-086503: A Review of Smart Grid Technologies: Past, Present, and Future Outlook

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The rapid evolution of smart grid technologies has transformed the traditional energy landscape, resulting in the enhanced efficiency, reliability, and sustainability of energy transport. This comprehensive review delves into the latest developments in smart grid technologies, analyzing their impact on modern power systems and their respective end users, both industrial and residential. This paper outlines the smart grids' fundamental principles and components, encompassing advanced metering infrastructure, communication networks, and intelligent control systems. It explores the integration of renewable energy sources and energy storage within smart grids, assessing their role in optimizing energy generation, distribution, and consumption and minimizing the downtime of power plants. In addition, emphasis is placed on deploying machine learning algorithms and artificial intelligence in smart grid management, showcasing their ability to forecast demand, detect anomalies, and optimize grid operations in real time. It also discusses the real-time accurate monitoring of parameters with the help of smart technologies applied in the grid, which enhances the safety of manpower and the protection of the environment, assets, or equipment to prevent system damage. Furthermore, this paper addresses the challenges associated with the widespread adoption of smart grid technologies, including cybersecurity risks, interoperability issues, and standardized protocols. Finally, research gaps and future directions and opportunities are presented to motivate future researchers who want to venture into this field.

sciforum-090403: Agro-Industrial Residues from Sugar Cane for Energy Use and Application in Energy Storage Devices

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Obtaining new materials from waste plays an important role in contributing to sustainability, innovation and reducing the environmental impact of industrial activities, thus contributing to the circular economy of the main production process that gives rise to that waste. Sugar cane bagasse has attracted interest due to its technological and environmental applications, as it is used as a raw material for producing materials that offer a sustainable solution for managing agro-industrial waste, reducing greenhouse gas emissions, as well as being used in the manufacture of electrodes for energy storage and in the production of sensors due to its high carbon content and porosity. The aim of this study is to characterize the residue generated from unburned sugarcane bagasse in the steam generation process in terms of its energy and technological potential. Calorific value analysis enabled the energy potential of this residue to be quantified, while scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR) and X-ray photoelectron spectroscopy (XPS) and proximate analysis enabled the structural and chemical composition of this residue to be characterized The analyses identified the material's energy and technological potential, given its lower calorific value of around 24 MJ/kg and its 70% carbon-based composition, which allows the waste to be used as a precursor in routes to obtain carbon-based materials and studied as a basis for energy-storing materials.

sciforum-088867: Amplification of One- and Two-Photon Excited Emission of a Stilbazolium Dye–Laponite Hybrid

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Non-linear optics plays a pivotal role across diverse applications, such as biomedicine, photonics, optoelectronics, and surface science. Recently, the non-linear optical characteristics of two-dimensional materials and organic–inorganic hybrid materials have been of particular interest. Here, we demonstrate the first evidence that Laponite can be a highly promising medium to intensely enhance the efficiency of the emission of a stilbazolium dye by both one-photon and two-photon excitations. This can be attributed to the interaction of the dye with the ionic microenvironment of Laponite. Our findings illustrate that the adsorption of this cationic dye onto the negatively charged faces of Laponite platelets in an aqueous dispersion results in a remarkable enhancement in fluorescence intensity, by up to a factor of 15. A series of experiments, including viscosity measurements, ionic conductivity measurements, dynamic light scattering, and small-angle X-ray scattering, were conducted to explore the intricate interaction between the organic dye and Laponite. The results uncover alterations in the local molecular environment of the dye due to its interaction with Laponite, leading to the suppression of non-radiative recombination pathways. Consequently, both the linear and nonlinear fluorescence in this novel hybrid system increase, which has the potential to impact applications in biosensors, fluorescent probes, imaging, etc., requiring highly emissive properties.

sciforum-087754: An Energy-Efficient Routing Technique Based on Concentric and Progressive Clusters for Wireless Sensor Networks

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Modern cities often have smart parking. Wireless sensor networks, which are used to identify, track, and gather information about the availability of every parking space in a specific region, are the main equipment used in these smart parking lots. A wireless sensor network is made up of sensors that can collect, process, and send data to the sink. Nonetheless, the quality and performance of the wireless sensor networks are impacted by the sensor's power and communication constraints. The lifespan of the nodes and the wireless sensor network as a whole both decline as a result of the node's declining batteries and energy. In order for the base station to receive data from the whole wireless sensor network, we offer a routing protocol in this paper that implements an effective and reliable algorithm that permits the establishment of clusters. This protocol uses an effective and dependable method that reduces sensor energy dissipation and lengthens the wireless sensor network's lifespan. The simulation results of the suggested protocol shows that it is efficient and reliable in terms of the power consumption, data transmission reliability, and durability of the wireless sensor network when compared to other parking lot management protocols that are currently in day-to-day use.

sciforum-090465: An Intelligent Diagnosis and Fault Detection Model Based on Fuzzy Logic for Photovoltaic Panels

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The growing significance of photovoltaic (PV) monitoring systems and diagnostic methodologies is evident in their role in enhancing the power generation, efficiency, and durability of photovoltaic systems. The operational efficacy of these systems is primarily influenced by factors such as irradiation levels and cell temperature. Consequently, there exists a pressing need for dedicated scrutiny and scholarly investigation into the identification and diagnosis of defects within these systems, aiming for swift identification and rectification of failures in PV stations. This paper thus endeavors to introduce a diagnostic methodology focused on fault detection and categorization of eight types of faults occurring in shading, series resistance, shunt resistance, and bypass diode faults (disconnected, short circuited, shunted with resistor) within photovoltaic panels. This analysis employs two distinct algorithms: the initial algorithm employs the thresholding method, while the second algorithm is grounded in a Fuzzy Logic classifier (Sugeno model). Upon examination of the simulation outcomes, it becomes evident that the threshold method fails to identify all faults, necessitating the adoption of a more effective classification technique. Moreover, the Fuzzy Logic (FL) method has proven to be the most suitable approach for diagnosing PV module issues. The findings indicate that all specified faults are detectable in a discernible manner. These approaches have demonstrated proficient accuracy and efficacy in pinpointing and characterizing various faults within PV panels. Notably, our simulation endeavors were conducted utilizing Simulink/Matlab software.

sciforum-087389: Application of the Finite Element Method (FEM) to Analyze the Mechanical Behavior on Peizoelectric Materials when an Electric Field Is Applied to a Piezoelectric Structure (Inverse Piezoelectricity)

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Modeling the inverse effect of piezoelectricity on the mechanical behavior of smart (piezoelectric) materials utilizing the finite element method (FEM) involves a comprehensive framework that encompasses various components and intricacies. By employing the FEM, researchers aim to analyze and understand the intricate interplay between the mechanical behavior and piezoelectric properties of smart materials. This modeling process involves the utilization of numerical techniques which help to examine the inverse effects of piezoelectricity on mechanical behavior in a precise and accurate manner. The FEM provides a robust and efficient approach to simulate the intricate behavior and response of smart materials under different loading conditions, considering the complex interactions between the mechanical and electrical fields. Through this modeling approach, researchers are able to gain valuable insights into the underlying mechanisms and phenomena governing the inverse effect of piezoelectricity, thereby paving the way for the development of advanced smart materials with enhanced performance and functionality. Therefore, modeling the inverse effects of piezoelectricity on the mechanical behavior of smart materials using the finite element method is a fundamental and crucial aspect of material science research, contributing to advancements in various fields such as robotics, energy harvesting, and structural health monitoring.

The main objective of this work is to model the effect of inverse piezoelectricity on the mechanical behavior of piezoelectric materials; we applied the principles of continuum mechanics to mechanical and electrical considerations to calculate the mechanical field when an electric field is applied to the piezoelectric structure.

sciforum-090474: Characterisation of Oil Palm Trunks for Potential Bioenergy Recovery and Utilization

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The cultivation of oil palm (*Elaeis guineensis* Jaq.) and its production generate large quantities of solid wastes annually. Current strategies adopted for tackling oil palm trunks (OPTs), which account for a significant proportion of oil palm waste (OPW), are considered expensive, inefficient, and unsustainable. Analysts posit this scenario could exacerbate efforts to not only effectively dispose and manage OPT but also lower the carbon footprint of the Oleo industry. Hence, immediate and urgent attention is needed to address the challenges posed by current strategies. Biomass torrefaction has recently gained traction as a practical approach for OPW valorisation into biochar. Therefore, this study seeks to (i) characterise the physicochemical characteristics of OPT through ultimate, proximate, and calorific analyses and (ii) examine the thermochemical, degradation, and temperature profile characteristics of OPT as potential torrefaction feedstock using thermal gravimetric analysis (TGA). TGA was performed at torrefaction temperatures; T_t = 200–300 °C (Δ25 °C stepwise increase) under isothermal/non-isothermal conditions of nitrogen (N_2) flowrate 100 mL/min), heating rate 20 °C/min, and 30-min residence time. The results showed that OPT contains high carbon (>45 wt.%), hydrogen (>6 wt.%), volatile matter (>80 wt.%) but low ash (2 wt.%), fixed carbon (5 wt.%), and moisture (10 wt.%) contents. OPT experienced 14.55–60.82 wt.% weight loss during TGA degradation from 200 to 300 °C. The increase in temperature resulted in a corresponding rise in OPT biochar yields ranging from 85.45 to 39.18 wt.% and higher heating values of 20–23 MJ/kg. The DTG plots showed that the TGA torrefaction process occurred in two stages, (i) 100 °C and (ii) >100 to the selected T_t, which could be ascribed to the drying and devolatilization/depolymerisation of OPT, respectively. Overall, this study demonstrated that OPT is a potentially practical feedstock for torrefaction into biochar.

sciforum-090596: Comprehensive Performance Evaluation of Biodiesel Blends with Nanoparticles in VCR Engine

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Day to day rise in fuel price, stringent emission norms and power requirements makes the researchers for alternative fuel. The biodiesel performance in variable compression ratio (VCR) engine provides the equivalent performance in fuel requirements. Nanoparticles plays major role in combustion characteristics of engine analysis. Different nanoparticles with 75 ppm under varying compression ratio from 16:1 to 19:1 for combination of loads. Waste cooking oil methyl ester (WCOME) attracts a wide attention in towards its availability in India and its inherent properties comprehend with diesel. The nanoparticles are prepared and blended using ultrasonication process. Then, the Experiment is designed using Taguchi design and the results will be compared with predicted results. The results show significant reduction in carbon monoxide (CO), hydrocarbon (HC and smoke are recorded with slight increase in Nitrogen oxides (NO_x) emission. The error obtained is less than 5% for all predicted responses. The robust design will be useful for predicting the engine performance with minimum cost. The experiment is first designed using design of experiments (DOE) using Minitab17 version. The variables are used as Compression ratio, load and different nano-particles under three level and three factor designs. The expected responses are brake thermal efficiency, fuel consumption, exergy efficiency, entropy generation and CO, HC, NO_x and smoke emissions.

sciforum-090451: Development of Composite Electrodes for Efficient Generation of Green Hydrogen through Photovoltaic Energy

Isadora Dos Santos Pires Soares, Leandro Ferreira Pinto, Renivaldo José dos Santos and Leonardo Lataro Paim

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Hybrid systems for hydrogen production via photovoltaic electrolysis (PVEL) are recognized as environmentally clean but economically impractical. Consequently, a critical need has emerged for novel materials in both photovoltaic panels and electrolysis cell electrodes. This project aimed to develop carbon-based composite electrodes integrating iron oxide anchored on graphene and multi-walled carbon nanotubes (MWCNTs) for hydrogen generation via aqueous electrolysis under neutral pH conditions utilizing photovoltaic energy. Synthesis of iron oxide nanoparticles (Fe_3O_4) occurred through ammonia solution precipitation, followed by their combination with graphene oxide (GO) and MWCNTs. Subsequently, electrodes were crafted through drop-casting with varying Fe_3O_4 nanoparticle, GO, and MWCNT proportions on copper substrates.

SEM and Energy-Dispersive Spectroscopy (EDS) analyses were conducted to investigate the nanocomposites' morphology and composition. High-resolution environmental scanning electron microscopy (SEM) and an EDS module were employed. Morphological tests revealed homogeneous Fe_3O_4 nanoparticles with a nanoscale diameter, showing the presence of carbon, oxygen, silicon, and iron, consistent with the substrate elements. The results indicate successful Fe_3O_4 nanoparticle synthesis. Utilizing carbon-based composites with anchored iron oxide nanoparticles sought to enhance the hydrogen evolution efficiency and stability under neutral pH, fostering the development of efficient and eco-friendly hydrogen production systems driven by photovoltaic energy. Controlled potential electrolysis (CPE) experiments evaluated the water reduction capacity using the Fe_3O_4/FMWCNT/OG-modified electrode in a 0.1 M phosphate buffer at pH 7.0. Monitoring charge accumulation revealed its reliance on the applied potentials. Notably, at −1.1 V, charge accumulation was initiated and increased steadily, with a higher negativity yielding greater accumulations. Remarkably, at −1.4 V, the maximum charge accumulation reached 488 mC, highlighting the modified electrode's catalytic efficacy in hydrogen production. These findings underscored the electrode's effectiveness in facilitating hydrogen evolution under neutral pH, emphasizing its potential in practical clean hydrogen generation systems powered by photovoltaic energy.

sciforum-087761: Environment Friendly E-Bike with Reduced Power Drain on Gradient Surface

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This abstract is written with consideration of current problems affecting the efficiency of electric bike batteries. Pollution has an impact on changing the environment in daily life; to avoid this, eco-bikes have been introduced to the market. This electric bike is electricallypowered with a high eco system contribution and uses an alternate source of fuel. In comparison to current electric bikes, the amount of energy used is very small, making it a more eco-friendly mode of transportation. E-bikes use rechargeable batteries, and the lighter ones can travel up to 45 km/h depending on local laws. We consider the present scenario of the electric bikes available on the market, which have a battery to supply the motor connected to the bike. This battery will be drained on gradient surfaces, and current electric bikes also fail to deliver an equivalent amount of efficiency to a fuel-based motorbike. Due to this drawback found through the customary method, this proposed system incorporates solutions for the electric bike's efficiency as well as its battery drainage conditions on gradient surfaces. It is designed in such a way as to provide higher efficiency than the current E-bikes available on the market. For this efficient process, a highly powered battery has been newly designed. In addition to this, a Global Positioning System, a theft alarm system, and an IoT-based locking system have been installed in this eco-bike. This bike also provides safety measures to the person who is driving it. It also avoids accidents while driving by using sensors. If this design model is successful, a reduction in the power drainage of the battery on a gradient surface can be achieved. In the future, we will also update the solar mode of energy with a Smart Mobility System.

sciforum-084469: Evaluating the Present Energy Demand and Electricity Market in Mozambique: A Thorough Examination of the Energy System

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This research thoroughly examines Mozambique's energy system and current energy consumption. Despite having significant natural resources, such as hydropower, coal, and natural gas, Mozambique needs help ensuring its population's energy needs are met. This study investigates the variables that contribute to these issues, such as insufficient infrastructure investment and limited access to finance. It also explores the significance of renewable energy in Mozambique's energy portfolio, emphasising the potential for additional investment in this area. Furthermore, the study dives into the policy and regulatory frameworks required to allow the construction of a more sustainable and reliable energy system in Mozambique. The LEAP model was employed in this study to depict Mozambique's present energy situation and formulate future projections based on specified assumptions. The paper proposes significant infrastructure expenditures and the creation of a solid regulatory framework to support the growth of Mozambique's energy market. The authors claim that shifting to renewable energy sources might alleviate problems confronting the country's energy industry, encouraging a more sustainable and stable energy system. The paper's distinctiveness stems from its unique focus on Mozambique, its complete study of the country's energy system, its identification of difficulties, its emphasis on renewable energy, and a proactive strategy pushing for policy reforms and investments. In conclusion, the study provides valuable insights into Mozambique's energy environment, emphasising the importance of increased investments and regulatory reforms to solve difficulties in the country's electrical market. This study's findings show the importance of a reliable and sustainable energy system in supporting economic growth and improving the quality of life for Mozambicans.

sciforum-086255: Evaluation of Axial Flow Impeller Fabrication Process by Wire Arc Additive Manufacturing and Machining

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In order to achieve an eco-friendly energy system for the purpose of a sustainable society, it is necessary to consider not only the energy balance during operation, but also the energy costs, such as during the manufacturing of the components of the system. One of these components is a turbomachinery that is used in thermal and nuclear power generation. These turbomachines are often large machines with special specifications, and if they could be modified into eco-friendly manufacturing processes, the benefits would be significant and of industrial value. In recent years, studies have been conducted using additive manufacturing in various industrial applications. In particular, various research and development efforts have been made in wire arc additive manufacturing (WAAM) because of its compatibility with large parts that have complex shapes, although research results using real industrial parts as test pieces have been limited. In this study, firstly, the axial flow impeller of an industrial pump was fabricated using a hybrid system of WAAM and machining to verify the feasibility of manufacturing by applying AM technology. Several axial flow impellers were then designed based on the fabricated axial flow impeller and the information obtained during the fabrication process using the hybrid system, and a comparison was made with the application of the traditional fabrication process to determine the advantages of using this hybrid system. Based on these results, it is expected that the application of WAAM will lead to an eco-friendly turbomachinery manufacturing process.

sciforum-090356: Experimental Performance Evaluation of Aqueosus KCl and PEG6000 Solutions as Eutectic Phase-Change Materials (PCMs) for Portable Cold Storage Applications

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The Food and Agriculture Organization (FAO) reported a staggering annual waste of 1.3 billion tons of food worldwide. A significant portion of this waste, approximately 42%, can be attributed to vegetables and fruits. This issue arises from challenges in distribution to remote regions and lengthy supply chains, leading to spoilage before consumers are reached. To preserve the freshness of perishable foods, which require cooler temperatures, recent advancements in cold storage technology have centered on employing phase change materials (PCMs) in different configurations within cold storage.

This research aimed to further enhance portable cold storage performance by using smaller packs, allowing for a broader range of configurations of phase change materials (PCMs). The selected PCMs were a eutectic mixture of 10% KCl with water and 10% PEG6000 with water. The PCMs were put inside eight PCMs within HDPE packs with a mass of 200 g. The packs were placed in six different configurations in a portable cold storage unit measuring 340 mm $\times$ 255 mm $\times$ 285 mm. The measurements were focused on temperature distribution within the cold storage unit and heat transmission through its walls.

The results show that optimal performance was achieved by placing the PCM packs on the upper side of the portable cold storage unit. This setup optimized temperature homogeneity within storage, making it more suitable for cold storage applications. Additionally, a eutectic PCM comprising a 10% aqueous KCl solution (KCl wt.%) demonstrated its effectiveness in maintaining temperatures above 5 °C, with a maximum cooling capacity of 307.59 kJ. Conversely, a 10% aqueous PEG6000 solution (PEG6000 wt.%) was capable of sustaining temperatures above 10 °C, with a maximum cooling capacity of 332.05 kJ.

sciforum-087665: Exploring the Feasibility of Grapevine Pruning Gasification for Electricity Production and Electric Vehicle Charging in Non-Urban Areas: A Preliminary Technical–Economic Assessment

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The progressive electrification of road transport is the cornerstone of the European Commission's "A clean planet for all" strategy, which lays the foundations for reducing the use of fossils. In this context, electric mobility is spreading more and more rapidly in the European scenario, but the limited driving range of battery-electric vehicles (BEVs) still remains an important consideration for consumers. The charging infrastructure is in fact concentrated in urban areas and focus is needed on their capillary development for competitive, widespread access.

It is therefore necessary to find strategies for the diffusion of charging points outside urban centers, involving the so-called marginal areas in the electrification process. These areas are often agricultural and produce tons of organic waste every year, which is often not valorized. This is the case of the wine production chain that, in Italy, produces large quantities of wood waste (from 1 to 5 tons/ha per year).

In this work, a statistical model combines the use of biomass cogenerators (gasifiers) to convert prunings into electrical energy and to feed a high-power charging station for BEVs. Through the use of a battery energy storage system (BESS), it is in fact possible to decouple the production power from the charging power, increasing the quality of the service.

This study demonstrates how the current selling prices of energy for recharging vehicles are more than sufficient to guarantee a payback time between 6 and 10 years. This result generates positive effects on the field: (a) the production of electricity allows rural areas to establish sustainable electric transportation networks, reducing their marginalization; (b) the production portfolio of farms or agricultural consortia is diversified; (c) a carbon-negative recovery chain for vine prunings is created, offering a sustainable solution for their disposal.

sciforum-090288: Extraction of the Optimal Parameters of Single-Diode Photovoltaic Cells Using the Earthworm Optimization Algorithm

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This study introduces a novel method for assessing and deriving the electrical properties of simple diode model solar cells through the utilization of the Earthworm Optimization Algorithm (EOA). Earthworms learn how to avoid barriers and maximize their search in their pursuit of nourishment. In a similar vein, the algorithm imitates this capability by avoiding the problem of concentrating on a local solution. The communication channels between members of the virtual swarm are essential to the optimization process carried out by the earthworm swarm. Through information sharing regarding prospective solutions, these exchanges help to steadily improve the solutions that are eventually accepted by the entire swarm. The virtual cooperation of the "earthworms" increases the effectiveness of solution space exploration and ultimately results in the identification of the mathematical model's ideal parameters. This metaheuristic algorithm has proven effective in optimizing complex systems across various domains. Furthermore, the outcomes obtained via the EOA are contrasted with those derived from other algorithms, namely gray wolf optimizer (GWO), whale optimization algorithm (WOA), sine cosine algorithm (SCA), moth–flame optimization (MFO), ant lion optimizer (ALO), and multiverse optimizer (MVO). Statistical assessments are employed to verify the accuracy of the derived parameters, demonstrating that the theoretical outcomes closely align with experimental data, showcasing superior precision compared to other algorithms.

sciforum-087615: Flexing the Energy Per Day of Electric Vehicles in Northern Ireland

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Electric Vehicle (EV) charging will add to the demand for electricity in Northern Ireland (NI) and will prompt upgrades at points on the electricity grid. The impact on the grid will depend on location with respect to existing infrastructure and the level of increasing electricity demands from low-carbon technologies like EVs. While certain network upgrades will be inevitable, being able to charge EVs at different times of the day and the aggregate amount of energy demand through EVs present electricity demand flexibility opportunities, especially in NI, where a pioneering proportion of variable renewable energy resources, mostly wind turbines, have been connected to the electricity grid. With an estimation of the aggregate energy through EVs in NI, the aggregated electricity demand flexibility opportunities are presented through different charging times such that the use of existing electricity network and renewable energy generation infrastructures are optimised, and EV users benefit from lower charging rates. Current and future EV levels of EV uptakes are used as scenarios of aggregated electricity demand, and the impact and benefits of scheduling are analysed with respect to the resources at different locations within the NI electricity supply system. The results show the specific energy per day that using EVs for all journeys in NI will require. When a storage device is to be included at a public charging site for time-of-use electricity demand, the results show at what point that makes economic sense, considering the cost of battery, available tariff, and EV usage at that point. The results also suggest the level of EV usage required and tariff differences needed at locations of the NI electricity supply system.

sciforum-087480: Impact of Climate Change on the Thermoeconomic Performance of Binary-Cycle Geothermal Power Plants

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The thermoeconomic performance of binary-cycle geothermal power plants is influenced by a variety of site-specific factors, major economic variables and the type of the involved technology. Besides those, ambient conditions also play a role in the geothermal power generation by acting on the cooling towers. This study focuses on the performance analysis of subcritical and supercritical isobutane cycles for power generation from geothermal source temperatures between 150 and 200 °C, additionally accounting for the impact of short- and long-term variations in the ambient conditions. Short-term variations are represented by hourly, daily and seasonal variations in the ambient conditions while long-term variations are described by climate projections under two representative concentration pathways (RCPs): the intermediate RCP4.5 scenario and the extreme RCP8.5 scenario, over the period from 2021 to 2100. The global climate models from the most recent Climate Model Intercomparison Project (CMIP6) are compared against observed temperature data from the reference period 1991–2020. The predictive power of the CMIP6 climate models is evaluated using the root mean square error (RMSE) and the Kullback–Leibler (KL) criteria. The thermoeconomic performance of the geothermal power plant is expressed in terms of net power output, annual electricity generation and levelized cost of electricity (LCOE). The results revealed that a reference geothermal power plant with 10 MW net power output and an LCOE of 74 US$/MWh at the standard ambient state (t = 20 °C, rh = 50%, p = 101,325 Pa) is subject to daily, monthly and seasonal variations by as much as 25% in net power output and up to 15% in the LCOE. Over the period from 2021 to 2100, the annual electricity generation of the reference geothermal power plant is reduced by 5% and 3% in the extreme (RCP8.5) and intermediate (RCP4.5) climate change scenarios, respectively.

sciforum-090440: Investigation of Thermal Stability of $Mg_{84}Cu_{16}$ as New Potential High-Temperature Phase Change Materials for Latent Heat Storagee

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This work examines the thermal stability testing results of $Mg_{84}Cu_{16}$ as a new phase change material for its potential use in latent thermal energy storage systems for 488 °C transition temperatures. The results obtained in a previous study (El Karim et al., 2019) showed that the Mg_{84}-Cu_{16} alloy is one the most promising materials for thermal energy storage applications due to their eutectic nature and because the highest thermal conductivity (106 W/mK) was reported in the 400–550 °C temperature range. To confirm these results, the thermal stability of this alloy and its behavior with container materials during its use in industrial conditions were evaluated. In the first part, the Mg_{84}-Cu_{16}, with latent heat of 232 J/g, was subjected to short-term thermal cycling tests in 30 melting/solidification cycles in order to identify any potential changes in their thermophysical and structural properties. Variations in thermophysical properties were analyzed using the DSC technique. The evolution of the eutectic microstructure was examined via SEM. The second part of this study studies the compatibility between the selected materiel and the different containment materials, such as SS304, SS316, and INCONEL, in order to identify the most suitable stainless steels that can be used in the construction of thermal energy storage unit for the $Mg_{84}Cu_{16}$ alloy.

sciforum-088327: Marine Oil Spill Detection with Deep Neural Networks

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Oil spills, primarily due to accidents involving pipelines, tankers, and storage facilities, significantly impact marine life, particularly fish and shellfish. These leaks harm the fish and shellfish living in the seas. Within the scope of this study, open-source ocean images were used, with or without oil spills. In the dataset, there are 150 images in each class, and a total of 300 images. Before the training in deep neural networks for oil spill detection, data augmentation by rotating the dataset at certain angles to the right and left and various data preprocessing processes were applied. After the data augmentation process, the total amount of the dataset was increased from 300 to 400. In addition, as a dataset distribution, there are 320 images in the training data and 80 images in the validation data. Validation data were also used as test data. Deep learning-based deep neural networks MobileNetV2, Convolutional Vision Transformer (CvT), and ConvNeXT were used for classification processes in which oil spill detection with artificial intelligence is performed. When the application results were examined, it was observed that the classification results in deep neural networks had an accuracy rate of over 90%. Future work will aim to develop a real-time object detection interface that classifies and accurately locates oil spills.

sciforum-090349: Numerical Performance Evaluation of Aqueous LiCl and $CaCl_2$ Solutions as Liquid Desiccants in Dehumidification Systems

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In tropical countries like Indonesia, humidity levels are generally high, with relatively constant temperatures. This explanation emphasizes that in a room, the responsibility of regulating humidity and air temperature to ensure comfort is significant. To control the amount of water vapor, the dehumidification process can be carried out using liquid desiccants. The purpose of this research is to test the system scheme and types of liquid desiccants used to enhance air quality by reducing humidity. This study aims to determine the transfer performance of aqueous LiCl and $CaCl_2$ liquid desiccants by numerical means, including the process of reducing water content in the air via the absorption of water content in the air by the liquid desiccant, and the heat and mass transfer phenomena that occur with the liquid desiccants. The research is conducted numerically by simultaneously solving heat and mass transfer equations using the finite difference method explicitly, with the changes in property values of the liquid desiccant in each control volume. The results indicate that comparisons with experimental values show an error of less than 5%. The differences in fluid characteristics and property values between the aqueous LiCl and $CaCl_2$ solution remarkably affect the reduction water content from the air. The performance of an aqueous LiCl solution with a concentration of 40% (wt. of LiCl) in absorbing water vapor from the air is better than that of the aqueous $CaCl_2$ solution. When using the $CaCl_2$ solution, performance decreases by 15% compared to the LiCl solution. During the process of absorbing water vapor from the air, the liquid desiccant undergoes an exothermic reaction, leading to an increase in the temperature of the liquid desiccant of around 13%. Apart from performance, considering the corrosive nature of LiCl and the relatively cheaper price of $CaCl_2$, $CaCl_2$ can be considered a fairly reliable alternative liquid desiccant.

sciforum-089623: Optimal Power Management and Control of Hybrid Solar–Wind Microgrid including Storage System

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This paper aims to propose an application of artificial intelligence and nature-inspired optimization algorithms to design an optimal power management and frequency control loop that allows the integration of a large number of distributed generators, such as wind farms and solar PV generators, in isolated and islanded power systems. In addition, the proposed strategy was coordinated with a Hybrid Energy Storage System (HESS) including a redox battery and fuel cells. The HESS was used to support the frequency regulation loop and reduce frequency oscillations during disturbances. An optimal Fuzzy-PID controller was employed to cope with system fluctuation using a recently developed optimization algorithm named Marine Predator Algorithm (MPA). The MPA algorithm was used to optimize the parameters of Fuzzy Logic and the PID controller. Furthermore, the proposed power management method was used to minimize the use of diesel generators by maximizing the participation of wind, PV, and storage systems to satisfy the load. To show the effectiveness and validity of the proposed strategy, various case studies have been simulated and presented in this work. A comparative study between some metaheuristic algorithms such PSO and GA have been carried out. Finally, robustness analyses have been performed in the presence of high-penetration wind farms and solar PV arrays with different load disturbances.

sciforum-090228: Performance Analysis of Maximum Power Point Tracking Techniques for Photovoltaic Battery Charging Systems

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Photovoltaic (PV) battery chargers utilize solar energy to charge batteries. They are generally used in off-grid applications where access to grid electricity is limited. They are also used in portable electronic devices. PV battery charging systems play an important role in harnessing renewable energy and reducing dependence on fossil fuels. To improve the efficiency of photovoltaic systems and optimize their performance, the utilization of Maximum Power Point Tracking (MPPT) techniques is crucial.

This work aims to simulate and compare the performance of three MPPT methods under various environmental conditions when applied to a PV battery charger application: the perturbation and observation (P&O) method, the Fuzzy Logic Controller (FLC), and the Adaptive Neuro-Fuzzy Inference System (ANFIS) strategy. The proposed system comprises the following components: a 305 W-rated power solar panel, a buck converter, and a lithium-Ion battery. The system aims to extract the maximum power point and charge the battery optimally. It is implemented and simulated using MATLAB/SIMULINK software.

The simulation results of the output power of the PV panel and buck converter using different controllers are compared. Performance analysis reveals that the controller using an ANFIS regulator has reduced gap oscillation around the maximum power point, enhanced rapidity characterized by a shorter convergence time, better voltage regulation of the battery, and higher efficiency.

sciforum-089765: Power System Transient Stability Analysis in the Presence of Renewable Energy

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This paper carries out power system transient stability analysis in the presence of renewable energy sources (RESs), including wind farms and solar photovoltaic PV generators. The integration impact of RESs on power system time domain simulation and transient stability were analyzed using the Western System Coordinating Council (WSCC) IEEE 14 bus system. Through this work, we aimed to analyze and improve the transient stability of electrical networks by integrating renewable energy for a reduced Critical Clearing Time (CCT) when a fault appears. Therefore, it is important that the energy system can remain in a state of equilibrium functioning under normal operating conditions and can be able to reach an acceptable state of equilibrium after having been disturbed. For this, we studied the influence of the integration of renewable energy (wind turbines and PV generators) in an electrical network on the transient stability of the system. The standard test network (IEEE 14 buses) was employed for the simulation using PSAT software, which is a dedicated tool used for the static and dynamic analysis and control of electrical networks, and which runs under Matlab environment. Several scenarios that simulate transient stability are carried out in three periods: before, during, and after a three-phase short circuit fault.

sciforum-087784: Study of Structure and Electrochemical Properties of $LaFeO_3$ and La_2FeO_4 as Electrode Materials for Super-Capacitor Application

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Perovskite oxides have introduced a new advancement in the field of energy storage technologies. Because of their outstanding properties, perovskite oxides are a diverse and exciting class of compounds that have attracted a lot of interest. Perovskite oxides have attracted considerable interest as potential electrode materials for supercapacitors due to their unique structure, compositional flexibility, and intrinsic oxygen vacancy. Synthesized single-phase perovskite $LaFeO_3$ and its 2D equivalent Ruddlesden-Popper oxide La_2FeO_4 were obtained via a solid-state reaction method. X-ray diffraction and field emission scanning electron microscopy have been used to study the crystal structure and surface morphology of the produced materials, respectively. The optical band gap for $LaFeO_3$ is 2.10 eV, while for La_2FeO_4, it is 2.04 eV, as determined by UV-vis measurements. Electrochemical impedance spectroscopy (EIS), charge/discharge analysis, and cyclic voltammetry have all been used to study the electrochemical characteristics. Both of the samples exhibited typical pseudocapacitor behavior, as indicated by the presence of a redox peak in cyclic voltammetry, which was recorded in the potential window of 0 to -1 V. For both compounds, the faradic charge transfer resistance (Rct) was determined to be close to ~1 Ω. After 100 cycles of testing the charge/discharge characteristic, the specific capacitance of $LaFeO_3$ and La_2FeO_4 in a 3M KOH electrolyte solution stabilized at around 6 Fg-1 and 10 Fg-1, respectively.

sciforum-088875: Toward Sustainability: Interventions for Implementing Energy-Efficient Systems in Hotel Buildings

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The hospitality industry is increasingly focusing on environmental responsibility and cost savings, so adopting sustainable energy practices is paramount. This article investigates sustainable energy systems tailored for hotel buildings, exploring infrastructure improvements and potential interventions to enhance energy efficiency. This paper synthesizes existing literature, industry reports, and case studies to provide insights into effective strategies for implementing energy-efficient solutions in hotel infrastructures. The paper examines hotel buildings' current energy consumption patterns and the environmental impacts of traditional energy sources. It then delves into various sustainable energy systems applicable to hotel settings, including solar photovoltaic panels, geothermal heating and cooling systems, energy-efficient lighting, and smart building management systems. Case studies showcasing successful implementations of these technologies in hotel properties highlight their potential in reducing energy costs and carbon footprints while enhancing guest satisfaction. The current study identifies key interventions and best practices for integrating sustainable energy systems into hotel buildings. These interventions encompass technological upgrades and behavioral changes, such as energy audits, employee training programs, and guest engagement initiatives. This paper discusses the importance of stakeholder collaboration, regulatory compliance, and financial incentives in driving the adoption of sustainable energy solutions within the hospitality sector. The challenges and barriers hindering the widespread implementation of energy-efficient systems in hotel buildings, including upfront costs, technical complexities, and cultural resistance to change, are also discussed. Strategies for overcoming these obstacles, such as leveraging financing options, conducting feasibility studies, and fostering a culture of sustainability within hotel management and staff, are also proposed. This study emphasizes the urgent need for sustainable energy interventions in hotel buildings to mitigate environmental impacts, reduce operating expenses, and enhance long-term competitiveness. By implementing energy-efficient systems and fostering a culture of sustainability, hotels can achieve cost savings and contribute to global efforts toward a more sustainable future.

Abstracts

Session C. Food Processes

sciforum-090093: Optimization of Caffeine Extraction from Various Tea Types Using Dichloromethane as an Organic Solvent

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Caffeine, as 1,3,7-trimethyl-1H-purine-2,6-dione, represents a naturally occurring alkaloid within the methyl xanthine family. Exhibiting bitterness and an odorless state in its pure form, caffeine manifests as needle-like crystals. Found abundantly in tea, coffee beans, kola nuts, and cocoa beans, this compound possesses stimulating effects on the central nervous system, respiration, and cardiac activity. Ubiquitously present in everyday products such as soft drinks, tea, coffee, chocolates, pharmaceutical drugs, and skincare items, caffeine plays a pivotal role. This study focuses on the extraction of caffeine from various tea types, including used tea, utilizing dichloromethane as an organic solvent. Investigating the impact of temperature and residence time on extraction efficiency, we observed a direct correlation between these factors and efficiency. Notably, the residence time exhibited a significant effect up to a certain threshold, beyond which no substantial difference in extraction efficiency was observed. The optimal conditions for caffeine extraction were identified at 100 °C with a residence time of 30 min. The findings revealed the extraction of 0.089 g of caffeine from black tea, 0.06 g from used black tea, 0.08 g from green tea, and 0.047 g from used green tea.

sciforum-090236: Assessing Quality of Food Products Using Electronic Noses: A Systematic Review

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In the global food industry, companies face various challenges, including the need for innovation to keep up with competition, expanding into new markets, and satisfying the ever-changing demands of consumers. Our senses of smell and taste provide invaluable insights into the analysis of various food products, beverages, and their combinations. Mimicking the biological function of the mammalian nose, the electronic nose (e-nose) emerges as a revolutionary technology. It utilizes an array of chemical gas sensors that interact with odor molecules, generating signals that are then transmitted to a computer. Through pattern recognition methods, the computer figures out patterns and details in the smells, just as our brains understand different scents. A systematic review of the research literature was conducted, identifying 14 articles that fit the inclusion criteria, which were then analyzed. Only studies focusing on food products published after 2013 were included. Most of these studies found that homemade e-noses were successful in quality analysis. The findings indicate that sensor-based electronic nose systems can effectively assess the quality of food products. Furthermore, they suggest that these systems can also be used for freshness assessment, quality control, and process monitoring. By leveraging e-nose technology, food companies can enhance their efficiency, reduce waste, and maintain consistent quality standards across their product lines. However, despite its promise, the widespread adoption of e-nose technology in the food industry faces significant challenges. These include the need for further refinement to enhance accuracy, reliability, and versatility, as well as addressing cost concerns and regulatory hurdles. Overcoming these obstacles is crucial to unlocking the full potential of e-nose technology and realizing its transformative impact on the food industry.

sciforum-089471: Ethanol Production from *Oxalis tuberosa* Starch: Optimization of Enzymatic Hydrolysis and Alcoholic Fermentation

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Andean tubers are an important source of starch. Although potatoes, sweet potatoes and cassava are the best-known sources, there are other underutilised tubers such as oca, arracacha or mashua, which are mainly consumed by the rural populations surrounding their production area. However, they are not typically used for large-scale applications, giving them a greater added value. The aim of this study was to evaluate the potential use of oca (Oxalis tuberosa) starch to obtain ethanol, studying the optimal conditions of starch enzymatic hydrolysis and subsequent alcoholic fermentation. An initial screening using a Plackett/Burman design (15 treatments, performed in triplicate) to identify the independent variables with the highest impact on the hydrolytic process was applied. Subsequently, the identified variables were used in a Rotational Central Composite Design (CRDC) (11 treatments, performed in triplicate) to determine the optimal values of these variables in the hydrolytic process. Among the main results, the concentration of the enzymes had a significant impact on the hydrolytic process, achieving a conversion of up to 93% in starch hydrolysis to dextrins (liquefaction) at an optimal α-amylase concentration of 0.41%, as well as the subsequent hydrolysis of those dextrins into fermentable sugars (saccharification) at rates greater than 93% at an optimal glucoamylase concentration of 0.75%. In the alcoholic fermentation stage, a conversion efficiency of sugars into ethanol of 89% was obtained using yeast extract as the N source for the yeast Saccharomyces cerevisiae. Based on the results, for every 1000 kg of oca, up to 30 L of ethanol can be produced, which can later be used for different purposes such as the production of alcoholic beverages, biofuel, as well as for medicinal use, among other applications. These results, despite being obtained at the laboratory level, may have practical implications for optimizing hydrolysis processes and guiding future research to obtain ethanol from other underutilized sources of starch.

sciforum-087403: Impact of Flour Particle Size and Starch Damage on Baking Properties of Wheat Flour Grown in Dry Climate: In the Case of Uzbekistan

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The impact of flour particle size and starch damage on the baking properties of wheat flour cultivated in dry climates, focusing on Uzbekistan, is investigated. Given the critical role of bread and flour products in Central Asian diets, understanding grain cultivation's influence on these products is imperative. Dry climates affect wheat quality, particularly its protein and glutenin content, influencing dough resistance and bread appearance. This study evaluates how flour particle size and starch damage affect baking properties using wheat flour grown in semi-arid regions, aiming to assist wheat growers in post-harvest irrigation decisions. Through a combination of chemical and physico-chemical methods, including particle size analysis, damaged starch measurement, and baking tests, the study elucidates the relationship between flour characteristics and baking performance. Results indicate that smaller flour particle sizes enhance dough mixing properties but may adversely affect crumb firmness. Furthermore, high levels of starch damage negatively impact flour quality and baking properties. Importantly, the study underscores the significance of understanding these factors in optimizing wheat cultivation and flour processing for improved bread quality in dry climates. Specifically, results show that for high-grade flour (Sardor), the control sample had a gluten content of 25.6%, with a drop number of 190, and a degree of starch damage of 26.9 units. Conversely, flour samples from locally grown soft wheat demonstrated higher starch damage, ranging from 3.4 to 3.9 units compared to imported samples. Additionally, regression analysis revealed significant coefficients for particle size and starch damage on the amount of wet gluten washed from the flour samples.

sciforum-084877: Therapeutic Potential of Fractions of *Globimetula oreophila* (Oliv. ex Hook.f.) Leaf Extract Growing on *Azadirachta indica* against *Plasmodium berghei*-Infected Mice: An In Vivo Approach

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Introduction

The development of parasite resistance to first-line antimalarial medicines, especially the ACTs, has made the research and development of novel antimalarial medications vital. *Globimetula oreophila*, a plant used in traditional medicine to treat malaria, is an example of a natural product that may provide new antimalarial drugs with fewer side effects, less drug resistance, and greater efficacy than synthetic drugs. This study aims to evaluate the antiplasmodial properties of *G. oreophila's* fractions.

Methods

After collection and authentication, the leaves were air-dried and reduced in size using a pestle and mortar. The pulverized plant was macerated in 70% ethanol and fractionated with solvents in the increasing polarity of n-hexane, chloroform, ethyl acetate, and n-butanol to produce the various fractions. The antiplasmodial activity of the n-hexane, chloroform, ethyl acetate, and n-butanol fractions of *Globimetula oreophila* leaf extract was assessed using an in vivo method in *Plasmodium berghei*-infected mice.

Results

In the mice, the fractions' median fatal dose (LD_{50}) was calculated to be more than 5000 mg/kg. At doses of 125, 250, and 500 mg/kg, the fractions significantly (p 0.001) reduced the parasitemia level.

Conclusions

The fractions of *G. oreophila* showed significant in vivo antiplasmodial activity, which upholds the earlier in vivo findings for the crude extract as well as its folkloric use.

sciforum-087600: A Comparative Evaluation of Various Extraction Methods for the Extraction of Pectin from Peach Pomace

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The current study aimed to investigate and contrast novel methods for the extraction of beneficial substances like pectin from peach pomace. Conventional extraction techniques result in significant waste and carbon footprint generation, as well as decreased energy and productivity levels. Therefore, five different novel and innovative procedures were used to extract pectin: ultrasound-assisted extraction (UAE), ohmic heat extraction (O_HAE), microwave-assisted extraction (MAE), ultrasound-assisted microwave extraction (UAME), and ultrasound-assisted ohmic heat extraction (UAO_HE). The percentage of pectin extracted varied from 7.83% by O_HAE at 45 V to 33.64% by UAME at 520 W. To determine whether pectin is suitable as a food additive, the maximum amount of pectin from each process was subjected to additional analysis, including color, scanning electron microscopy (SEM), degree of esterification (DE), and galacturonic acid concentration (GalA). DE varied between 63.26% and 76.43% (MAE and UAME). Since all the extracted pectin has a DE of more than 50%, it is methoxy pectin. From 767.89/kg (O_HAE) to 965.55/kg (UAME), GalA was measured. Colors "L" through "b" ranged from 25.41 (UAE) to 69.04 (UA_HOE), and color "a" reached 69.04 (UAME). Images from the SEM clearly showed how different extraction methods work and how they affect pectin yield. All the methods were used to extract pectin, and the findings showed that while MAE is a faster method, UAE is still favored over MAE because of its safe zone ultrasonic sonication. Although MAE increased efficiency, the high power caused damage to the pectin structure. After ultrasonic pre-treatment to extract pectin and subsequent processing at a reduced power level, UAME was deemed the best technology. This method resulted in less natural product breakdown and an increase in pectin amount and quality. Therefore, when compared to other procedures, extraction using the UAME technique produced a higher yield in less time.

sciforum-083235: A Review of Hydroponic Systems for Medicinal Herb Cultivation: Practices and Prospects

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This literature review extensively explores the promising application of hydroponics in cultivating endangered medicinal plants, with a particular emphasis on the renowned *Rhodiola rosea*. The aim of this study is to evaluate the feasibility and potential advantages of integrating hydroponic systems into the cultivation of endangered plant species, addressing the pressing need for sustainable approaches in herbal medicine production. By systematically examining the impact of hydroponic systems on plant growth and the production of bioactive compounds, this review provides valuable insights into the optimization of hydroponic methods for the sustainable cultivation of medicinal herbs. The scope of this review encompasses a comprehensive analysis of the existing literature related to the use of hydroponics in cultivating endangered medicinal plants, with a specific focus on *Rhodiola rosea*. It seeks to synthesize and critically evaluate research findings, methodologies, and outcomes in the field. Moreover, this review extends its scope to explore the broader significance of integrating hydroponics into the cultivation of endangered medicinal plant species. It emphasizes the crucial roles hydroponics can play in ecological conservation, promoting sustainable agriculture practices, and its implications for the pharmaceutical industry. This comprehensive review not only contributes to the body of knowledge on sustainable medicinal herb production, but it also underscores the significance of hydroponic cultivation in the preservation of genetic diversity within endangered plant species.

sciforum-084463: A Review on the Drying Kinetics of Common Corn (*Zea mays*) Crops

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The incorporation of drying technology in the production of agricultural products to address food demand has been known to have beneficial effects in terms of quality and profitability. Common corn crops (*Zea mays*) such as sweet corn, wild violet corn, waxy corn, white corn, purple corn, and young corn are types of cereal grains that typically undergo a drying process to produce a wide variety of food products. The drying process is important in maintaining the quality and prolonging the shelf life of crop products. Thus, drying kinetic research studies on common corn crops are necessary due to the significance of drying parameters in drying operations and are vital in the process that substantially influences the corn drying rate. In this review article, the role of different process parameters like airflow and temperature, relative humidity, sample size preparation, and initial moisture content is presented. In addition, different drying kinetic mathematical model equations such as the Weibull and Peleg model, Midilli Kucuk model, and Page and Modified Page models were studied to give a basis for design parameter evaluations. Finally, this review article aims at bringing about a better understanding for both researchers and scientists on how drying technology can be utilized in food manufacturing.

sciforum-089928: An Updated Review on the Quantification, Prevalence, and Pretreatment Approaches for Mycotoxins in Peanuts and Tree Nuts

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Mycotoxins, produced as secondary metabolites by specific filamentous fungi under certain conditions, pose a significant health risk when they contaminate nuts and nut products. These toxic compounds, particularly aflatoxins and notably aflatoxin B1 (AFB1), are among the most dangerous mycotoxins in the human diet due to their carcinogenic and immunosuppressive effects. In response, international food safety authorities have set limits for mycotoxin levels in nuts to mitigate these risks. To detect these mycotoxins, various methods have been developed, with high-performance liquid chromatography (HPLC) and ultra-high-performance liquid chromatography coupled with triple quadrupole mass spectrometry (UHPLC-QqQ-MS/MS) standing out for their efficiency and sensitivity. Our review paper seeks to offer a detailed analysis of the primary mycotoxins affecting nuts, their health implications, and their prevalence across the globe. It also examines the pretreatment processes for nut samples, the analytical approaches for mycotoxin identification in nuts, and the latest developments in the materials and solvents used for these analyses. It also identifies significant challenges in mycotoxin detection in nuts, including variability in detection methods and a lack of comprehensive data from some nut-producing regions, underscoring the need for further research in these areas. In addition, the strengths and drawbacks of analytical methods for identifying mycotoxins in nuts are well explained.

sciforum-085286: Application of Thiolated Silica Nanoparticles in Food Industries

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This study demonstrates the synthesis of silica nanoparticles (Si-NPs) using the sol-gel method, followed by thiolation via mercaptopropyl tri-methoxy-silane, to encourage the covalent binding of *Aspergillus oryzae* β-galactosidase with the developed nanosupport. A higher yield of 89% for enzyme immobilization was obtained on the obtained surface functionalized nanobiocatalyst. The pH and temperature optima of the immobilized and soluble enzymes were found to be 50 °C and pH 4.5, respectively. Nevertheless, when compared to soluble β-galactosidase (SβG), β-galactosidase bound to thiolated Si-NPs (IβG) demonstrated a marked increase in activity under extreme temperature and pH variations. This was due to the improved tolerance towards harsh pH ranges and the limitation of the enzyme's thermal movement at higher temperatures. Furthermore, it was noted that even after an hour, IβG still retained 58% activity at 5% galactose concentration. However, SβG displayed 23% activity in similar experimental conditions. The immobilized enzyme was found to be reusable, retaining 63% of its activity even after six repeat uses. According to the batch reactor experiment, IβG showed 86% and 79% lactose hydrolysis at 50 °C and 60 °C, respectively, whereas the soluble enzyme showed 71% and 60% lactose hydrolysis under the same conditions after 8 h. Further investigation into the stability of the generated nanobiocatalyst will be necessary to produce lactose-free dairy products in continuous reactors and to produce galacto-oligosaccharides.

sciforum-090235: Comparative Analysis of Milling, Appearance, and Cooking Qualities of Traditional, Improved *Oryza sativa Indica* and *Oryza sativa Japonica* White Rice Varieties Cultivated in Sri Lanka

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Rice is consumed as a staple food by more than half of the world's population and is also the primary staple food in Sri Lanka. Additionally, white rice is the most popular choice due to its perceived sensory attributes. Therefore, this study compared only white rice varieties, including four traditional rice varieties, two improved rice varieties and the *Nipponbare* Japonica Variety. This study revealed that the milling quality of traditional, improved varieties and the Japonica white rice variety was significantly different (*p* 0.05), except for the bran percentage. The head and broken rice percentages for selected white rice varieties ranged between 61% and 75% and 1% and 44%, respectively. Among the selected traditional white rice varieties, a higher head rice percentage (74.28 ± 2.33) and lower head percentage (61.88 ± 3.20) were shown by *Suwandel* and *Rathal*, respectively. With alower head rice percentage, the *Rathal* white rice variety reported a higher broken rice percentage (11.19 ± 4.16), while a lower broken rice percentage (1.98 ± 0.54) was observed in *Kahawunu*. The *Nipponbare* white rice variety reported 48.77 ± 0.88% head rice percentage and 20.78 ± 1.10% broken rice percentage. The grain size varied from short to medium to long, while the shape changed from round to oblong to medium, and the *Nipponbare* rice variety was categorized as middle round. Appearance quality parameters, including surface area, volume, geometric diameter, equivalent diameter, sphericity, aspect ratio, and thousand kernel weight, were significantly different (*p* 0.05). In contrast, bulk density, true density, and porosity were not significantly different ($p > 0.05$). The rice varieties displayed varying gelatinization temperatures, with all except *Nipponbare* classified as having a hard gel consistency and being high in amylose. Significant differences (*p* 0.05) were observed in cooking parameters such as elongation ratio, cooked length-to-breadth ratio, water uptake, volume expansion ratio, and minimum cooking time among the selected white rice varieties.

sciforum-090365: Comparative Analysis of Shelf-Life Extension of Grape Juice by Ohmic Heating and Ultrasonication

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Grapes are consumed as a fresh fruit or as a fresh juice. Grape juice has higher antioxidant properties. These antioxidants help reduce free radicals. Grapes are stored best at a 0–5 °C temperature. About 10–15% of fresh grapes lose their market value and consumer acceptance due to poor post-harvest techniques. The water activity of grape juice is high, and therefore juice is highly susceptible to microbial growth. So, it is not easy to store it for a long period without processing. Ohmic heating and ultrasonication are novel techniques that were used in this research for the shelf life of grape juice. These non-thermal techniques have a positive effect on the shelf life of grape juice. Grape juice was treated by taking seven different treatment groups; T0 was the control sample, while T1, T2, and T3 were heated ohmically at 20 V/cm for 10, 20, and 30 s, respectively, and T4, T5, and T6 were treated with ultrasonication at 20 kHz for 10, 20, and 30 min, respectively. The best treatment was determined to be storing grapes for up to 7 days at 4 °C. Both treatments showed slight changes in the physicochemical parameters of grape juice. Both treatments at set voltages and different times caused changes in pH. A greater decrease in pH was observed by Ohmic heating as compared to ultrasonication. A decrease in pH was considered to protect the juice from microbial deterioration, and it could be stored for one week. A microbiological analysis of grape juice treated by Ohmic heating and ultrasonication revealed that Ohmic heating caused a reduction in the total plate count and total coliform count more effectively as compared to the ultrasonicated grape juice. Therefore, Ohmic heating was considered more effective as it provides uniform and rapid heating during processing, and it was found that grape juice treated by this treatment can be stored for up to 7 days.

sciforum-090188: Comprehensive Chemical, Nutritional, and Antioxidant Profiling of Homemade Milk Kefir Drink

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Introduction

Kefir is an acidic-alcoholic natural fermented milk drink with rich probiotic content that has been consumed since ancient times. This research study aims to develop a cow-milk kefir drink in household conditions and determine its bioactive compounds, nutritional and antioxidant properties.

Methodology

For the preparation of the synbiotic drink, kefir grains (3% w/v) were inoculated in cow milk and further allowed to ferment at 25 °C for 24 h. The drink was formulated with the same procedure in triplicate, stored at 4 °C, and then further used for analysis. Nutritional and physiochemical analyses were performed as per AOAC methods, DPPH radical-scavenging activity and phenolic compounds were estimated using a UV spectrophotometer, and bioactive compound identification was performed using GC-MS.

Results

The nutritional and antioxidant profiling of kefir milk drink resulted in the following: protein 3.6 g, carbohydrates 2.66 g, fat 3.4 g, iron 2.99 mg, calcium 29.3 mg, potassium 107 mg, and sodium 59.4 mg per 100 mL, DPPH antioxidant potential 54%, and 18 mg/100 GAE phenolic compounds. The GC-MS results show that the home-based kefir milk drink contains numerous volatile compounds, including phenols for antioxidants, esters for the aroma and to potentially inhibit pathogenic microbes, unsaturated fats for cardioprotective support and anti-inflammatory properties, steroids for stability, polyalkenes for clarity and possible antioxidant support, and aromatic aldehydes for aroma and antimicrobial components.

Conclusions

This research study highlights the unique nature and characteristics of the home-based kefir milk drink, recognizing the inherent variety of different parameters in home environments. Physicochemical, nutritional and bioactive compound profiling helped us to establish promising prospects for milk kefir drinks as healthy nutritional biomarkers.

sciforum-087633: Cultivar-Driven Variations in the Production of Apple Cider Vinegar

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Apple cider vinegar has gained widespread popularity for its numerous health benefits and versatile applications in human consumption. Beyond its distinct organoleptic properties, which render it invaluable in numerous ways, alongside acetic acid, it contains trace amounts of various minerals and biologically active compounds. Many researchers have outlined its positive impact on digestive health, blood sugar regulation, body weight management, and heart health, as well as its antioxidant properties and antimicrobial effects, making it beneficial in detoxification processes and even in certain skin care procedures when diluted and applied topically. Apple vinegar production emerges as a valuable strategy for valorizing apple raw materials, transforming them into a product with diverse applications, health benefits, and a positive impact on sustainability. By integrating apple vinegar into their product portfolio, producers contribute to the economic, environmental, and culinary facets of the apple industry; this approach also addresses the effective utilization of blemished and bruised surplus apples, which otherwise go to waste, concurrently fostering waste reduction and aligning with sustainable practices. This research seeks to explore the lab-scale production of apple vinegar using a traditional batch fermentation process, using different apple cultivars. The fermentation process was monitored by measuring refractive index, pH, conductivity, acidity (via titration with NaOH), and carbohydrate degradation (via high-performance liquid chromatography) at predefined intervals. An empirical mathematical model was developed to enhance process understanding and to potentially serve as a cost-effective tool for controlling the fermentation process.

sciforum-089987: Determination of Qualitative Changes in Edible Oils during the Oxidation Process Using the FTIR Method

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In the food industry, including the fat and oil sector, chemical methods are commonly used for routine quality analyses. These analyses are typically time-consuming and often require the use of toxic solvents and reagents. Moreover, in some cases, sophisticated instruments such as gas chromatographs are used, which are expensive and a form of advanced instrumentation. As an alternative approach, it is possible to use simpler methods utilizing spectroscopic techniques, like FTIR spectroscopy, the results of which have been reported to correlate with those obtained using wet chemical methods. In this study, we used the FTIR technique to assess the oxidative stability of some edible oils available on the Polish market. The oils studied were nigella seed, pumpkin seed, flax seed, linseed, evening primrose seed, and thistle seed oils. FTIR/ATR spectra of the undiluted oils were recorded in the range of 500–4000 cm^{-1} with a resolution of 2 cm^{-1}. To monitor the oxidation process, the peak at 721 cm^{-1}, related to cis double bonds of unsaturated fatty acids (UFAs), and the peak intensity at 986 cm^{-1}, associated with the presence of conjugated diene groups of hydroperoxides (HPs), were analyzed. The content of free fatty acids (FFAs) and the ratio of unsaturated/saturated fatty acids (UFAs/SFAs) were qualitatively expressed by the intensity band at 1712 cm^{-1} and the peak ratio of 3011/2925 cm^{-1}, respectively. Additionally, using the Triphenylphosphine/Triphenylphosphine Oxide (TPP/TPPO) assay, the peroxide value (PV) was calculated. The parameter analysis revealed significant variations among the tested oils. Moreover, all determined parameters from the FTIR spectrum changed during the oxidation process. However, the nature and degree of these changes differed depending on the oil tested. The findings indicated that the straightforward instrumental FTIR method could serve as a rapid analytical tool for evaluating the level of oxidation or comparing the quality of edible oils.

sciforum-075209: Effects of LED Light Irradiation on Ripening and Nutritional Quality of 'Puwalu' Banana (*Musa* sp.) during Postharvest Storage

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Bananas (*Musa* sp.) are a vital source of food in many tropical countries, and this study focused on a local banana variety known as 'Puwalu' and explored how different types of light, specifically light-emitting diodes (LEDs), could affect the ripening and nutritional quality of mature green bananas during an 8-day postharvest storage period. We used LEDs to study how different light (blue, 464–474 nm, and red, 617–627 nm) affects postharvest banana characteristics. We compared the results with bananas that were not exposed to any additional light (the control group). We used statistical methods such as a complete randomized block design, t-tests, and one-way ANOVA with SAS 9.1 software to analyze the data. When we looked at the total soluble solid content, we observed significantly higher values in the blue light treatment group compared to the red light treatment and control groups. Similar trends were seen in measurements of CO_2 emissions and antioxidant activity (FRAP and DPPH assays). Regarding fruit firmness, both the blue and red light treatments resulted in significantly softer bananas compared to the non-illuminated control, with no significant difference between the blue and red treatments. The total polyphenolics content followed a similar pattern. When we assessed the peel color of 'Puwalu' bananas, we found significant differences, with the control group having the highest hue values, followed by the red light treatment, and the blue light treatment showing the lowest values. This research advances our knowledge of using LED lighting to improve banana postharvest management, thereby increasing their market appeal and nutritional content, with the most significant impact observed in the blue light treatment, followed by the red light treatment, as compared to the non-illuminated control group.

sciforum-088734: Elevating Sustainability in Design: Advancing State-of-the-Art Food Drying Methods to Optimize Efficiency, Preserve Nutritional Value, and Minimize Waste in Contemporary Food Production

Nnadikwe Johnson

Johnson Global Scientific Library

Drying foods is pivotal in food production, fostering ingredient exploration and product innovation. Recent advancements in pretreatments, procedures, and cutting-edge technologies like microwaves and ultrasound drying have reshaped the industry. These innovations not only boost efficiency and quality but also promote sustainability in food drying processes. By leveraging these state-of-the-art technologies, the food industry can embrace a more resource-efficient and technologically advanced approach to meet the demands of modern food production while preserving nutritional value and minimizing waste.

The promising advancements in drying technologies, such as microwaves and ultrasound, boost efficiency and maintain product quality. To maximize their impact, wider dissemination and adoption of these technologies within the business sector are crucial. By embracing these cutting-edge drying methods, businesses can enhance sustainability, improve production processes, and ultimately increase profitability. This integration of advanced technologies aligns with the industry's goal of achieving efficient and sustainable food production practices.

The study aims to connect research with practical applications, showcasing the practicality and advantages of modern drying technologies for food sustainability. By embracing these innovative methods, businesses can play a key role in fostering a sustainable food system and gaining a competitive advantage in the market. This research seeks to empower businesses to implement cutting-edge drying technologies effectively, paving the way for a more sustainable and efficient future in food production.

sciforum-087946: Encapsulation and Characterisation of the Aqueous Extract of Hancornia speciosa-Mangaba from the Cerrado of Goiás

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Recently, there has been a notable upsurge in the investigation of liposomes as a preferred strategy for encapsulation. These diminutive spherical entities, comprising one or more lipid bilayers, have garnered increased attention across various domains, including drug delivery, cosmetics, and food science. This increased interest can be attributed to liposomes' unique characteristics, including their biocompatibility, versatility, and ability to encapsulate hydrophobic and hydrophilic compounds. In this study, the following liposomes composed of soybean (SL) lecithins were produced by means of reverse phase evaporation and used to encapsulate phenolic extracts of Mangaba (SL-MAPE). In this way, the encapsulation efficiency (EE%) was verified as soon as the liposomes were characterized in terms of size distribution, polydispersity index (PDI), and ζ-potential (mV), obtaining the following results, respectively: SL-MAPE 1.0 mg/mL: 197.43 nm/PDI 0.280 and −37.00 mV; SL-MAPE 1.5 mg/mL: 318.2 nm/PDI 0.490 and −33.7 mV; and SL-MAPE 2.0 mg/mL: 238.33 nm/PDI 0470 and −35.7 mV. SL-MAPE liposomes exhibited high EE% (SL-MAPE 1.0 mg/mL: 80,14%; SL-MAPE 1.5 mg/mL: 86.18%; and SL-MAPE 2.0 mg/mL: 88.09%). After obtaining preliminary results, it was found that liposomes are good candidates for encapsulating phenolic extracts from mangaba (SL-MAPE). So, this study increases our understanding of the encapsulation of phenolic extracts from the fruits of the Goiás savannah. The results provide vital details for developing liposome formulations for pharmaceuticals and foodstuffs.

sciforum-090475: Exploring FTIR Absorption Spectra of Agriculturally Applicable Biodegradable Films with Structural Reinforcement

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FTIR (Fourier Transform Infrared Spectroscopy) analysis is a crucial process in characterizing biodegradable films produced from food waste. The FTIR technique helps monitor changes in molecular structure during the degradation process. Identifying specific chemical bonds and functional groups helps in understanding mechanical properties, offering crucial data for evaluating the effective biodegradability of films. The objective of this study was to obtain and characterize biodegradable films from agro-industry residues prepared from the casting technique. Sugarcane fiber was used as a strengthening agent of the structure, with the addition of antimicrobial, potassium sorbate and glycerol plasticizer to reduce environmental impacts. FTIR analysis was performed on the biodegradable films. The results of the analysis showed that the formulations of the films presented spectra in characteristic bands. The broadband at 3336 cm^{-1} associated with the two samples corresponds to the stretching of the O-H groups present in the starch and water molecule. The 2926 cm^{-1} band is attributed to the stretching of the C-H group of the aldehydes present in the polymer matrix, while the 2850 cm^{-1} band is associated with the spectrum in which the fibers were added to the C=O absorption of esters. The 1646 cm^{-1} band corresponds to the functional group C=C. The 1033 cm^{-1} absorption band associated with the two samples corresponds to the C-O stretch of esters. Thus, in this study, it was noted that there were modifications in the chemical bonds of the water-treated film. Displacement or intensities of different bands were also observed, which indicate greater or lesser interaction between the additional components. Therefore, this technique allowed the identification of chemical compositions present in the films, such as polymers and additives. By applying FTIR, it is possible to assess the quality, stability, and integrity of films, ensuring that they meet the necessary standards for food packaging.

sciforum-090378: Functional Properties of *wala* Ripened Jackfruit Seed Flour

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Introduction

Jackfruit is cultivated in tropical regions, offering the potential for year-round harvests. The seeds of the jackfruit are often discarded. Jackfruit seed flour is an underutilized resource that offers nutritional and health benefits. The incorporation of jackfruit seed flour into various food products enhances their nutritional value and contributes to sustainable agriculture.

Methods

Experiments were conducted at the biomedical research laboratory of General Sir John Kotelawala Defence University in Sri Lanka. Seeds were subjected to lye peeling and dried at 60 °C for 15 h. The dried seeds were ground to fine particles. The functional properties of the flours, such as swelling capacity (SC%), water absorption capacity (WAC, %), oil absorption capacity (OAC, %), emulsion activity (EA, %), emulsion stability (ES, %), foam capacity (FC, %), foam stability (FS, %), gelatinization temperature (GT, °C), porosity(%), and bulk density (g/mL), were then analyzed. All properties were measured in triplicate. The experimental data were analyzed statistically (p 0.05).

Results

The value for SC, measured as 1.63 ± 0.32%, had a strong positive correlation with the WAC value of 177.00 ± 15.7% (r = 0.980, p 0.05). The value of OAC was observed to be 212.13 ± 0.58% and had a strong negative correlation with the EA value of 41.10 ± 1.52% (r = 1.00, p 0.05). ES was 50.72 ± 2.51%. GT was 71.3 ± 4.0 °C and had a strong positive correlation with OAC (r = 0.99, p 0.05). BD was 0.74 ± 0.03 g/mL. The value of the porosity was recorded as 9.65 ± 0.03% with a significant positive correlation with ES (r = 1.00, p 0.05). FC was recorded as 13.63 ± 0.03 with significant negative correlations with ES and porosity (r = −1.00, p 0.05). The FS value was observed to be 89.53 ± 0.06% with significant positive correlations with EA and BD (r = 0.98, p 0.05).

Conclusions

Studies have shown a possibility of using seed flour as a source for bakery items by blending it with the wheat flour in different ratios to maximize its functional properties.

sciforum-090128: Harnessing Charcoal Briquettes as Eco-Friendly Fuel Alternatives for Smoking Fish in Nigeria

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Fish is an important commodity that accounts for 40% of animal protein consumption in Nigeria. Due to its perishability, fish must be processed 6 h after harvest. Fish is commonly processed by smoking, but the process wastes firewood and is hazardous. Charcoal briquettes (CBs) made from agricultural wastes have been identified as a substitute for firewood (FW). This study aimed to investigate the nutritional composition of three fish species—*Synodontis membranaceus*, *Clarias gariepinus*, and *Labeo senegalensis*—smoked using CB, FW, and wood charcoal (WC). The drying capacity and fuel efficiency were also determined. CB induced the highest moisture loss (84.49%) and highest fuel efficiency (i.e., 0.76 fuel consumption rate), and was most cost-effective (N 795). The proximate analysis of moisture, ash, crude lipids, and crude proteins was carried out. Results of smoked *C. gariepinus* were significantly different (p 0.05) for all fuels. In smoked *L. senegalensis*, moisture and crude protein were significantly different, while in *S. membranaceus*, only ash was not significantly different ($p > 0.05$). WC-smoked fish retained more proteins than FW and CBs. The iron, zinc, copper, manganese, magnesium, sodium, potassium, and calcium content were investigated in the smoked fish and were not significantly different ($p > 0.05$) across the fuels. The fuel type did not significantly determine the mineral content. CBs reduced the moisture (10%) in the smoked fish, which reduced biological activities that caused spoilage. Lastly, CB smoking is cheaper and has higher fuel efficiency than FW and WC.

sciforum-089767: Harvesting Insights: AI-driven Rice Yield Predictions and Big Data Analytics in Agriculture

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This paper explores the transformative potential of artificial intelligence (AI) and big data analytics in predicting rice yields within the agricultural domain. By employing advanced algorithms and innovative methodologies, our study aims to contribute to the optimization of crop management strategies, providing a glimpse into the future of sustainable agriculture. The integration of AI and big data analytics allows us to unveil novel insights into rice yield predictions, emphasizing their broader implications for global food security. Our optimized Random Forest Regression model exhibited impressive results, with a Mean Forecasting Error (MFE) of 0.0001, a Mean Absolute Error (MAE) of 0.00016, a Mean Square Error (MSE) of 0.000014, and a Root-Mean-Square Error (RMSE) of 0.003. Our innovative methodologies involve combining climatic data, rice yield from previous seasons, and cultivated areas as input variables for prediction models. Additionally, we employ advanced optimization methods such as Optuna and Hyperopt to enhance our model. The integration of AI with big data analytics into rice yield predictions aids in preparing the data to achieve high quality before applying our models. This includes selecting optimal features and simulating our model with generated data to ensure it avoids overfitting. The potential of our approach has led to the creation of a digital agricultural twin for monitoring, analyzing, and visualizing data provided by sensors installed on a farm in Rosso during the study period. Looking forward, this digital twin enhances precision agriculture practices, contributing to sustainable farming and global food security. As a future perspective, we aim to create an intelligent system using our models and integrate IoT technologies to expose our model results as a service. We plan to publish the first Mauritanian agricultural database for other researchers to use in their future research.

sciforum-087638: HPLC Profiling of Soluble Carbohydrates for Unveiling Low-Flatulence Potential Soybean Genotypes

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Soybean is a globally significant crop, holding multifaceted importance due to its diverse applications in food, feed, and fuel production, along with its utilization in the synthesis of various chemicals. Beyond these, soybeans are gaining importance in health and medicine due to their exceptional nutritional and health-promoting attributes. Consequently, there are increasing efforts to enhance soybean breeding, focusing on enhancing the protein, fatty acid, and soluble sugar content. Soluble carbohydrates, particularly sucrose, are pivotal constituents that shape soybeans' quality and nutritional worth. The composition of these compounds plays a pivotal role in shaping the soybean's quality, digestibility and nutritional worth. However, their potential is hindered by compounds like stachyose and raffinose, which are known for causing flatulence. This research aimed to develop a high-performance liquid chromatographic (HPLC) method for comprehensively fingerprinting the soluble carbohydrates in soybeans to differentiate soybean genotypes that are abundant in flatulence-inducing carbohydrates from those with minimal quantities of such compounds. Plant materials were harvested from various cultivars at the Research and Development Station for Agriculture Turda, Romania. An optimized isocratic HPLC method was developed for the analysis of glucose, fructose, sucrose, raffinose, and stachyose using a Shimadzu Prominence HPLC system with differential refractive index detection, completed in less than 22 min using a Nucleosil amino column. Subsequently, the preprocessed chromatographic data underwent principal component analysis (PCA) using MatLab. The analysis revealed distinct carbohydrate profiles in different genotypes, influenced by genetic factors; notably, saccharose and stachyose were the predominant carbohydrates, with levels exceeding 4 g/100 g. The resultant PCA model provided insights into the genotypes with superior quality attributes and highlighted similarities among the studied genotypes. This approach holds promise for quality control assessments and practical implications in soybeans' nutritional attributes. It addresses flatulence-related concerns associated with soybeans consumption, offering valuable insights for breeders and researchers working towards enhancing soybeans' quality.

sciforum-087606: Impact of Nitrogen Levels on the Growth and Yield of Super Basmati Rice (*Oryza sativa* L.)

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The impact of nitrogen levels on the growth and yield of super basmati rice (*Oryza sativa* L.) at student's experimental farm. The rice crop that ranked first contained 72 kg of nitrogen, covered 17.33 m^2 $acres^{-1}$ (20% higher than recommended), had a plant height of 73.00 cm, 16.00 m^{-2} tillers, a kernels spike-1 of 129.00, a seed index of 24.00 g, a biological yield of 345 kg ha^{-1}, and a grain yield of 4781 kg ha^{-1}. The crop supplied with 48 kg $acre^{-1}$ (20% less than recommended) ranked third in performance with 20.00 m^2 and had a plant height of 67.75 cm, 13.81 m^{-2} tillers, a kernels spike-1 of 126.91, a seed index of 23.18 g, a biological yield of 261 kg ha^{-1}, and a grain yield of 3872 kg ha^{-1}. Rice crop with 54 kg $acre^{-1}$ (10% less than recommended) that ranked fourth in performance with 18.33 m^2 had a plant height of 61.46 cm, 11.48 m^{-2} tillers, a kernels spike-1 of 122.32, a seed index of 22.48 g, a biological yield of 321 kg ha^{-1}, and a grain yield of 3548 kg ha^{-1}. The 60 kg $acre^{-1}$ (recommended) ranked last in performance with 13.00 m^2, a plamt height of 56.08 cm, 10.20 m^{-2} tillers, a kernels spike-1 of 118.08, a seed index of 22.06 g, a biological yield of 309 kg ha^{-1}, and a grain yield of 3209 kg ha^{-1}. It was concluded that the effect of nitrogen level on the growth and yield traits of rice was remarkable (p 0.05) and the nitrogen level of 72 kg $acre^{-1}$ (20% higher than recommended) produced a higher grain yield (4781 kg ha^{-1}) than 66 kg $acre^{-1}$ (10% higher than recommended) (4100 kg ha^{-1}) and 48 kg $acre^{-1}$ (20% less than recommended) (3872 kg ha^{-1}).

sciforum-090332: Impact of Sonication on Apricot Juice Quality Characteristics

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A non-thermal potential technique, sonication, can be used for enhancing the quality of fruit juices. To decrease microbial load and increase the storage life of apricot juice, the study intends to examine the effect of sonication on certain significant quality parameters of apricot juice. Quality characteristics include physicochemical (pH, titrable acidity (TA), total soluble solids (TSSs), Hunter color values, DPPH free radical scavenging activity, vitamin C content, and antioxidant capacity). A bath-type sonicator was used for the sonication of apricot juice at a fixed frequency of 37 kHz and a constant temperature of 30 °C. The present research work was conducted by applying sonication for 15, 30, 45, and 60 min at a constant frequency of 37 kHz. Apricot juice samples were stored at refrigeration (4 °C) temperature in pre-sterilized glass bottles and examined every 7 days for a 21-day storage period. A significant increasing trend was observed during storage in pH and acidity was found to range from (3.47 to 3.22 g/L) and (0.213 to 0.266 g/L), respectively. Ascorbic acid increased after treatment, while reduction was found during storage. TPC (41.99 to 52.99 mg GAE/100 g) and DPPH (38.66 to 31.87%) showed their minimum and maximum values after treatment during storage. DPPH was increased after treatment, while a decreasing trend was observed during storage. Color (L*, a*, b*) attributes (47.23 to 34.13, 2.87 to 5.01, and 13.09 to 19.45) also show increasing trends during storage respectively. Microbial loads ranging from 3.46 to 4.20 log CFU/100 mL showed a decreasing trend after sonication treatment and an increasing trend during the storage period. There is a suggestion that sonication is a reliable treatment method for delaying the spoilage rate, maintaining the quality characteristics of apricot juice, and successfully employing an industrial scale for the processing of apricot juice. The technology can be appropriate as a substitute for thermal treatments and other treatments that result in quality degradation.

sciforum-090259: Impact of Various Drying Techniques on the Nutritional Components of Plum Tomato

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Tomatoes are currently considered one of the most important vegetable crops in the world, as they significantly affect the incomes of many growers around the globe. The tomato is ranked second in many countries and is one of the most widely grown vegetables worldwide. Most agricultural products have a moisture content ranging between 25 and 80%, while plum tomato moisture was found to be 93.94% in this research. This value of moisture content is much higher than what is required for long-term preservation. A certain amount of moisture reduction in crops slows down the effects of bacteria, enzymes, and yeast. The purpose of the study is to evaluate dried plum tomatoes using different techniques. Samples were dried using a solar dryer, a heated plate, and sundry. The dried tomato samples were evaluated for total lycopene, ascorbic acid, pH, and titratable acidity using established methods. The results showed that the sun-dried and solar-dried sample had higher pH levels than the control sample. The ascorbic acid and lycopene levels in sun-dried and solar-dried tomatoes were lower than in the control. Significant increases in ascorbic acid and lycopene content were seen when the heated plate-dried sample was compared to the control sample. The findings indicated that using a heated plate drying method was the best way to preserve the quality characteristics of dried tomatoes.

sciforum-087631: Impact of Various Processing Techniques on the Quality and Shelf Life of Apricots

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Apricots, a popular fruit, are rich in essential nutrients that support healthy skin, eyes, immune systems, and digestive systems. In addition to being high in nutrients, they have numerous other health-related advantages. Apricots, however, are quite susceptible to spoiling and are exceedingly perishable. Thus, several processing techniques are applied to increase the shelf life and quality attributes of apricots. This study evaluated the impact of four processing techniques (freezing, blanching, frying, and drying) on the quality and shelf life of apricots. Five batches, each containing one kilogram of apricots, were made. The first batch served as a control sample, and the following batches underwent different procedures: drying at 80 °C for 8 h, blanching at 95 °C for 10 s, frying at 195 °C for 2.5 min, and freezing at −4 °C. After the apricots were processed, proximate studies were conducted using standard evaluation techniques. The results showed that the T_3 (dry) batch had the lowest moisture (62.33%), while the T_1 (blanched) batch had the highest moisture (78.66%). Every sample had nearly the same amount of ash in it. The sample that was blanched had the highest proportion of crude protein (12.33%), whereas the sample that was frozen had the lowest amount (1.95%). None of the samples' crude fiber contents differed noticeably from one another. The fried samples had the highest crude fat content (11.93%), while the frozen sample had the lowest (1.21%). The frozen sample had the lowest carbohydrate content (4.6%), while the dried apricot samples had the greatest (19.49%). Overall, the study's findings showed that, for preserving moisture, ash, fiber, and protein contents, T_2 (blanching) is a relatively superior approach to frying or frying, respectively, for preserving fat and carbohydrate contents.

sciforum-090196: Improving Apricot Preservation in Uzbekistan via Solar Drying

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Solar drying is an environmentally friendly and sustainable approach to preserve agricultural products, particularly in regions with abundant sunlight. In terms of apricot cultivation, the implementation of solar drying methods can significantly impact post-harvest handling and storage. In the conditions of Uzbekistan, drying of apricot products in indirect solar dryers is the next stage of development. This research aims to investigate the effectiveness of solar drying techniques for apricots in Uzbekistan, focusing on optimizing drying parameters and assessing the quality of the dried products. This study involves the design and implementation of solar drying systems for apricots. Various drying parameters such as the temperature, humidity, and drying time are monitored and controlled during the experiment. Additionally, the quality of the dried apricots is evaluated through analyses of color, texture, and nutrient retention. According to the results, when apricots were dried in a solar dryer at 55 °C and 35% humidity outside, their moisture content decreased from 85–90% to 12–18% within 4 h. The solar radiation intensity and ambient temperature play a crucial role in the acceleration of the time in the drying process. In general, utilizing equipment-based solar drying methods for apricots in Uzbekistan has the potential to rival traditional drying systems in terms of both quality and drying duration.

sciforum-087634: Lactose-Free Goat and Camel Milk: The Impact of Ohmic and Conventional Pasteurization

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Diabetes, lactose intolerance, allergy to milk proteins, and high cholesterol are the main issues with dairy-based diets. In advanced countries, the market for dairy products is significantly impacted by vegetarianism and religious prohibitions on eating animal products. To make lactose-free milk, the enzyme lactase is added to camel and goat milk. The purpose of this study was to compare the effects of conventional and ohmic heating techniques on lactose-free goat and camel milk after pasteurization. Both conventional heating and the electromagnetic heating of milk samples were conducted for 15 min at 65 °C and 15 min at 72 °C. Milk samples were stored at 4 °C both before and after storage to measure enzymatic activity and bacterial viability. The optimal combination of 75% goat milk and 25% camel milk produced stable lactose-free milk. Based on the treatment strategy, lactose-free milk was created, and its quality characteristics were examined. During the storage hours, the pH of the treatments varied from 6.3 to 7.3. While specific gravity decreased over time, titratable acidity ranged from 0.22 g/L to 0.33 g/L. This increase in storage time was seen. In the case of microbial analysis, the maximum value of microbial analysis was found 48 h after storage treatment T_7. *Staphylococcus aureus* content ranged from 1.06 to 1.56 CFU/mL, whereas *E. coli* and *salmonella* count ranged from 0.33 to 0.53 CFU/mL. T_6 had the greatest results in the methylene blue reduction test because it took the longest to decrease the dye. Pasteurized milk sample plate counts varied not that much. The current study found that milk samples cooked both conventionally and ohmically undergo complete treatment, indicating that the ohmic approach was more effective. Because the ohmic technique has decreased the heating time and minimized milk sample nutritional loss, it may be used for lactose-free milk pasteurization.

sciforum-088377: Modeling of the Fluidized Bed Drying Process of Pirul (*Schinus molle* L.) Leaves

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The pirul tree (*Schinus molle* L.) is utilized for the recovery of essential oil obtained from its bark, leaves, and fruits, and the phenolic compounds contained in its leaves have demonstrated antimicrobial activity. For the extraction of these and other compounds of interest, a preliminary drying of the leaves is carried out, which promotes contact between the solvent and the vegetal material by maximizing the mass transfer area. Drying involves complex heat and mass transport phenomena, and a proper analysis of this process would allow for the optimization of this energy-intensive operation. An estimation of mass and energy transfer properties is required for the design of drying processes and equipment. The objective of this study was to estimate the diffusivity coefficients and activation energy during the fluidized bed drying process of pirul tree leaves. Drying was performed in a fluidized bed dryer at temperatures of 50, 60, and 70 °C. According to the results, the drying times ranged from 270 to 135 min. Effective diffusivity was determined by numerically solving Fick's second law, obtaining values from 1.64 to 3.03×10^{-11} m^2s^{-1}, with an activation energy of 19.92 kJ mol^{-1}. Additionally, the retention of total flavonoids (TFs) during the drying process was evaluated using spectrophotometry with an Al_2Cl reagent, revealing that the drying process had no significant effect ($p < 0.05$) on the TF content, with values of 35.8 ± 0.7 mg quercetin equivalents/g leaf (d.b.). The obtained results will enable the design of processes for the drying of pepper tree leaves as a pretreatment for obtaining extracts with antimicrobial activity.

sciforum-090507: Optimization of Extraction Conditions for Bioactive Phenolic Compounds from Orange Peels Using Response Surface Methodology

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Orange peels, often deemed as waste, are in fact a natural reservoir of polyphenols, which are phytochemicals with antioxidant properties beneficial to health. Regular consumption of these, particularly through infusion, can enhance overall well-being and mitigate the risk of chronic diseases.

Optimizing the extraction process of orange peels results in a higher-quality infusion and increased yield. This ensures maximum extraction of beneficial compounds, enhances taste and aroma, and preserves heat-sensitive nutrients. By fully harnessing these bioactive substances, it becomes feasible to augment the concentration of antioxidants in the extracts, thereby offering additional health advantages.

The aim of this study is to optimize the infusion-based extraction conditions to elevate the total polyphenols content (TPC) in the extract. To achieve this, we employed response surface methodology (RSM) in conjunction with a Box Behnken Design plan (BBD). We simulated interactions among three extraction variables: the mass–solvent ratio (from 1:100 to 1:50 g/mL), extraction temperature (from 40 to 60 °C), and extraction time (from 15 to 30 min). Their effects on the TPC, expressed in mg GAE/g DW, were scrutinized.

ANOVA analysis underscored the significant quadratic model ($p = 0.0005$), with a regression coefficient R^2 exceeding 0.9, signifying a robust correlation between the chosen extraction conditions and polyphenols concentration. Optimal conditions for maximal polyphenols extraction encompassed a plant–solvent ratio of 1:50 g/mL, an extraction temperature of 60 °C, and an extraction duration of 30 min. These parameters yielded a higher TPC output of 1600 mg GAE/g DW.

sciforum-090345: Optimizing Amino Acid Derivatization in Food Matrices

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Amino acids are the fundamental units that proteins are composed of. They are organic molecules essential for life and play vital roles in our bodies. Some amino acids are produced by our bodies (non-essential amino acids), while others need to be obtained through food (essential amino acids). In addition, these molecules perform crucial functions, such as speeding up biochemical reactions (enzymes), acting as chemical signals (hormones), forming structural components (muscles, tendons, and nails), and conferring diversity to each specific protein [1]. Methods for the derivatization and analysis of amino acids often involve chemical modification to improve detection sensitivity, with techniques such as high-performance liquid chromatography (HPLC) being typical. However, the derivatization process can be problematic for specific amino acids, leading to incomplete reactions or the instability of the derivatives. This work aims to optimize the amino acid derivatization reaction in food matrices through high-performance liquid chromatography (HPLC) analysis to improve the sensitivity and precision of amino acid quantification. To optimize the amino acid derivatization reaction, a systematic approach was used, varying the concentrations of OPA and 3-MPA (10, 15, 20, 25, and 30 mM), as well as the concentration of FMOC-Cl (1, 2, 5, and 10 mM) and the reaction time (0.5, 1, 1.5 and 2 min). In the HPLC system, an acetate buffer was used as the mobile phase, and a solution of acetonitrile, methanol, and water was used. With this experimental method, it was possible to identify the ideal conditions using a specific combination of concentrations of OPA, 3-MPA, and FMOC-Cl, together with the time of occurrence, which was investigated for greater sensitivity and precision in the quantification of amino acids. This study improved the methodology for analyzing amino acids in food matrices using HPLC, enabling more reliable and accurate results.

sciforum-085765: Phytochemical Analysis and Antioxidant Evaluation of Blackberry, Blueberry, and Goldenberry Extracts

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This study investigates three widely used berry varieties—Blackberry (*Rubus fruticosus*), Blueberry (*Vaccinium sect. Cyanococcus*), and Goldenberry (*Physalis peruviana*)—which hold significance in traditional medicine and contribute substantially to global fruit consumption. These berries have long been recognized for their medicinal properties in traditional medicine, prompting the need for a comprehensive examination.

Objective

The primary objectives of this study were to analyze the phytochemical composition of methanolic extracts from Blackberry, Blueberry, and Goldenberry, and to assess their antioxidant activity using the DPPH spectroscopy assay.

Materials and Methods

Berries were procured from the local market, meticulously cleaned, shade-dried, and ground. A 24-h soaking process with methanol as the solvent produced individual methanol extracts at a concentration of 2 g/100 mL. Extraction yield was determined through reduced-pressure drying. Phytochemical screening involved the identification of alkaloids, phenols, steroids, glycosides, and saponins using standard methods. Antioxidant activity was evaluated using the DPPH spectroscopy method.

Results

The analysis revealed the presence of phyto-constituents in all three berry varieties. The DPPH assay demonstrated concentration-dependent scavenging of DPPH free radicals by the methanolic extracts. The results revealed that Blueberry exhibited the highest antioxidant activity, followed by Blackberry and Goldenberry, indicating significant variations among these berries.

Conclusions

Blackberry, Blueberry, and Goldenberry exhibited commendable antioxidant activity, establishing them as valuable sources of natural antioxidants. These findings underscore the potential health benefits associated with the consumption of these berries, aligning with their traditional medicinal applications and emphasizing their role as natural antioxidants in a balanced diet.

sciforum-090563: Process Engineering for Enhanced Bioavailability: Unlocking the Nutritional Potential in a Sorghum Sports Drink Premix

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Introduction

A sports drink is a type of functional beverage which provides hydration and electrolytes that help to boost energy and lead to performance enhancement. Sorghum is an ancient gluten-free grain which constitutes a great option as a base ingredient as it has a good nutritional and antioxidant profile. The present study focuses on formulating a sports drink premix emphasizing the increased overall availability of protein and carbohydrates and improving processing versatility through the popping technique. Further, the study investigates the nutritional and antioxidant profile, and the characterization of bioactive compounds present in the drink premix.

Methods

The sports drink premix was formulated using sorghum flour, Bengal gram flour, pumpkin seed powder, flax seeds, chicory root powder, dehydrated carrot, beetroot, and banana powder. Nutritional analyses include the proximate analysis using AOAC methods, followed by the estimation of antioxidant potential using 2,2-diphenylpicrylhydrazyl (DPPH) radical-scavenging activity. The phenolic compounds were estimated using a UV Spectrophotometer. Furthermore, unknown bioactive components were identified using GC-MS.

Results

The proximate analysis showed that the developed product contains 65 gm carbohydrates, 15.8 gm protein, 7.43 gm fat, and 14.21 gm fibre per 100 gm. The total phenolic content was 77.61 mL/100 gm GAE, the total DPPH was 93%/100 gm of sports drink premix, and the total Flavonoid compounds were 88%/100 mL of sports drink premix. The GCMS analysis of the sports drink premix confirmed the presence of antioxidants, esters, alkanes, carboxylic acids, ketone, and alcoholic compounds. The drink premix contains 0 caffeine compared to commercially available sports drinks containing 200–4000 mg caffeine.

Conclusions

The identified bioactive components in the drink premix may be helpful in reducing oxidative stress, promote recovery, and enhance performance. The formulated sports drink premix is a combination of natural ingredients, and it is nutrient-rich, high in antioxidant capacity and caffeine-free, thus proving to be a promising alternative to conventional options.

sciforum-090034: Rapid Assessment of Canned Fish Quality via Fast Protein and Metabolite Liquid Chromatography

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The consumption of canned fish as an affordable food source for consumers, and as a suitable option forlong-term-storage food with high nutritional value, is steadily growing in many parts of the world. An important and often overlooked factor that influences canned fish quality is the freshness of raw fish used in the production process. It was shown before that the freshness of fish can be assessed using fast proteins and metabolite liquid chromatography (FPMLC). The aim of our study is to evaluate the applicability of FPMLC to analyze the quality of canned fish. Fifteen samples of various canned fish from different manufacturers were acquired from local supermarkets. FPMLC chromatograms of the samples were processed with the compact optoelectronic chromatographic sensor using PD-10 mini-columns and photometric detection at 255–265 nm with a deep UV LED. All chromatograms showed two peaks: the first one was related to proteins and the second one one was formed by adenosine triphosphate (ATP) metabolites. The delay time between peaks (the *Time* index) varied in a range from 138 s to 195 s. It was suggested that the higher the time index, the less fresh raw fish was used. In several chromatograms, a characteristic "hump" related to hypoxanthine emerged clearly, indicating that the raw fish was in the early stages of bacterial spoilage. For the additional verification of the FPMLC technique, four samples chosen as the most representative were analyzed via HPLC and two of them via NMR spectroscopy. The *time* index of the FPLMC chromatograms was in a good correlation with well-established nucleotide-based K and K_1 indices (quality factors) estimated from HPLC chromatograms and NMR spectra, which confirms the fact that the FPMLC method can be used to assess the freshness of raw materials in processed fish products.

sciforum-088253: Revalorization of Cinnamon Leaves via a Phenolic Compound Extraction Process: An Optimization Using Box–Behnken Design

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The cultivation of cinnamon (Cinnamomum zeylanicum) is one of the most important worldwide. In Mexico, states such as Veracruz and Puebla are the main producers. The bark is the main product due to its culinary properties; however, it contains bioactive compounds of interest for different industries. The cinnamon leaves contain polyphenolic compounds with antimicrobial, antioxidant, and insecticidal properties. This study aimed to optimize the ultrasound-assisted extraction process conditions for phenolic compounds from cinnamon leaves. Leaves of trees from Zozocolco de Hidalgo (Veracruz, Mexico) were utilized. A Box–Behnken design was used to determine the optimal values of the solid/solvent ratio (7–13 g/mL), temperature (20–50 °C), and time (10–30 min) factors for the recovery of total flavonoid compounds (TFCs) and total phenolic compound (TPC). Ferric aluminum and Folin–Ciocalteu reagent were used for spectrophotometric determination of TFC and TPC, respectively. According to the results, the recovery of TFC ranged from 49 to 1089 mg quercetin equivalents/g of sample (DW), with the temperature being the significant factor ($p < 0.5$). The phenolic extracts obtained were similar to those reported from other geographical regions. This study highlights the potential use of C. zeylanicum leaf extracts as a source of polyphenols. Furthermore, the antibacterial and antifungal activities of the extracted fractions must be evaluated.

sciforum-087592: Revolutionizing Quality: Exploring Advanced Food Processing Techniques for Elevated Food Quality

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Preservation methods can extend the shelf life of food products, which not only reduces food waste but also ensures that the end consumers have access to fresh products for a more extended period. In this extensive investigation into advanced food processing techniques, we navigate beyond the confines of conventional methods, immersing ourselves in the transformative potential of novel approaches. At the forefront of this exploration, there are cutting-edge technologies such as high-pressure processing, pulsed electric fields, and ultrasound-assisted processes, each promising to redefine our understanding of food quality. Our scrutiny encompasses a thorough examination of how these innovative techniques interact with the diverse array of food products. We focused on the intricate mechanisms that underlie their impact on food quality, with a particular emphasis on the preservation of essential nutrients, the enhancement of flavors, and the reduction in processing times. Through detailed analysis, we aim to uncover the synergies between these novel techniques and the inherent characteristics of different food items, offering insights into their potential applications across a spectrum of culinary offerings. Yet, no exploration of novel techniques is devoid of challenges. We dissect the hurdles associated with adopting these methods, ranging from technological constraints to regulatory considerations. By addressing these challenges head-on, we aim to provide a deep perspective on the feasibility and scalability of implementing these innovations within the broader context of food processing. Furthermore, our investigation extends beyond the immediate technological aspects, considering the environmental implications and sustainability factors associated with these advancements. We explore how these novel techniques may contribute to reducing waste, energy consumption, and environmental impact, aligning with the growing emphasis on sustainable practices within the food industry. This comprehensive abstract serves as a gateway to understanding the diverse landscape of emerging food processing techniques.

sciforum-090081: Sage Essential Oils: Chemical Characterization and Evaluation of the Antioxidant Activity of Commercial Samples

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The essential oil of *Salvia officinalis*, an aromatic plant belonging to the Lamiaceae family, is very useful in the pharmaceutical, food and cosmetics industries due to its biological properties, which have anti-inflammatory, antioxidant and antimicrobial effects. The present work aims to optimize the extraction of essential oils from commercial samples using an experimental design with two independent variables, the solid/liquid ratio (*w*/*v*) and time, followed by an evaluation of the response variables, yield and biological activity. A chemical characterization of the oils was also carried out. For this, the material obtained from local stores in the city of Rio de Janeiro was subjected to hydrodistillation in a *Clevenger* apparatus, and the identification and quantification of the compounds in the isolated oil were carried out using GC/MS. The antioxidant capacity was determined by calculating the percentage inhibition of the DPPH$^\bullet$ radical, resulting in a variation between 8.7 and 28.3% inhibition. The results show that the number of compounds identified and their respective chemical classes have an impact on the difference in the percentage of inhibition of the radical due to their particular properties. In this work, we chose to evaluate the experiments that presented the best and worst responses in the experimental design, which where obtained in the following conditions: the solid/liquid ratio was 1:14 (*w*/*v*) for 180 min and 1:50 (*w*/*v*) for 60 min, respectively. The first condition showed the best results, which may be associated with a higher concentration of sesquiterpenes, highlighting β-caryophyllene, which has recognized antioxidant and anti-inflammatory effects. It can therefore be concluded that sage essential oil has significant bioactive properties; however, the differences in extraction conditions have a direct influence on antioxidant activity, since during the process, the conditions applied can lead to the loss of important volatile compounds.

sciforum-090025: Some Properties of Lactic Acid Bacteria Isolated from Natural Sources

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Cheeses are a group of fermented dairy products manufactured worldwide. The fermentation process is carried out by lactic acid bacteria, which may function as starter cultures or as an additional microflora affecting the ripening process of cheese. Cheese production is a complex process influenced by various factors, such as the sodium chloride content. This is an important indicator in the technical process for producing different types of cheese.

The aim of this research was to isolate lactic acid bacteria (LAB) from natural sources and home-made fermented milk products from the Belgorod Region, Russia, and to investigate their individual characteristics.

During the course of the research, ten strains of LAB were isolated. All of the isolated strains could grow in the presence of 5% NaCl. Some isolates could tolerate concentrations of NaCl as high as 6% or more. The ability of the LAB to produce lactic acid and aromas is a crucial factor in the production of the final product. For this reason, the titratable acidity (○T) was determined for each strain, as well as the ability of certain strains to form gas-like compounds on a sodium citrate medium. Based on the evaluation of culture characteristics, morphological features, and biochemical properties and a 16S rRNA sequence analysis, the isolated bacteria were identified as representatives of *Lactococcus lactis subsp. lactis* and *Lactococcus lactis subsp. cremoris*.

The isolated strains of LAB have great potential as starter cultures for the production of cheese. Further research could investigate the features of their enzymatic activity in order to create an optimal microbial composition for starter cultures.

Funding: The work was supported by grant no. 075-15-2024-174 (project no. 20180177).

sciforum-080519: Surfactant-Assisted Extraction of Bioactive Compounds from Turmeric (*Curcuma longa* L.)

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Turmeric, the dry rhizome of *Curcuma longa* L., is valued for its biological properties (e.g., antioxidant, antimicrobial, anti-inflammatory properties). These are mainly attributed to a group of secondary metabolites, namely curcuminoids, the most distinctive of which is curcumin. Due to their hydrophobic nature, curcuminoids are usually isolated using organic solvents, such as hexane, acetone, methanol, etc. However, due to increasing consumer demand for organic and solvent-free products, strategies for the aqueous extraction of polyphenols have gained new attention.

To this end, the aim of the present study was the optimization of curcuminoid extraction from turmeric powder using aqueous, surfactant-based mixtures, combined with ethanol, as extraction solvents. The recovery was optimized through response surface methodology (RSM) using a central composite design (CCD). Solid–liquid extractions were performed through stirring and mild heating ($T \leq 30$ °C), while Polysorbate 80 (non-ionic) was used as the surfactant. The independent factors tested were the extraction duration (min), the ethanol concentration (% v/v) and the surfactant concentration in the solvent (% w/v). Total phenolic content (Folin–Ciocalteu assay), antioxidant activity (DPPH radical-scavenging activity assay) and curcumin concentration (UV-Vis standard curve 0.75–6 ppm) were determined in the extracts (responses). In optimized conditions, extractions were performed with other surfactant types (anionic, cationic, amphoteric) and pure ethanol, for comparison purposes. All the optimized extracts were further analysed with HPLC (curcumin standard curve 0.5–50 ppm) for the quantitative determination of curcumin and other curcuminoids.

Based on the results, the optimized extraction conditions were determined at 59 min, 29% v/v ethanol and 5% w/v surfactant. Curcumin concentration in the extracts was affected by the surfactant type and concentration (% w/v). Surfactant-based solvents yielded higher curcuminoid content compared to ethanol. The present study highlights the potential of surfactant-based extraction of curcuminoids and their possible future applications in nutraceutical or cosmeceutical formulations.

sciforum-089898: The Effect of Furazidine on the Parameters of the Leukocyte Formula of Chickens

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The global consumption of chicken meat is growing because poultry meat is an inexpensive and valuable source of protein. However, poultry meat consumers are concerned about the uncontrolled use of antimicrobials in agriculture. Based on the literature data, in 2010, the total use of antibiotics in animal husbandry was 63,151 tons, and by 2030, it is projected to increase by 67%.

Antimicrobials that accumulate residually in meat and organs of poultry can pose two main dangers: the development of antibiotic resistance in humans when consuming such products, as well as some toxicological effects. However, we should not forget that the complete cessation of the use of antibiotics in poultry farming has negative economic consequences in the form of increased production costs and higher prices for consumers.

The aim of the work was to study the effect of antibiotic furazidine on the parameters of the leukocyte formula in birds.

To study the effect of furazidine on the blood of poultry, groups of day-old Hysex Brown chickens were formed. Then, the chickens were evaporated with furazidine at a dosage of 200 mg/L. According to the results of blood sampling on the 1st, 3rd, 5th, 7th, and 9th days, the blood parameters of chickens were evaluated using standard methods centred around the microscopy of a poultry blood smear followed by calculations of the leukocyte formula.

The results of the study showed that the most pronounced changes were observed in the number of pseudoeosinophils on the 1st and 3rd days after discontinuing the drug, and the number of pseudoeosinophils increased by 8.9% (and by 5.9% on the 5th day). On the 7th day after discontinuing the drug, the increase in the number of pseudoeosinophils was 5%. On the 9th day, this indicator returned to the control values.

Thus, the parameters of the leukocyte formula do not undergo significant changes under the action of furazidine.

sciforum-090241: The Sensory, Physicochemical, and Microbiological Properties of a Milk Beverage Infused with Bee Honey and Pepper (*Piper nigrum*)

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Fortifying dairy beverages with natural additives is a widely accepted public health strategy to deliver bioactive substances. This study aimed to develop a pasteurized cow milk-based beverage enhanced with bee honey and pepper. The process involved cream separation from the raw milk, followed by preheating at 40 °C. Subsequently, honey and pepper were incorporated into the mixture, which was then pasteurized at 63 °C for 30 min. Bottled samples were stored under refrigerated conditions. The most acceptable formulation of pasteurized milk beverage, with 16% bee honey (*v*/*v*) and 0.6% pepper (*w*/*v*), was selected among three predetermined formulations using sensory analysis. Results of the physicochemical and microbiological characteristics over 21 days of refrigerated storage revealed that the total solids (14.45% to 16.92%), ash (0.51% to 0.52%), titratable acidity (0.17% to 0.19%), free fatty acids (1.14% to 1.34%), total sugar (10.31% to 16.00%), and viscosity (21.65 mPa·s to 36.87 mPa·s) of the milk beverage increased, and the moisture (85.55% to 83.08%) and pH (6.61 to 6.14) decreased significantly (p 0.05) during the storage period. Based on the colour analysis, milk beverages' L* and b* values increased, and the a* value decreased significantly (p 0.05) during storage. The microbiological quality assessment of the milk beverage indicated a significant increase (p 0.05) in the total bacteria count (3.75 log CFU/mL to 5.45 log CFU/mL) during storage. This study sheds light on the potential for creating novel dairy beverages with natural additives with enhanced flavor profiles and nutritional characteristics.

sciforum-089780: Ultrasonication and Thermal Treatment Impact on Quality Attributes of Lemon Functional Drink: A Comparative Study

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This study aimed to compare the effects of ultrasonication and thermal treatments on the quality attributes of a lemon-based functional beverage. The beverage samples were subjected to different treatments and analyzed for physicochemical parameters and microbial load over a four-week refrigeration period. The thermal treatment involved exposing the beverage to a temperature of 70 °C for 10 min, resulting in a notable 30% increase in shelf life compared to the untreated samples. However, this thermal treatment led to a significant reduction in bioactive compounds, including a 15% decrease in polyphenols, a 20% decrease in flavonoids, and a 25% decline in ascorbic acid content. In contrast, sonication, performed at a temperature of 20 °C and a frequency of 37 kHz, effectively reduced the microbial load from 6.16 CFU/mL to 3.82 CFU/mL. The application of sonication also demonstrated a superior preservation of the nutritional properties and antioxidant content of the functional beverage compared to the thermal treatment. A storage analysis revealed that sonication maximized antioxidant levels when compared to thermal heating at a temperature of 4 °C. The findings of this study have significant implications for the food industry. Sonication emerged as a cost-effective and efficient alternative to thermal treatment for producing high-quality fruit beverages. Its ability to reduce microbial load while preserving nutritional properties makes it an attractive option for large-scale production. The integration of sonication into existing production processes is also feasible, as it requires minimal equipment and can be applied at ambient or controlled temperatures. In conclusion, this study highlights the advantages of using sonication as a non-thermal technique for enhancing the quality and safety of lemon-based functional beverages. The findings support the adoption of sonication in the food industry to meet the growing demand for functional and healthy beverages while maintaining the desired quality standards.

Abstracts

Session D. Chemical Processes and Systems

sciforum-090028: Computational Insights into Thiosemicarbazone Metal Complexes: Structural Elucidation, Reactivity Patterns, and Biomedical Implications

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Computational studies of thiosemicarbazone metal complexes play a crucial role in elucidating their structural, electronic, and reactivity properties, thus contributing significantly to various scientific fields. Thiosemicarbazone ligands are renowned for their versatile coordination behavior and diverse biological activities, making their metal complexes subjects of keen interest in chemistry and related disciplines. Through density functional theory (DFT) and molecular modeling techniques, computational investigations offer predictive insights into the structural features of these complexes, aiding in the interpretation of experimental data and guiding synthetic endeavors. Furthermore, computational methods enable the exploration of electronic structures and spectroscopic properties, facilitating the understanding of reactivity patterns and establishing structure-activity relationships (SAR) crucial for the rational design of complexes with tailored functionalities. In catalysis and organometallic chemistry, computational modeling elucidates reaction mechanisms involving thiosemicarbazone metal complexes, thereby contributing to the development of efficient catalytic processes and the design of novel catalysts. In the realm of biological applications, computational studies provide valuable insights into the interactions between these complexes and biological targets, offering a molecular-level understanding of their mechanisms of action and guiding the development of therapeutic agents with enhanced efficacy and reduced toxicity. Overall, computational studies offer a cost-effective and time-efficient approach to explore the structures, properties, and applications of thiosemicarbazone metal complexes, spanning from fundamental coordination chemistry to drug discovery and environmental remediation, thus underscoring their significant importance in contemporary scientific research.

sciforum-090160: In Vitro Antioxidant and Anti-Inflammatory Activity of the Polyphenol Complex from *Habarlea rhodopensis*

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Bulgaria stands out in Europe for its abundance of resurgent plants thriving in the wild, with *Haberlea rhodopensis* being one such example from the Gesneriaceae family. The plant's noteworthy benefits stem from its leaf composition, particularly its polyphenolic components. To delve deeper, researchers fractionated the polyphenolic complex using solvents of varying polarity (hexane, chloroform, ethyl acetate, and butanol), and subsequently evaluated each fraction for potential biological activity.

The butanol and ethyl acetate fractions exhibited the highest concentrations of total phenols (841.12 and 797.58 mg GAE/g extract) and tannins (792.10 and 571.49 mg TAE/g extract). These fractions underwent scrutiny for antioxidant and anti-inflammatory properties, gauged through hydrogen peroxide scavenging activity and inhibition of albumin denaturation (IAD), respectively.

The antioxidant activity of the fractions ranged from 105.61 μg/mL to 486.73 μg/mL. Notably, polyphenols isolated with polar solvents (ethyl acetate, chloroform, and butanol) demonstrated significant antioxidant potential. In assessing the anti-inflammatory prowess, the inhibition of the albumin denaturation method was employed using human albumin. Standard ibuprofen and ketoprofen, known for their anti-inflammatory effects, were utilized for comparison. Their IC_{50} values, estimated as IADs, were 81.50 μg/mL and 126.58 μg/mL, respectively. The IC_{50} values for the *H. rhodopensis* fractions ranged from 143.89 to 307.87 μg/mL, indicating a comparatively lower degree of albumin protection.

Examining the polarity-based protection of albumin, the butanol, chloroform, and ethyl acetate fractions exhibited similar efficacy, surpassing that of hexane.

sciforum-090486: Synthesis of Hexamethylenetetramine Mono- and di(p-Methoxyphenylacetochloride)

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In this study, hexamethylenetetramine mono- and di(p-methoxyphenylacetochloride) synthesis is presented in a clear and effective manner. Under mild conditions, p-methoxyphenylacetyl chloride and hexamethylenetetramine undergo a synthesis reaction. By adjusting the reactant and reaction conditions, the mono- and di-substituted products were produced selectively. The reaction of 4-methoxyphenylchloroacetate with various amines is a nucleophilic exchange reaction, and it was found that these reactions can be proceeded under normal conditions at the liquefaction temperature of the solvent. Before carrying out these reactions, the properties of amines were studied briefly. It can be found that the activity of the hydrogen attached to the nitrogen atom of amines depends on the nature of the group attached to the nitrogen. This relationship was expressed by Menshutkin's kinetic equation and Arrinius' equations. In addition, it became known that the reactions can be carried out easily due to the activity of the electrons that are not involved in the bond. To study the reactivity of tertiary amines, uratropin was chosen and its 4-methoxyphenylchloroacetate was reacted at 1:1 and 1:2 ratios, and the products were isolated. When the spectra of the obtained substances were analyzed, it was proven that a new substance was formed with the presence of an absorption region characteristic of the N-substituted amine group.

sciforum-090262: Use of Bioelectrochemistry Techniques and Machine Learning for Real-Time Characterization of Mixed-Species Biofilms

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Biofilms are complex microbial communities that adhere to surfaces and interfaces, exhibiting distinct and emergent characteristics compared to the sessile state of planktonic cells [1]. Biofilms create favorable conditions for colonization on the surface of biomedical devices and inside tissues, show resistance to abiotic and biotic stress factors, and display intense inter-species and intra-species signaling interactions between microorganisms [2]. While most studies focus on single-species models, in real-world scenarios, biofilms are mixed-species communities consisting of different microorganisms such as bacteria, archaea, protists, and fungi. These open systems are open to influx and contamination from the surrounding environment [3].

Mixed-species biofilms might pose significant challenges in healthcare, contributing to difficult-to-treat infections and the emergence of antimicrobial-resistant microorganisms through horizontal gene transfer. However, most studies focus on single-species biofilms, necessitating costly animal models for validation. Thus, there is a knowledge gap regarding the understanding of mixed-species biofilms in open systems. Their composition makes their characterization with current methods (such as sequencing) difficult and expensive. Furthermore, no single technology is available for monitoring mixed-species biofilms in medical and industrial research [4].

The need for the development of quick and low-cost methods for characterizing mixed-species biofilms is crucial for rapid pathogen identification in biofilm infections, water systems, and surface-associated infections to achieve improved health outcomes and reduced maintenance expenses. In this work, we hypothesize that bioelectrochemical methods can be combined with probabilistic machine learning (PML) analysis for rapid characterization of mixed-species biofilms [5]. Specifically, we design and optimize a short-term amperometric method to probe early mixed biofilms in static bioelectrochemical cells.

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sciforum-089736: ZnO Quantum Dot Synthesis and Integration with Carbonaceous Materials

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The biomedical area uses nanostructured materials to maximize therapeutic advantages while minimizing invasiveness and toxicity. Their applications include drug delivery, therapy activation, diagnostics, and real-time therapeutic response monitoring. The development of materials for sensors and electrochemical analysis has become essential for monitoring biomolecules. The concentration, size, and dispersion of nanoparticles in the carbonaceous matrix are the main factors that influence the conductivity of nanocomposites. The strong interactions and high surface energy of graphene materials often moderate its homogeneous compatibility with various media. In the present work, we propose the synthesis of zinc oxide quantum dots (ZnO QDs) and their integration with carbonaceous materials to create nanocomposites with electrochemical uses. ZnO QDs were obtained through the precipitation method. Graphene oxide (GO) was synthesized using the Hummer technique. ZnO-GO was obtained via the in situ hydrothermal method. The samples were characterized through a variety of analytical methods to understand their morphology, size, structural phase purity, functional groups, and wetting capacity. Using spectroscopic analysis, the materials—the oxide, the carbonaceous material, and the composite—were examined from a structural perspective. Using a field-emission scanning electron microscope, the surface morphology, particle size, and distribution of the nanoparticles in the carbon material were investigated. The goniometric investigations monitored the nanocomposite's wetting and percolation capacities.

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sciforum-087717: 2,2,3,3,4,4,4-Heptafluorobutyl Acetate: Transesterification Reaction of 2,2,3,3,4,4,4-Heptafluoro-1-Butanol and Isopropyl Acetate and Side-Product Composition

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As an investigation object, in the present work, the reactive distillation (RD) process based on the transesterification of isopropyl acetate and 2,2,3,3,4,4,4-heptafluorobutanol under acidic conditions is considered. The process is aimed at obtaining 2,2,3,3,4,4,4-heptafluorobutyl acetate (HFBA), which is used in the production of non-aqueous electrolytes, ethyllithium sulfate, charge retention medium, ultraviolet light-absorbing oligomers, etc. An important factor in the RD design is the selection of the proper process conditions, both in terms of the separation subsystem and the chemical constituent. This first requires a clear understanding of the mixture qualitative composition (including reaction side-product composition and their formation conditions) and the component distribution of the reaction mixture over the height of the column. The presence of alcohols (by-product—isopropanol (IPol)) in the system suggests their possible intermolecular dehydration (potentially, the formation of up to three ethers), and the acid residue—the appearance of acid and even anhydride (most unlikely). In the present work, the RD process was carried out in batch mode at atmospheric pressure, and the temperature of the reaction area varied from 95 to 105 °C. The identification of by-products requires their significant amount in the reaction mixture. Thus, the process was carried out under «harsh» acidic conditions; H_2SO_4 was used as a catalyst (up to ≈0.2 mol. fr. in the reaction area). Through a combination of NMR spectroscopy (^1H and ^{19}F) and GC-MS, it was determined that during the process, the following are primarily formed in the system: target HFBA (which, relative to other components of the system, is also a low-volatile component) and by-product IPol. As side-products were identified diisopropyl ether, acetic acid, water, and 2,2,3,3,4,4,4-heptafluorobutyl isopropyl ether (in the case of a batch process, the etherification reaction grows in influence during sulfuric acid concentration increasing in the reaction area). No bis(1H,1H-heptafluorobutyl)ether or acetic anhydride were identified in the system.

sciforum-091077: Enhancing Carbon Capture Efficiency in Chemical Looping Combustion Using Fe_2O_3 and Mn_2O_3 Oxygen Carriers: Insights from ASPEN Plus Modeling

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This study investigates the carbon capture efficiency of a Chemical Looping Combustion (CLC) process employing Fe_2O_3 and Mn_2O_3 as oxygen carriers, modelled within the ASPEN Plus simulation platform. Evaluating various coal compositions characterized by diverse ultimate and proximate analyses, the study focuses on a temperature range spanning 950 to 980 °C. The investigation reveals consistently high carbon capture efficiencies across all coal types, achieving nearly pure CO_2 capture. This exceptional performance highlights the potential of CLC technology as a robust solution for efficient carbon capture in coal combustion processes. The findings underscore its significance in mitigating greenhouse gas emissions, particularly within energy-intensive industries. By leveraging ASPEN Plus simulation, this research contributes to optimizing and refining CLC systems, offering insights crucial for enhancing their performance and scalability. The observed efficiencies underscore the versatility of CLC technology, which can accommodate various coal compositions while maintaining high capture rates. Such capabilities are pivotal in transitioning towards cleaner energy production and realizing climate mitigation goals. Overall, this study underscores the promising role of CLC technology in addressing carbon emissions from coal combustion. As industries strive to reduce their environmental footprint, advancements in carbon capture technologies, as demonstrated by CLC, emerge as indispensable components of sustainable energy strategies. The insights presented in this research provide valuable guidance for further developments in carbon capture technology, facilitating progress towards a more sustainable and environmentally conscious energy landscape.

sciforum-090569: Enhancing Photodegradation of Congo Red Dye under Visible Light Irradiation via ZnO Photocatalyst: Process Optimization Using Response Surface Methodology

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The Red Congo (RC) dye, widely employed across various industrial sectors such as textiles, food, and pharmaceuticals, owes its popularity to its deep red hue. However, despite its widespread usage, the presence of Red Congo raises significant environmental and health concerns. Due to its stable structure, CR dye is non-biodegradable, leading to severe health disorders in humans. Its extensive application in dyeing textiles, food products, medications, and other items often contributes to environmental issues, particularly wastewater pollution. The intricate chemical composition and resistance to the degradation of Red Congo present considerable challenges for wastewater treatment and pollution control. Consequently, researchers specializing in water treatment are increasingly driven to develop effective methods for removing Red Congo from industrial effluents.

This study focuses on the degradation of RC through a photocatalytic process utilizing zinc oxide (ZnO). The efficiency of ZnO as a photocatalyst is optimized using response surface methodology (RSM) combined with a Behnken design (BBD) under visible light conditions. Parameters, including the RC concentration (ranging from 20 to 60 mg/L), photocatalyst dosage (from 100 to 500 mg/L), and irradiation duration (from 20 to 100 min), are examined to evaluate their impact on the RC degradation rate (%). This study achieves an optimal photodegradation efficiency of up to 100% at an RC concentration of 20.24 mg/L, a ZnO dosage of 495.06 mg/L, and an irradiation duration of 97.71 min.

sciforum-080636: Growth of Nanotubes inside eDIPS Carbon Nanotubes

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The growth of carbon nanotubes is a very important process. It is controlled by the synthesis parameters, such as the catalysts, the catalyst support, the carbon source, temperature, and pressure. There are the different experimental setups for this method. The results of the conducted work are the following. Here, pristine outer single-walled carbon nanotubes (SWCNTs) are obtained by means of enhanced direct injection pyrolytic synthesis (eDIPS), and they have a diameter of 1.7 nm [1]. The filling of the SWCNTs with ferrocene is performed using the gas phase method at 350 °C in a quartz ampoule sealed under an ultrahigh vacuum. The annealing of the ferrocene-filled SWCNTs leads to the growth of the inner SWCNTs with different diameters. Therefore, double-walled carbon nanotubes (DWCNTs) are formed. I analyze all DWCNTs using the Raman spectroscopy method with different laser wavelengths between 458 and 647 nm. The growth process is traced at different annealing temperatures between 500 and 1000 °C. The temperature difference of about 70 °C is found for the diameter difference of about 0.16 nm.

Reference

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sciforum-085938: Hydrogen Peroxide Industrial Production: A Patent Prior Art Analysis

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The aim of this study is to present an overview of industrial hydrogen peroxide production processes. Searches were conducted on two databases, namely Espacenet (`https://worldwide.espacenet.com`) and Orbit (`https://www.orbit.com`), using mainly IPC and CPC classification symbols, sometimes combined with keywords.

Espacenet and the new EPO tool for categorizing CPC text (available at `https://epn.epo.org/cpc-text-categoriser`) were used to retrieve specific classification codes on patented information related to the production of hydrogen peroxide.

An analysis of the data from the Orbit database reveals that the anthraquinone auto-oxidation process and electrochemical methods have the highest number of active patents.

When examining patent applications filed from 2020 onwards, electrochemical methods are found to be the most prevalent, followed by the auto-oxidation of anthraquinone.

These are typically patent applications filed in China by academic institutions or companies.

By using the ‘acceleration’ indicator, which is defined as the ratio between the number of applications filed from a specific time (in this case, from 2020) and the total number of published and currently active applications, it is possible to determine which patented technology has experienced the greatest increase in the number of filings over time. In this case, the synthesis from water, carbon monoxide, and oxygen followed by electrochemical methods has shown the highest increase in filings.

The data suggest that companies are investing less in the anthraquinone auto-oxidation process compared to electrochemical methods. Research is now focused on synthesizing hydrogen peroxide from water, carbon monoxide and oxygen instead of direct synthesis using H_2 and O_2.

sciforum-088291: Modeling of Cutting Thin-Walled Gears from Steel with Laser Beams

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The article provides information on the theoretical foundations, technological processes, and equipment used for the laser cutting of steel from thin-walled (4–10 mm thick) gears, which has received the widest industrial application of all laser processing technologies. The process of cutting a light flux incident on a material, partially absorbed by the surface of the material, the molten film, and the side surfaces of the cut, and partially reflected, has been studied.

Physical phenomena in the cutting cavity and models for calculating the main technological parameters of the process are considered. In addition, an assessment is made on the dry laser cleaning technology used onthe surface of a solid from contaminated particles based on the rapid heating and thermal expansion of radiation-absorbing particles or the surface layer of the base material via a pulse of laser radiation. Recommendations are given for the selection of cutting modes for steel materials using continuous and pulse-periodic radiation from industrial lasers.

The measurements made it possible to determine the values of the specific radiation energy for different thicknesses of the material being cut. According to our calculations, the specific energy required to heat up to the melting temperature and melt a unit volume of steel was 12 J/mm^3.

The specific radiation energy decreased monotonically after increasing the thickness of the material being cut. However, the measured p value was greater than the calculated value. It can be assumed that the decrease in specific radiation energy when cutting thick workpieces may be due to a more efficient use of the oxygen jet.

sciforum-090508: Optimization of House Price Prediction Machine Learning Techniques

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The real estate market is a cornerstone of global economics and social dynamics, significantly shaping housing decisions and investment strategies. Within this context, the accurate prediction of housing prices is essential. Leveraging advanced Machine Learning (ML) techniques, this research delves into the pivotal role of the real estate market, highlighting its economic and social importance, particularly regarding housing prices. The study aims to develop a robust property price prediction model by considering crucial factors such as location and size. Recognizing the challenges posed by the dynamic nature of the real estate market, the research endeavors to create an accurate and reliable forecasting tool with a user-friendly interface. With urbanization driving migration trends, traditional methods reliant on real estate brokers often prove inadequate, necessitating accessible interfaces empowering users to obtain precise property price predictions independently. Ultimately, this research aims to bridge the information gap within the real estate sector by providing a data-driven solution in the form of a machine learning model. The study's focus encompasses Support Vector Machines (SVMs), Random Forest, and Gradient Boosting models. Notably, the Random Forest model demonstrates promising results, yielding an R-squared value of 0.8 and a low error rate of 0.28, indicating significant improvement over previous methodologies. The implications of this study extend to consumers, industry professionals, and policymakers alike, fostering enhanced efficiency and equity within housing markets. Looking ahead, ongoing research in ML-driven predictive modeling holds the potential to revolutionize real estate decision-making processes, ensuring adaptability to evolving market dynamics and bolstering overall market efficiency.

sciforum-090537: Optimization of Methylene Blue Photodegradation Using Copper (II) Oxide Photocatalyst under Visible Light: A Response Surface Methodology Approach

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Methylene blue (MB) serves as a widely employed dye within both industrial sectors and laboratory settings. Its utility extends to the biological staining of tissues, cells, and various samples in biology and microbiology laboratories, as well as industrial applications including textile, paper, plastic, and chemical coloring processes. Consequently, its presence is commonly detected in liquid effluents from these industries, posing ecological hazards due to its inherent toxicity and potential for bioaccumulation. Methylene blue, characterized by its multi-core aromatic composition, can induce acute toxicity and engender serious health issues such as respiratory distress, chest pain, burning sensations, nausea, vomiting, and diarrhea.

To address this issue, various methods are employed to remove methylene blue from wastewater, such as adsorption, biodegradation, ion exchange, and advanced oxidation processes. In this study, the degradation of methylene blue using a photocatalytic process with copper (II) oxide (CuO) was explored. The performance of CuO as a photocatalyst was optimized using response surface methodology (RSM) combined with a Box–Behnken Design (BBD) under visible light. Variables such as MB concentration (10–40 mg/L), photocatalyst CuO dosage (0.1–1 g/L), and irradiation time (10–90 min) were evaluated for their impact on the MB degradation rate (%). An optimal photodegradation efficiency of 99.85% was achieved with an MB concentration of 10 mg/L, a CuO dosage of 1 g/L, and an irradiation time of 90 min.

sciforum-089891: Predicting the Volumetric Mass Transfer Coefficient in a Double Coaxial Mixer: An Artificial Neural Network Approach

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In recent years, there has been a significant emphasis on predicting the mixing effectiveness of mechanically agitated tanks, particularly those employing coaxial mixers. Coaxial mixers, characterized by central impellers and a close clearance anchor, have shown superiority over conventional systems in achieving homogeneous gas dispersion and enhancing the volumetric mass transfer coefficient (k_La). Evaluating the efficiency of these mixers, especially with high-viscosity non-Newtonian fluids, poses challenges due to their complex design and intricate interactions between operating variables.

Large-scale coaxial mixers, equipped with multiple central impellers, aim to enhance mass transfer at a constant power consumption, but their complex geometry and rheological characteristics further complicate accurate predictions of mixing effectiveness. Traditional correlations for estimating k_La based on experimental data have limitations within specific operating conditions. Enter machine learning methods, specifically Artificial Neural Networks (ANNs), which have gained traction in various industries, including chemical engineering.

ANNs, trained with experimental data, demonstrate remarkable success in predicting k_La within the covered ranges. They excel in examining the impact of design parameters, operating conditions, and fluid properties on multiphase processes. The study at hand focuses on developing an ANN model for predicting k_La in a double coaxial mixing system with yield-pseudoplastic fluids. The system comprises two pitched-blade impellers and an anchor, using different concentrations of xanthan gum solutions. The model considers the central impeller speed, anchor speed, aeration rate, and rheological parameters of the xanthan gum solution. The ANN model, constructed using experimental data obtained through the simplified dynamic pressure method, outperforms empirical correlations proposed in the existing literature, providing more accurate estimations for k_La. Overall, the study showcases the potency of ANNs in predicting mixing effectiveness in gas–liquid mixing tanks, particularly in complex systems with non-Newtonian fluids.

sciforum-086278: Recent Developments of Microreactors for Process Intensification

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Microreactors for process intensification transform chemical synthesis, providing precise control over reactions in compact devices and enhancing efficiency. This review article explores their application in catalytic biomass conversion, emphasizing advantages in mixing, temperature control, and heat transfer. It delves into fundamental aspects, addressing challenges in design, operation, material selection, and scaling. Fundamental microreactor design principles involve scaling strategies such as internal and external numbering up, geometric similarity, and continuous pressure drop procedures. Materials like silicon, steel, and polymers, particularly polydimethylsiloxane (PDMS), play a crucial role in microreactor construction. Fabrication techniques, including microfabrication, are essential for creating complex designs and ensuring reliability. This review addresses challenges and research gaps while showcasing the versatility of microreactors. Challenges include automation, integration, optimal configurations, process optimization, and cost analyses. Overcoming these is crucial for widespread adoption in industries like pharmaceuticals and petrochemicals. The future outlook for microreactors focuses on recent advancements, collaboration between academia and industry, and the integration of automation and sensors. This envisions microreactors as key players in revolutionizing chemical production, with potential applications in fuel cells, mini-chemical plants, and next-generation catalysts. Therefore, it is of utmost importance that addressing current challenges and advancing research related to this study solidifies their role in shaping the future of chemical engineering.

sciforum-089709: Sensors in Alternative Samples: A Powerful Tool in Forensic Toxicology

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The identification of drugs of abuse in biological samples is an essential component of forensic toxicology, which benefits both criminal investigations and public health initiatives. However, due to the limited advancement of immunoassays, the field faces difficulties, especially in the detection of drugs of abuse. The growing importance of sensor technologies as practical alternatives in forensic toxicology is addressed in this review. These technologies provide accurate, effective, and real-time detection capabilities for a range of sample types.

One notable advantage of sensor technologies lies in their adaptability to alternative samples such as hair, sweat, oral fluid, and others. These alternative specimens present unique advantages in forensic toxicology, offering extended detection windows and overcoming limitations associated with traditional matrices like blood and urine. For instance, hair samples provide a retrospective timeline of drug exposure, while oral fluid and sweat offer non-invasive collection methods that are suitable for on-site testing in various settings.

The development of sensor technologies that are specifically suited for forensic toxicology applications is still lacking, despite their potential. By investigating the possibilities of portable sensor technologies for identifying drug abuse in different samples, the present work seeks to address this gap. We anticipate improved drug abuse detection speed, accuracy, and accessibility through the integration of these technologies into forensic toxicology practices, revolutionising the effectiveness of criminal investigations and public health initiatives.

Closing this technological gap might result in a new era of thorough and effective analysis in the field of forensic toxicology. As sensor technologies develop further and adapt to a wider range of sample matrices, they present a viable path forward for forensic toxicology, promising rapid, precise, and reliable outcomes that are essential for pursuits related to justice and public health.

sciforum-087658: Study of the Effect of Xanthation Temperature on Viscose Quality

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The xanthation reaction is an exothermic reaction between alkali cellulose (AC) and carbon disulfide (CS_2) used to regenerate a viscose solution. The cooling system plays an important role during the reaction to yield more of the main product, cellulose xanthate (CX), instead of the byproduct, sodium trithiocarbonate (TTC). Minimizing the yield of byproducts during the reaction phase may lead to less byproduct generation during the ripening process due to free caustic and excess CS_2 in the system. The reaction was performed in a batch reactor with an agitator (9.7 rpm) under vacuum conditions (350 mbar), and the temperature varied from 20 °C to 35 °C, as is applicable in industrial plants. Meanwhile, the CX and TTC were determined by UV spectroscopy. Since the temperature reaction will affect the period of the reaction, which impacts the productivity of industrial applications, the experiment was conducted with a temperature change during the reaction to obtain a good-quality product without impacting productivity. This work aimed to reach an optimum xanthation temperature under the same combination of hardwood and softwood dissolving pulp. The results indicated that the xanthation reaction has an advantage at lower temperatures compared to higher ones; however, having a lower temperature led to a longer reaction period. The TTC was shown to be 17.7% lower at lower temperatures than at higher temperatures, which means that the CX was at a higher percentage at lower temperatures. Interestingly, the combination of higher and lower temperatures gave good viscose quality, which may lead to less consumption of CS_2 and improve the environment due to less sulfur production during spinning.

sciforum-090075: The Analytical Investigation of Electrocoagulation of Perfume Profile for the Odor Active Compound

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In this research, miniaturized electrocoagulation (EC) system has been employed for the treatment of odor-active compounds in 2 mL small-scale perfume extracts. The system utilized an electrochemical cell with two spring coil electrodes with the perfume liquid sample and directly applied onto the power supply at 9 V. This EC system facilitated the electrochemical reaction of the compounds, inducing subsequent changes in their volatile organic compound (VOCs) profiles within the extracts. The VOCs in the samples, collected at different times of the system before and after EC treatment, were tentatively identified using headspace-solid-phase microextraction (HS-SPME) with gas chromatography-mass spectrometry (GC-MS) for compound identification of total intensity of chromatogram peak areas correspondence with retention time (R_t). The specific peak of interest was identified by comparing its mass spectrum with standard compounds mass spectra. This comparison was based on NIST22 library, assisting in the accurate identification of the targeted compound.

The outcomes revealed variations types in term of qualitative analysis of odor active compounds in the samples following the EC treatment as final product, resulting in enhanced fruity and floral smells with the possible VOCs product as hexanol (fruity and alcoholic), sabinene (oily-peppery), pseudolimonene (fatty spicy aroma odor), Benzene,(3-methylbutyl)-(floral green rose), 2,4-Heptadienal,2,4-dimethyl-(green pungent fruity spicy odor) and isobornyl acetate (camphoraceous earthy pine balsam).

The developed EC technique demonstrates potential for cost-effective adjustment of essential oil and perfume quality. This highlights its applicability in the field of modifying and enhancing the characteristics of essential oils and perfumes in a cost-efficient manner.

sciforum-081100: The Evolution of Defect Formation during the Deposition of Thin Layers of ZnO on the Surface of Hierarchical Porous Silicon and Subsequent Multi-Stage Annealing

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Research on the formation of substances at different hierarchy levels of structure is a promising scientific direction. The multilevel surface of the sample was obtained via the electrochemical etching of silicon and the subsequent deposition of thin layers of zinc oxide via spray pyrolysis. Studies using the "Box counting" method revealed fractal properties at macro-, micro-, and nano-levels of the investigated surfaces.

It is known that the sensor responses depend on the level of ordering regarding particles of matter. If the structure is regular and the degree of fractality is high, the exciting signal moves along a short trajectory at a given speed. If there is a local deviation in the wave, the path length and the duration of the response increase.

The growth of structures in a certain direction with predetermined properties is due to the nature of the interaction between paramagnetic centers. EPR studies on samples showed the presence of a hyperfine spectrum structure, where the splitting of levels is the result of the influence of two different nuclei on the paramagnetic center. The sequential annealing of samples at a gradually increasing temperature led to the manifestation of the complex character of the signal from the trapped charges. Based on the variety of EPR signal saturation mechanisms, ZnO synthesis occurred at the boundaries of porous hierarchy structures with different sizes.

Paramagnetic centers are involved in the movement of charges through a jumping mechanism. At the same time, the highest concentration of particles with dangling bonds is located at the boundaries of structures (pores and clusters). Consequently, with an increase in the number of surface structures, the velocity of charge movement increases. This mechanism significantly enhances the sensitivity of sensors, the surface of which includes several levels of hierarchy.

sciforum-089870: Advanced Investigation of Indazole Derivatives as Corrosion Inhibitors for Brass in Acidic Environments: Electrochemical, Theoretical, and Surface Analysis

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The study represents a comprehensive exploration of the adsorption behavior and corrosion inhibition properties of a recently synthesized heterocyclic compound, known as Ind-NO_2, derived from indazole, particularly focusing on its interaction with brass surfaces within a hydrochloric acid (HCl) environment. This research is pivotal in the field of corrosion protection as it addresses the crucial need for effective inhibitors to safeguard metal surfaces from deterioration in aggressive chemical environments. The primary objective of this study is to assess the efficacy of Ind-NO_2 in preventing brass oxidation. To achieve this goal, a diverse array of experimental techniques is employed, each providing unique insights into the inhibition mechanism and adsorption characteristics of the compound on the brass surface. Electrochemical impedance spectroscopy (EIS) offers valuable information regarding the electrical properties and corrosion kinetics of the brass–Ind-NO_2 system. Potentiodynamic polarization (PDP) analysis helps elucidate the electrochemical behavior of the brass surface in the presence of the inhibitor, aiding in understanding its ability to control the corrosion rate. Additionally, X-ray photoelectron spectroscopy (XPS) provides detailed insights into the chemical composition and bonding states of the adsorbed inhibitor molecules on the brass surface, offering molecular-level understanding. The results obtained from these experimental techniques demonstrate a significant inhibition efficiency of the Ind-NO_2 compound, with a remarkable 90.5% reduction in corrosion rate observed. Moreover, analysis based on the Langmuir adsorption model reveals that the inhibitor molecules adhere to the brass surface in a monolayer effectively forming a protective barrier against corrosive attacks. Further insights into the morphology and composition of the protective film formed on the brass surface are obtained via supplementary analyses utilizing scanning electron microscopy/energy-dispersive X-ray spectroscopy (SEM/EDS) and X-ray diffraction (XRD). In summary, this investigation contributes valuable insights into the adsorption properties and corrosion inhibition mechanism of the novel heterocyclic compound Ind-NO_2.

sciforum-087608: Analyzing Power Consumption in a Coaxial Bioreactor Using Machine Learning Techniques with Computational Fluid Dynamics

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Agitated bioreactors are the subject of many studies regarding their design and scale-up to enhance the productivity in various chemical and biochemical industries. In this regard, accurately predicting their power consumption is very important, because it influences the mass transfer rate and flow uniformity inside the bioreactor. A literature review revealed that no study has been conducted to investigate the performance of coaxial bioreactors in terms of their power consumption using a machine learning method. In this study, a computational fluid dynamics (CFD) model was developed and validated against experimental data. Subsequently, 500 simulations at different aeration rates (2–6 L/min), anchor impeller speeds (3.5–9.5 rpm), central impeller speeds (60–150 rpm), and rotating modes (co-rotating and counter-rotating) were conducted. The data from these simulations were utilized to train and test various machine learning models. Initially, the *k*-nearest neighbor (KNN) classification model was employed to categorize the coaxial bioreactors into different rotating modes. It was found that with just the torque value and central impeller speed, the model achieved successful classification. In addition, various regression models, including multi-layer perceptron (MLP), KNN, and random forest, were developed to predict the torque that would be produced by the coaxial bioreactor. For all models, the hyperparameter tuning and cross-validations were performed. The mean squared error (MSE) evaluation showed that the random forest model had superior performance compared to its counterparts.

sciforum-089729: Application for Validation of Compound Identification in GC × GC Based on Retention Index

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Comprehensive two-dimensional gas chromatography (GC × GC) is a powerful technique for separating, identifying, and quantifying volatile and semi-volatile compounds in complex samples. Typically, mass spectrometry (MS) is used for peak identification in GC × GC, but relying solely on MS library comparison can have limitations, especially for isomers with similar mass spectra. Additionally, optimizing the separation conditions to achieve improved resolution in GC × GC can be challenging.

This research presents a computational approach to simulate GC × GC results using a calculation method based on first- and second-dimensional retention indices (1I and 2I). The simulation includes the prediction of the retention times (1tR and 2tR) and contour plots of samples from GC × GC-MS data. For cases where 1tR and 2tR data of alkane references (1tR(n) and 2tR(n)) are not available, the following steps are applied: curve fitting based on the van den Dool and Kratz relationship to simulate 1tR(n) using a training set of volatile compounds with their experimental 1tR data; or simulation of 2tR(n) at different 1tR(n) values to construct isovolatility curves based on a nonlinear equation with six constants, obtained through curve fitting using the experimental 2tR data of the training set.

The approach was applied to simulate results for 622 compounds in various samples, including saffron, Boswellia papyrifera, acacia honey, incense powder/smoke, and perfume. The simulated results were compared with experimental data, showing good correlation with R^2 values, ranging from 0.975 to 0.999 for 1tR and 0.449 to 0.992 for 2tR. The approach was then applied to propose 10 compounds that may have been incorrectly identified in the literature based on significant differences between the simulated and experimental 2tR values.

sciforum-090200: Attainable and Operating Regions for Production of Hydrogen from Biomass

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The depletion of fossil fuels and the emission of greenhouse gases have led to a high demand for renewable and sustainable energy sources. Biomass is one such source, and its thermal conversion has the potential to produce hydrogen-rich syngas through gasification. This process involves the use of oxygen and steam as oxidising agents at high temperatures. The products obtained from biomass gasification are subjected to the Water Gas Shift (WGS) process, which helps in improving the quality of hydrogen. The objective of this study is to develop synthetic tools to optimize the reactor design of biomass gasification. This will be achieved by analysing the attainable and operating regions of the gasifier. These tools use mass and energy balances, partial pressures, and reaction equilibria to optimize outputs based on feed compositions and oxidising agent ratios in a gasification unit. The gas yield and hydrogen concentration both show a significant increase and then a decline as the reaction temperature rises. The maximum hydrogen concentration observed is 44.8 vol% at 950 °C. Increasing the reaction temperature further results in high energy consumption and it suppresses the exothermic water gas shift reaction. It has been observed that hydrogen levels increase as steam is added to the gasifier. However, there is a decrease in hydrogen levels as the steam-to-biomass ratio increases beyond a certain point. An optimal ratio to maintain gasifier efficiency has been identified between 1.2 and 1.3. Before investing time and resources into pilot plants and experiments, it's beneficial to explore attainable and operating region techniques for viable hydrogen production from biomass gasification.

sciforum-085846: Bioinformatics Approaches for the Molecular Characterization and Structural Elucidation of a Hypothetical Protein of *Aedes albopictus*

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The most critical issues in computational biology are characterizing and predicting uncharacterized proteins' secondary and tertiary structures from their uploaded amino acid sequences in databases. *Aedes albopictus*, sometimes referred to as the Asian tiger mosquito or forest mosquito and the carrier of dengue-like diseases, has many proteins, many of which are still poorly understood. The current work aims at elucidating the physicochemical properties and structures of the as-yet-uncharacterized *Aedes albopictus* protein AEW48448.1. ExPASy Protparam, CD Search, SOPMA, PSIPRED, and other advanced computerized tools were used following the standard flowchart for characterizing a hypothetical protein to ascertain the roles and structures of AEW48448.1. After identifying the protein's secondary and tertiary structures, the structures were evaluated for quality using tools like PROCHECK and the ProSA-web. Later, the active site was also discovered using CASTp v3.0. The protein is more stable because it has a higher aliphatic index value and more negatively charged than positively charged residues. The modeling of the proteins' 2D and 3D structures using multiple bioinformatics tools confirmed that they had domains, indicating that they were functional proteins with the host's antiviral, cytokine, and interferon production pathways. Additionally, the protein was revealed to have active regions where ligands may bind. This work aims at elucidating the characteristics and structures of an uncharacterized *Aedes albopictus* protein that may serve as a therapeutic target for the creation of antiviral candidates and vaccines.

sciforum-088466: Catalysis of NHC–Pd Complexes in the Suzuki–Miyaura Cross-Coupling Reaction

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Introduction

N-heterocyclic carbenes (NHCs) are considered important preferred auxiliary ligands for transition metals due to their strong σ-donor and weak π-acceptor properties and ease of structural modification in catalyst design. The functionalization of NHC by adding different substituent groups is an effective strategy for designing complexes with desired electronic and steric properties. NHC–Pd complexes are of particular importance due to their resistance to air, moisture and heat and their strong stability under catalytic and biological conditions. It is known that NHC–Pd complexes show excellent performance in the Suzuki–Miyaura cross-coupling reaction. The traditional Suzuki–Miyaura reaction involves the cross-coupling reaction of alkyl and arylboronic acids with aryl halides. This reaction has some advantages over other C-C coupling reactions. The use of water as a suitable and reliable solvent in the reaction, the fact that the reaction products are generally poorly soluble in water and can be easily separated from the reaction mixture, the use of non-toxic chemicals, the moderation of reaction conditions, and good functional group compatibility make it useful and worth studying. There are many examples of studies on the application of NHC–Pd complexes in the Suzuki–Miyaura reaction in aqueous media, and the highly effective catalytic activities and versatility of these reactions have been proven.

Methods

In this study, a series of benzimidazole-based Pd–NHC complexes were synthesized. The synthesized complexes were characterized by spectroscopic methods. All complexes were tested as catalysts in the Suzuki–Miyaura cross-coupling reaction.

Results

According to the obtained results, the synthesized benzimidazole-based Pd–NHC complexes were found to have high catalytic activity in the Suzuki–Miyaura cross-coupling reaction.

Conclusions

The synthesized Pd–NHC complexes can be used as potential catalysts due to their high catalytic activity. It is thought that these catalysts can be used in different biochemical studies in the future.

sciforum-086504: Comparative Evaluation of Milk Oligosaccharides Isolated and Fractionated from Indigenous Rathi Cow Milk for Anti-Oxidant and Anti-Adhesive Properties

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Milk, a cornerstone of neonatal nutrition and human health, harbors various components with antioxidant capabilities, including oligosaccharides. In this study, we explored the antioxidant potential of acetylated milk oligosaccharides (A-MOs) and deacetylated oligosaccharides (D-MOs) sourced from Rathi cow milk through assays, with a focus on their comparative efficacy. Concurrently, we evaluated the antioxidant activity of Ascorbic Acid (AA) for comparison. Results revealed significant dynamics within the antioxidant profiles of A-MOs and D-MOs. A-MOs demonstrated concentration-dependent antioxidant activity, with higher concentrations correlating with increased efficacy, while D-MOs displayed a distinct pattern, with varying antioxidant potential across concentrations. Notably, both A-MOs and D-MOs exhibited promising antioxidant activity, suggesting their potential as natural antioxidants. In contrast, AA exhibited a decline in antioxidant activity with increasing concentration, indicating a differing pattern from oligosaccharides. These findings underscore the significance of acetylation in modulating the antioxidant properties of milk oligosaccharides. Further investigation is warranted to elucidate the mechanisms underlying these observations and to explore the practical implications of A-MOs and D-MOs as functional food components or potential therapeutic agents. Overall, our study contributes to the understanding of milk oligosaccharides' antioxidant properties and highlights the potential of acetylated and deacetylated oligosaccharides from Rathi cow milk as valuable sources of natural antioxidants with diverse applications in nutrition and healthcare.

sciforum-089959: Comparative Phytochemical Profiling of Flowers and Pods in *Acacia mearnsii*

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Species belonging to the *Acacia* genus are recognized as invasive plants, displaying high levels of aggressiveness across diverse territories, thereby posing a notable threat to biodiversity and ecological equilibrium. Extensive research has been dedicated to understanding the chemical composition and biological activities of different components of Acacia trees. This study aims to clarify the chemical constituents of *Acacia mearnsii* extracts, focusing on their potential industrial applications. Extracts from both flowers and pods were subjected to rigorous analysis and processing via the energized dispersive guided extraction (EDGE) method. Using analytical techniques, including high-performance liquid chromatography (HPLC) with diode array detection (DAD) and liquid chromatography coupled with high-resolution tandem mass spectrometry featuring electrospray ionization (LC-ESI-HRMS/MS), phenolic and polyphenolic compounds were thoroughly examined. The analysis revealed the presence and quantification of twenty distinct compounds, with flowers displaying a more complex chemical composition than pods. Notably, flowers exhibited higher levels of vanillin, while the prevalence of rutin characterized pods. Compounds of interest identified in both extracts include (+)-catechin, *p*-coumaric acid, naringenin, and quercetin.

Regarding compound diversity within pods, *A. mearnsii* demonstrates similarities with other species investigated. However, regarding flower composition, *A. mearnsii* exhibited a diminished diversity of compounds compared with that in *Acacia retinodes*. Nevertheless, it displayed elevated concentrations of vanillin, *p*-coumaric acid, cinnamic acid, and naringenin.

sciforum-089718: Computational Analysis of Catalytic Combustion Using Finite Volume Method (FVM): Advantages, Constraints, and Potential Applications

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This study explores the computational analysis of catalytic combustion in cylindrical reactors using the Finite Volume Method (FVM) within Ansys Fluent. Through the incorporation of a combustion channel to facilitate diesel combustion, Ansys Fluent is utilized to predict the fluid dynamics during catalytic combustion. An extensive reaction mechanism file containing all related reactions is added into Ansys Fluent to model the catalytic combustion of methane. In this study, the catalyzed combustion of a methane, hydrogen, and air mixture is simulated on a heated platinum wall within a cylindrical channel using a 2D axisymmetric solver. Two mechanism files are employed: one defining gaseous species and the other including surface species definitions and surface reactions. Volumetric reactions are excluded from this analysis. The cylindrical channel comprises three sections, inlet, catalytic, and outlet, with the catalyzed reactions occurring on the wall surface of the catalytic section. The simulation results exhibit a gradual decrease in the mass fraction of reactants as catalytic combustion proceeds within the chamber, accompanied by a simultaneous increase in product formation. In particular, the presence of a catalytic channel within the combustion chamber catalyzes the combustion reaction, resulting in a higher chamber temperature. This study also presents predicted mass fraction profiles for both reactants and combustion products, highlighting the efficiency of Computational Fluid Dynamics (CFD) simulations in predicting chemical processes, particularly catalytic combustion. This research contributes to the understanding of complex phenomena such as catalytic combustion and underscores the potential of CFD simulations in explaining complicated chemical processes.

sciforum-090113: Computational Insight into Graphene Functionalization for DNA-Sequencing: A DFT Approach

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Most diseases, such as cancer, gene mutations, or infections among humans, are due to DNA nucleotide mis-sequence. Deoxyribonucleic acid (DNA) is vital in life science, and its sequence detection is imperative in the fields of disease diagnosis, forensic sciences, and genomics systems, making materials designed for DNA identification very crucial. Two-dimensional materials such as graphene doped with some hetero-atoms have been explored for DNA nucleobase detection, but the role of functional groups remains unclear. This study investigates the influence of functional groups in the discrimination of DNA nucleotides: Adenine (A), Guanine (G), Thymine (T), and Cytosine (C). Herein, we studied how functional groups like carboxylate, nitrile, alcohol, and carboxylic acid improve the adsorption capacity of DNA nucleotides onto graphene sheets. The stable configurations of DNA bases adsorbed onto the graphene surface were investigated using Spartan software and density functional theory (DFT) for quantum chemical calculations. The adsorption energies and band gaps were determined during the interaction. Our findings reveal that non-functionalized graphene is sensitive to G; alcohols and nitriles functionalized to A; and carboxylates functionalized to C. However, acetic (carboxylic) acid is significantly sensitive to all four nucleotides, making it suitable for DNA sequencing. The relative adsorption energies hierarchy of nucleotides was obtained with previous findings reported in the literature. Our findings confirm the potential of computational methods to predict functionalized graphene's selectivity in discriminating DNA nucleotides, offering a promising avenue for identifying mutations driving tumour growth, predicting prognosis, and guiding targeted therapies tailored to the unique genetic profile of each patient's disease.

sciforum-090127: Conduction Characteristics of Some Polymer/Carbon Nanotubes Composites: The Effect of Polymer Matrix Features

Nica Simona Luminita, Raluca Marinica Albu, Marius Soroceanu, Iuliana Stoica, Constantin Găină and Andreea Irina Barzic

Petru Poni, Institute of Macromolecular Chemistry, Iasi, Romania

The development of composites based on carbon fillers led to outstanding progress in various technologies over the past decade. Major importance was attributed to the proper selection of polymer and filler pairs, but also to the aspects derived from interfacial interactions and filler dispersion within the polymer medium. These factors are known to have a great impact on the performance of the designed multiphasic material. In this work, two categories of composites made of distinct polymers and carbon nanotubes were studied, emphasizing the effect of polymer matrix features on electrical properties. The first system was obtained based on a polyimide precursor that has a semi-flexible and non-symmetric structure, in which variable amounts of carbon nanotubes were incorporated. For comparison reasons, another system containing carbon nanotubes was proposed, which has as a matrix with a new polysulfone (PSF) structure. The latter was obtained via chlorometilation reactions, and subsequently via oxidation reactions and the acetalization of poly(vinyl alcohol) (PVA), rendering a PSF with PVA side chains. Each prepared composite system was investigated via molecular modeling, evidencing the effect of the polymer matrix on the overall Waals-surface-bounded molecular volume and polarizability. The dielectric constant of the polymer was determined either from theoretical calculations or from broadband dielectric spectroscopy experiments. Also, another important parameter obtained in this work was electrical conductivity. It was found out that conduction characteristics are affected by the amount of carbon nanotubes inserted in the polymer matrix. On the other hand, it appears that the structural features of the polymer have led to different conductivity values. All these results are relevant for making polymer-derived components for electronics.

sciforum-090343: Crystal Structure, Spectroscopic Studies, DFT Calculations, Cyclic Voltammetry and Catalytic Activity of a Copper Schiff Base Complex

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Herein, we describe the synthesis of a novel tetradentate Schiff base ligand, H_2L, with a diaminotoluene spacer, and its corresponding mononuclear copper complex, CuL, in methanol solvent. The characterization of all new compounds was conducted using various spectroscopic techniques, such as FT-IR, UV-vis, ^{1}H, ^{13}C, ^{1}H-^{1}H COSY-NMR and MS. Single-crystal X-ray diffraction analysis of the CuL complex revealed a monoclinic system with a *Cc* space group, comprising four molecules per unit cell. Conductivity measurements indicated the nonelectrolytic nature of the complex, while the electrochemical behavior exhibited a quasi-reversible redox process. Quantum calculations, performed using DFT and TD-DFT theory at the M062X/6-311**G/ SDD level, demonstrated good agreement with the experimental data. Notably, the copper compound displayed larger static and dynamic hyperpolarizability values compared to urea, suggesting potential as an excellent second- and third-order nonlinear optical (NLO) material.

Furthermore, the prepared complex effectively catalyzed the homogeneous oxidation reaction of cyclohexene in the presence of H_2O_2 as an oxidant, achieving a high conversion rate of 98% with CuL as the catalyst. The bromoperoxidase activity was explored in the oxidative bromination of phenol red as a trap, employing the studied complex which can be considered as a potential functional model of bromoperoxidase, with the reaction rate constant k equal to 2.203×10^5 (mol $L^{-1})^{-2}$ s^{-1}.

sciforum-086245: Cyclodextrin Metal–Organic Frameworks for Catalytic Applications: Current Research and Future Outlook

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Catalysis is a fundamental process in chemistry and industry, driving the transformation of reactants into valuable products while minimizing energy input and waste generation. The quest for efficient and selective catalysts has led to the emergence of Cyclodextrin Metal–Organic Frameworks (CD-MOFs), a unique class of porous materials combining the advantages of cyclodextrins and metal–organic frameworks. CD-MOFs are gaining recognition for their distinctive capabilities in catalysis, offering benefits in terms of catalytic activity, selectivity, and sustainability. This paper presents an overview of current research on CD-MOFs in catalysis, emphasizing their application as hosts for catalytic materials and as catalysts themselves. The exploration includes studies on the confinement of redox-active monomers within CD-MOFs, resulting in controlled polymerization and enhanced electrical conductivity. Additionally, this paper discusses the encapsulation of photocatalysts in CD-MOFs, leading to stable and active hybrid materials for selective reduction processes. Further investigations delve into the nanoconfined environment of CD-MOFs, showcasing their ability to influence the regio- and stereoselectivity of photodimerization reactions. The synthesis of bimetallic nanoparticles within CD-MOFs is also explored, highlighting their potential in catalytic applications with enhanced stability and recyclability. Despite significant progress, research gaps persist, necessitating a deeper understanding of the structure–function relationships within CD-MOFs. Mechanistic insights into the catalytic processes, scalable synthesis methods, stability under catalytic conditions, recyclability, and diversification of catalytic functions are identified as critical areas for future exploration. This paper concludes by envisioning the future of CD-MOFs in catalysis, emphasizing tailored structures for specific reactions, multifunctionality, sustainability, industrial integration, and the exploration of novel catalytic frontiers in challenging environments. The catalytic prowess of CD-MOFs hold promise for contributing to sustainable and efficient chemical processes, ushering in a new era of innovation at the intersection of materials science and catalysis.

sciforum-087205: Design and Fabrication of Heterojunctions of Thiosemicarbazones and Nanoparticles in Search of Their Medicinal Activity

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Introduction

Thiosemicarbazone (TSC) derivatives and their complexes have emerged as versatile medicinal agents. Now, the focus has shifted to targeted drug delivery, and here, the application of nanotechnology is being explored. Nanoparticle (NP) technologies are being explored, owing to their tremendous medicinal applications. They are also being explored to overcome the water insolubility of medicinal agents and for their ability to target specific targets.

Methods

This article aims at exploring the fabrication strategies and applications of functionalized TSCs conjugated with NPs for improved therapeutic potential. Studies were taken from the recent literature, and are indexed in leading databases.

Results

The literature survey reveals the fabrication of TSCs with chitosan-coated superparamagentic magnetite NPs, which showed significant anti-proliferative activity against a number of cell lines. Similarly, cobalt oxide nanoparticles conjugated with TSCs have been tested against hepatic cancer cell line HepG2. Other than for their anticancer activity, the functionalized nanoparticles have also been employed against drug-resistant pathogens. To improve oral bioavailability and pharmacological activity, nanoparticle-based block polymers have been proposed to encapsulate the TSCmoiety. The in vitro activity of the fabricated NPs was tested against *Leishmania amazonensis*. Against microphages, less cytotoxicity was observed.

Conclusions

The article may shed light on the structure–bioactivity relationship of novel nanocomposites derived from TSCs and NPs and their specific mechanisms of action.

sciforum-086551: Designing and Fabrication of Heterojunctions of Thiosemicarbazones and Nanoparticles in Search of Their Medicinal Activity

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Introduction

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Conclusions

The article may shed light on the structure–bioactivity relationship of novel nanocomposites derived from TSCs and NPs and their specific mechanisms of action.

sciforum-089727: Development of an Electrolysis for Oi Sobaegi Fermentation and Analysis of Volatile Compound Changes with Gas-Chromatography-Mass Spectrometer

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This research introduces a method for modifying, enhancing fermentation process and aroma of cucumber kimchi (Oi Sobaegi) based on an electrolysis mechanism using spring coil electrodes. The electrodes are immersed into kimchi, allowing electrochemical reactions of volatile compounds, leading to odor compound changes in composition, smell and concentration of the cucumber kimchi. Additionally, the potential of the approach to expedite the fermentation time was explored.

The cucumber kimchi samples, treated with electrolysis at 30 and 60 min were compared with untreated control samples collected at specified fermentation times. Samples were further analyzed using headspace solid-phase microextraction (HS-SPME) and coupled with gas chromatography-mass spectrometry (GC-MS) for volatile compound identification.

Results indicated that after 30 min of electrolysis treatment, there was an enhancement in the amounts of Citronellol (fresh, floral, clean rose), Trisulfide, di-2-propenyl (sulfurous garlic onion), (E)-β-Famesene (woody citrus herbal sweet), Terpinen-4-ol (mild earthy and woody odor), α-Terpineol (pine terpene lilac woody resinous cooling lemon citrus floral).

With a new compound, 3H-1,2-Dithiole with the odor of garlic asparagus, was also observed.

The established approach demonstrates the capability to adjust the fermentation enrichment and aroma of the cucumber kimchi, potentially serving as a tool for customizable food quality in the future.

sciforum-088211: Development of Electrocoagulation System of Fuel Using Supporting Medium for Identification of Volatile Compound Products

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This study introduces an electrocoagulation (EC) approach with a supporting medium, developed for investigating the stability of a biodiesel in terms of biodegradability advantages under electrochemical treatment. Gas chromatography–mass spectrometry (GC-MS) was utilized for volatile compound profile identification to analyze samples before and after the EC reaction. The main and minor compounds that were identified after EC treatment included branched cyclic alkanes, branched alkanes, straight-chain alkanes, aromatic compounds, aldehydes, ketones, esters, alkenes, alkynes, halogens, oxygenated compounds, and heterocyclic compounds, respectively, as the summation of peak areas of different compound classes.

Under the selected reaction conditions of 12 V and 60 min, the total peak area of compounds containing, e.g., 5-undecene, 1-octadecyne, dodecanoic acid methyl ester, and 2,4-Dichloro-5-fluorobenzyl alcohol increased significantly to 1.8 to 5.5×10^9 counts per/s, compared with 0 counts/s for the control of the peak areas. The most focused peak areas of alkene, alkyne, esters, and alcohol saw an increase of up to 33% of the total peak areas, observed after the selected EC condition in the experiment. Compounds with higher peak areas were the concentrated compounds mentioned, with retention indices ranging from 1073 to 1506.

The EC treatment predominantly increased the contents of straight and branched alkene, alkyne, and alcohols, while decreasing the content of branched cyclic alkanes. The developed two-phase electrocoagulation system is anticipated to find applications in investigating fuel properties in the future. This versatile system, designed for the electrochemical treatment of biodiesel, offers a cost-effective and efficient approach for evaluating the stability and composition of various fuel types. Its adaptability and simplicity make it a promising tool for exploring and understanding the characteristics of different fuels, providing valuable insights for fuel quality assessment and optimization.

sciforum-089626: Dielectric Analysis of Polypropylene-Based Composites Filled with Pyrolytically Stripped Pyrograf® III Carbon Nanofibers

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[3] Faculty of Sciences, Ibn Tofaïl University, Kenitra, Morocco

In this study, pyrolytically stripped (PS) Pyrograf® III carbon nanofiber (CNF)/polypropylene (PP) composite films produced by a scalable melt-mixing method are used to investigate the effects of CNFs' weight concentrations on their dielectric properties. Unexpectedly, the electrical conductivity of PP/CNF composite films showed only a slight improvement with respect to pure PP, with values in the order of 10^{-10} S m^{-1} for PP/CNF composite films containing 5 wt.% CNFs. This increase corresponded to an improvement in the dielectric constant up to a maximum of approximately 9 at 1 MHz. This change was attributed to the polarization effect at the interface between the CNF agglomerates and the PP matrix. Moreover, the Cole–Cole model was employed to analyze the effects of CNF concentrations on the dielectric relaxation of PP/CNF composite films, revealing that the incorporation of carbon nanofibers (CNFs) not only increased the dielectric strength of the composites but also extended their relaxation times. These discoveries provide valuable insights into the mechanisms responsible for the dielectric properties of polymer composites produced with commercial carbon nanofibers (CNFs), thereby providing information for potential applications in the electronics arena. Additionally, understanding these mechanisms can pave the way for optimizing composite materials for diverse electronic applications.

sciforum-090401: Enhancement of the Structural and Optical Properties of Ce-Doped V_2O_5 for Optoelectronic Applications

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Among transition metal oxides (WO_3 and MoO_3), vanadium oxides have garnered significant attention for their outstanding properties and diverse applications across various fields. For instance, vanadium pentoxide (V_2O_5) is known for its chemical sensing, photochromism, and catalytic properties, making it a suitable material for electronic information displays, electrochromic devices, optical–electrical switches, color memory devices, and more. Vanadium pentoxides (V_2O_5) have been already prepared by various methods. V_2O_5 is the most saturated (highest oxidation state) oxide and therefore the most stable one in the V–O system. It crystallizes with an orthorhombic unit cell structure belonging to the P_{mnm} space group. As materials with reduced dimensions often exhibit unique properties distinct from their bulk counterparts, recent efforts have focused on synthesizing nanostructures of vanadium oxides and studying their structure–property relationships. The $V_{2-4x}Ce_{5x}O_5$ (0) nanoparticles were prepared using a solid-state technique. Depending on the X-ray diffraction analysis, the NPs crystallized in an orthorhombic structure of $V_{2-4x}Ce_{5x}O_5$. A significant decrease in the crystallite size and band gap energy was observed. Eg was found to be 1.83 eV with Ce content. This is attributed to lattice expansion via Ce ions and the formation of oxygen vacancies within the bandgap. The absorption coefficient, optical transmission, and the complex refractive index were also determined. Substitution-doped V_2O_5 improved, allowing it to be useful for solar cells and optoelectronics.

sciforum-087680: Enhancing Microfluidic Systems' Mixing Efficiency Using Design Models with Convergent–Divergent Sinusoidal Microchannels Walls: Experimental Investigations Based on Entropy Minimization Flow Structures

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The mixing performance of five novel micromixers was assessed using the Villermaux–Dushman protocol. Mixing in passive mixers may be desired at a low or high Reynolds number (Re) depending on the configuration of the mixer's performance. This study is aimed at comparing the mixing performances of backward arrow-, loop-wave-, square-wave-, circular-wave-, and box-wave-shaped micromixers with a back arrow-shaped inlet using the Villermaux–Dushman protocol at Re > 50. A mixing performance test was performed at flowrates ranging from 1000 to 50 mL h^{-1}. Based on the UV absorbance values and mixing times of mixed fluids from the five micromixers, the order of mixing performance at Re > 50 was as follows: square-wave- > circular-Wave- > box-wave- > loop-wave- > backward arrow-shaped micromixers. This was because of the repeated perturbations of the fluid flow, which was identified in the square-wave with a 90 degrees angle in the sinusoidal direction compared to the loop-wave, which had no angle but was characterized by a crest and trough with repeated perturbation. Also, the split and recombination effect that was present in the circular and box-wave contributed to the better mixing performance than that of the loop and backward arrow shape.

As the Re increased from 50 to 700, the order of performance based on absorbance and experimental mixing times became more consistent and increased progressively from the square-wave to the back arrow shape. A comparison of the mixing efficiency of the five micromixers based on the predicted mixing time also gave a consistent order of performance at all Re values above 100. At an Re of 50 to 100, the mixing performance of the circular and box-wave changed drastically from the initial performance, and this was identified as the aging which occurred in the mixer due to the shape and configuration of the channel.

This design is deemed suitable owing to its enhanced mixing efficiency and simpler manufacturing process, particularly when compared to existing models that are employed in biomedical and biochemical analyses.

sciforum-090242: Evaluation of the Enzymatic Activity of Immobilized *Lysobacter* sp. Microorganisms

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The specific enzymatic activity of bacterial cultures illustrates the key applications of a studied strain of bacteria and the biological products based on it. The aim of this study was to determine the enzymatic activity of immobilized *Lysobacter sp.* cells on inorganic matrices. The proteolytic activity of extracellular enzymes in the temperature range 20–40 and the activity of β-1,4-glucanase were studied, and the influence of pH and temperature on the activity and stability of the enzyme was revealed. Optimal cultivation conditions for the *Lysobacter* strain were selected for the highest production of β-1,4-glucanase: glucose, 1% by weight; yeast extract, 0.2% by weight; CMC, 0.75% by weight; pH 7; amount of inoculum, 3.5% by volume; and optimal temperature for incubation, 30 °C. Enzyme stability results showed that the enzyme retained 90% of its activity after minimal preincubation at pH 5.5 and more than 60% of its maximum activity at pH 4–10, demonstrating stability over a wide pH range. Therefore, it can be considered as an acid/alkali-resistant enzyme. It was found that the greatest activity of the enzyme occurs at 50 °C. When the temperature is increased to 50 °C, the enzyme activity increases and then decreases linearly. More than 60% of β-1,4-glucanase's enzymatic activity is observed in the range of 20–60 °C. Consequently, biocompositions based on *Lysobacter sp.* can be used in a wide range of temperatures and pH, which represents its promising use as a probiotic drug.

sciforum-090300: Evaluation on the Effect of Nanoparticle Presence in Furnace Off-Gas on Heat and Mass Transfer in Extraction Ducting

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Ferromanganese smelters generate significant amounts of fume, containing saturated vapours of metals. The conditions favour the formation of metal oxide nanoparticles. The presence of these nanoparticles in furnace off-gas may significantly affect the heat and mass transfer to the extraction ducting. Understanding this phenomenon can improve the design of the gas cleaning equipment. In this work, a mathematical model has been developed to quantify the presence of the metal oxide nanoparticles on the overall heat and mass transfer in the gas flow.

The model considers the full set of Navier-Stokes equations for continuum fluid flows as well as the population balance equation to describe the spatial-temporal evolution of the particle size distribution. The model is built in the open-source OpenFOAM environment. The extended quadrature method of moments (EQMOM) is used to solve the population balance equation.

The simulation results include the distributions of velocity, pressure, temperature, and species concentrations in a typical exhaust duct. The model predicts the evolution of the moments of the particle size distribution function in the computational domain. The effect of the particles on the radiative heat transfer to the ducting is quantified.

Both the average particle size and distribution deviation increase along the flow in the ducting and in time. The rate of deposition of nanoparticles on the duct walls can be derived to determine the thickness and effective thermal conductivity of the layer deposited.

sciforum-090296: Extraction of Nd(III) by Hydrophobic Eutectic Solvent BTMPPA/Phenol from Nitrate Solution

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Today, rare earth elements (REEs) are used in the production of high-tech products, including permanent magnet lasers, computer equipment, etc. The recycling of NdFeB magnets is a promising REE resource, as the amount of waste-spent magnets increases with increasing demand. Solvent extraction is an effective method in the hydrometallurgical processing of NdFeB magnets. Recently, researchers have been using alternative solvents in the development of new REE extraction processes. Hydrophobic eutectic solvents are increasingly proposed as promising extractants for a wide range of organic and inorganic substances. The aim of the present work is to study the extraction of Nd(III) with a hydrophobic eutectic solvent based on di(2,4,4-trimethylpentyl)phosphinic acid (BTMPPA) and phenol. The HES was prepared from a hydrogen bond acceptor (BTMPPA) and donor (phenol) in a molar ratio of 1:3. All extraction experiments were carried out at a temperature of 25 °C and an atmospheric pressure of ~100 kPa in graduated centrifuge tubes with a thermostatically controlled shaker. The present study aims to determine the distribution coefficients of Nd(III) in the extraction system using HES BTMPPA/phenol. It was found that the distribution coefficient of Nd(III) is 0.43 with a ratio of aqueous phase and HES phase equal to 1:1. Changing the volume ratio of the phases will allow the metal to be concentrated in the HES phase. In addition, the influence of the acidity of the aqueous phase was found in the pH range from 0 to 7. The results showed the possibility of increasing the distribution coefficient of Nd(III) up to 0.97 with increasing pH. Thus, the promising use of HES BTMPPA/phenol in the extraction of neodymium from nitrate solution was shown. The obtained data can be used in the development of new effective hydrometallurgical processes of REE extraction from a leaching solution of spent magnetic materials.

sciforum-090389: Fatty Acid Profile, Total Fat, Protein, Moisture and Ash in Different Edible Parts of Albacore Tuna (*Thunnus alalunga* Bonnaterre, 1788)—Preliminary Results

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Studying tuna's nutritional composition and potential health benefits is essential for understanding its impact on health, particularly concerning the fatty acid (FA) and protein content in its edible parts. Tuna has a huge number of edible parts and each of them may differ in nutritional profile. Most studies on *Thunnus* genus only assess the nutritional value of the muscle in general. This study assessed the specific proximal composition and fatty acid profile of different edible parts of a 13 kg male *Thunnus alalunga* (Bonnaterre, 1788) caught in June 2023 in the Cantabrian Sea. Samples of 10 different tuna edible parts were taken at the fish market from a certified trader and subsequently frozen at −18 °C until analyzed. ANOVA and Boferroni's test (p 0.05) were performed. The moisture (oven dry, 103 ± 2 °C), ash (muffle furnace, 550 ± 50 °C), protein (Kjeldahl method) and energy content (UE Regulation No. 1169/2011) were significantly higher in the liver (75.0%), top and low loin (1.8%), top loin (28.2%) and belly (206.7 kcal/100 g), respectively. A total of 28 FAs (GC-FID with a HP5 column) were quantified as a percentage of the total fat extracted with the Soxtec method. In general, the value of total polyunsaturated FAs (PUFAs) was higher than that of total monounsaturated FAs (MUFAs) and total saturated FAs (SFAs). The belly was the tuna edible part with the highest values of fat content (12.5%) and PUFAs, n-3PUFAs EPA + DHA (eicosapentaenoic + docosahexaenoic) and h:H ratio (hypocholesterolaemic/hypercholesterolaemic) FAs. The belly and the tail cut had the highest values of EPA + DHA/total fat and PUFAs/SFAs. The belly and low loin showed the highest n-3/n-6 FA ratio. Compared with other parts, the top loin had the highest thrombogenicity index values. We concluded that there is significant variability in nutritional profiles among the samples, with some exhibiting particularly richness in n-3PUFA EPA + DHA beneficial to human health in terms of their fatty acid profile.

sciforum-086880: Functionalization Effect of Multi-Walled Carbon Nanotubes (MWCNTs) Used as Supports for Cu-Based Catalysts

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Carbon nanotubes have been extensively used as catalytic supports of metals due to their high specific surface area, porous structure, excellent electronic properties and both thermal and chemical stability. Furthermore, their surface chemistry can be easily modified by means of different functionalization strategies, such as thermal and oxidative treatments, affecting the size, dispersion and catalytic properties of metal phase.

Moreover, defective sites, functional groups and metal-support boundaries present at the surface could also serve as active centers for reactants to start the catalytic cycle. Thus, the present work proposes to study the effect of functionalization on the properties of multi-walled carbon nanotubes (MWCNTs) used as supports and their interaction with copper particles in final catalysts.

Commercial MWCNTs were submitted to two treatments: oxidation in liquid phase by concentrated nitric acid and oxidation in gas phase by air flow. Cu-based catalysts were prepared through the ultrasound-assisted impregnation of each support with a given amount of copper precursor, in order to obtain a metal composition of 1 wt.%, followed by drying and calcination under an inert atmosphere. Commercial MWCNTs without treatment were used as reference. The crystalline structure of the samples was characterized using X-ray diffraction (XRD), while textural properties were analyzed using N2 physisorption (BET).

Infrared spectroscopy (FT-IR) and thermogravimetric analyses (TGA) were also used to identify the functional groups bonded to the surface. Distinctive physicochemical properties achieved in the MWCNTs supports could be related to the nature of the functionalization treatment used, with their consequent effects on the features of Cu catalysts.

sciforum-090455: Investigating the Potential of Doum Fibers in Enhancing Geopolymer Composite Derived from Mining Waste

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The construction industry is currently focusing its scientific research efforts towards improving the sustainability of manufactured materials. This shift necessitates the adoption of environmentally friendly raw materials and innovative technologies to reduce energy consumption and natural resource depletion. Geopolymers are increasingly recognized as a viable eco-friendly alternative to conventional building materials due to their outstanding physical and mechanical properties. This study investigates the influence of different fiber loadings on the physical and mechanical properties of geopolymer composites made from mining waste as the base material and palm Doum fibers (PDFs). The manufacturing process involves activating mining waste with a concentrated sodium hydroxide solution to form a homogenous paste, which is then blended with PDFs. The resulting mixture is poured into molds and allowed to cure for 28 days. Following this, the formulated composites were tested to assess their physical, mechanical, and morphological properties, including the modulus of rupture (MOR), the modulus of elasticity (MOE), water absorption (WA) and thickness swelling (TS), and SEM microscopy.

The findings indicated that geopolymer composites reinforced with palm Doum fibers exhibited higher mechanical properties compared to the neat matrix. Optimal results were achieved with a fiber content of 2%, resulting in maximum values of 13.93 MPa for the MOR and 2.30 GPa for the MOE. However, the incorporation of PDFs into the mining waste matrix has led to increased levels of both WA and TS due to the higher quantity of hemicellulose, facilitating water infiltration inside the composite and the subsequent expansion of fibers. Furthermore, analyzing the morphological characteristics of interfacial failure highlights a clearly defined boundary between the matrix and fibers, offering a significant understanding into exceptional mechanical and physical attributes.

In conclusion, these materials offer a promising solution to the growing demand for eco-friendly construction materials.

sciforum-089470: Investigation of Scale-Up Strategies for an Aerated Bioreactor Comprised of a Coaxial Mixer with Yield-Pseudoplastic Fluid

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Defining bioreactor scale-up strategies is a complex task aimed at establishing a framework for achieving equal mixing and mass transfer quality at large scales when compared to smaller scales. A primary concern in developing these strategies is ensuring the applicability of empirical correlations derived from small-scale equipment to its large-scale counterpart. This applicability primarily depends on potential changes in flow regimes upon scale-up. In view of that, the present study aims to propose and evaluate scale-up frameworks based on empirical estimations of volumetric mass transfer coefficients obtained from a small-scale vessel. Experimental investigations were conducted on a coaxial mixer furnished with an anchor-PBT impeller in two scales with a yield-pseudoplastic xanthan gum solution. The process efficiency was assessed in terms of the volumetric mass transfer coefficient and specific power consumption at various agitation speeds and air flow rates. The experimental data were employed to validate a computational fluid dynamics (CFD) numerical approach, which was further utilized for evaluating the local mixing and mass transfer parameters. Among the five scale-up criteria investigated, the results demonstrated that the most accurate and energy-efficient scale-up approach consisted of maintaining an equal specific power consumption, speed ratio, and volume of air per volume of liquid per minute (vvm) across different scales. Additionally, the CFD simulations precisely characterized the mass transfer performance and gas distribution behavior, which enabled us to identify the flow regime on both scales. The numerical analysis also allowed us to investigate the local distribution of gas holdup and volumetric mass transfer coefficients for larger scales, which are particularly crucial for industrial applications. In fact, the combination of experimental analysis and CFD simulations proved valuable for validating scale-up strategies' applicability prior to actual operation.

sciforum-089457: Investigation of the Anticorrosive Properties of Urginea Maritima Extract for the Protection of Copper in an Acidic Environment

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The corrosion of metallic materials arises from their physical–chemical interaction with the environment, causing degradation influenced by various factors. To combat corrosion, inhibiting compounds containing heteroatoms have been extensively explored. Among these, plant extracts emerge as promising candidates due to their eco-friendly and cost-effective corrosion inhibition properties.

This study delves into the anticorrosive effects of Urginea maritima hydroalcoholic extract (EUM) on copper in a 0.5 M H_2SO_4 acid medium. Employing electrochemical techniques such as impedance spectroscopy (EIS) and potentiodynamic polarization (PDP), the research reveals EUM's inhibitory action, notably delaying the cathodic reaction responsible for corrosion initiation. By utilizing an appropriate electrical equivalent circuit model, the electrochemical impedance parameters are accurately determined, showcasing a notable increase in corrosion inhibition, reaching up to 95.2% at an EUM concentration of 1 g/L, as observed through EIS.

Further insights from PDP (potentiodynamic polarization) demonstrate EUM's mixed-type inhibition, which effectively retards the process of copper corrosion. Complementary SEM-EDX analysis confirms the formation of a protective EUM layer on the copper surface, elucidating its mechanism of action and reinforcing its efficacy in corrosion prevention.

Overall, this study highlights the potential of Urginea maritima hydroalcoholic extract as a viable solution for protecting copper against corrosion. Beyond its inhibitory effects, EUM presents itself as an economically feasible and environmentally sustainable alternative, offering significant promise for industries seeking eco-friendly corrosion prevention strategies. Through meticulous electrochemical characterization and material surface analysis, this research contributes to the growing body of knowledge aimed at developing effective corrosion inhibitors with minimal environmental impact.

sciforum-090467: Isolation of Polyphenols from *Clinopodium vulgare* L. with Different Solvents and a Study of Their Biological Activity

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Clinopodium vulgare L. (*Lamiaceae*) has a wide range of uses in Bulgarian folk medicine for cardiovascular disorders, kidney stones, an inflamed and enlarged prostate, night urination, diabetes, and others. *Clinopodium vulgare* L. is attracting the attention of phytotherapists and researchers. For this reason, we fractionated the polyphenol composition with solvents of different polarities using hexane, chloroform, and ethyl acetate. The hexane fraction had the highest yield (85.58%), followed by the ethyl acetate fraction (5.61%), and the lowest yield was found for the chloroform fraction (1.14%). Antioxidant activity depends on total phenols and total tannins. Total Phenolic Content (TPC) values range from 15.65 to 462.78 mg gallic acid equivalent per gram extract (mg GAE/g extract), and Total Tannin Content (TTC) from 32.71 to 410.68 mg tannic acid equivalent per gram extract (mg TAE/g extract). The results showed that the contents of TPC and TTC were highest in the ethyl acetate fraction.

Through a UHPLC-MS/MS analysis of all fractions, 24 components of the polyphenolic complex were identified in the studied herb. Dicaffeoylquinic acid, the flavonoid glycosides-eriodictyol-7-*O*-glucuronide, quercetin-3-*O*-glucoside, luteolin glycosides, apigenin-7-*O*-rutinoside, apigenin-7-*O*-glucoside and apigenin-7-*O*-glucuronide, and the aglycone luteolin, which have not been reported so far, were found in the polyphenolic composition of *Clinopodium vulgare.*

We used modern biochemical analysis methods to evaluate the in vitro biological activity of polyphenols from *Clinopodium vulgare* L. The antioxidant activity was evaluated via hydrogen peroxide scavenging activity. The ethyl acetate fraction showed the highest antioxidant activity (IC_{50} 38 μg/mL). Ethyl acetate and chloroform fractions are characterized by high in vitro anti-inflammatory activity, evaluated as the inhibition of albumin denaturation (IC_{50} 95.83 and 83.73 μg/mL, respectively). The same fractions showed high in vitro anti-arthritic activity evaluated as anti-tryptic activity with IC_{50} values of 147.95 and 136.40 μg/mL, respectively.

sciforum-090426: MHD Hybrid Nanofluid Flow through a Blood Vessel Containing the Drug

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Using blood as a carrier fluid in a rectangular domain between two permeable channels, the current work examines the laminar flow of a copper and copper oxide (Cu/blood and Cu + CuO/blood) hybrid nanoliquid. The drug delivery method and the microcirculatory system's flow dynamic mechanism are two examples of the things this study may modify. The impact of MHD and heat sources/sinks on the flow pattern were examined in the suggested model. Moreover, each channel's sides are permeable, enabling the nanoliquid to filter, exit, squeeze, and dilate at a set speed. The governing partial differential equations and the boundary conditions are transformed appropriately so that they may be computed. The resulting system of nonlinear differential equations is analytically approximated using the elegant homotopy perturbation method (HPM). The physical explanation for the simulated and evaluated features of flow characteristics, such as temperature profiles and velocity in response to variations in the emergent parameters, is provided. Since the magnetic field is essential to blood flow, more and more information on it has been added to the body of current literature. One of the study's many findings is that, in the flow regime's center, the pressure distribution decreases as the magnetic parameter's cumulative values rise. The electric conductivity and pH values are estimated via the increase in the temperature distribution. For pharmaceutical reasons, the Cu and CuO hybrid nanofluids are employed in this investigation. Since blood flow is significantly influenced by the magnetic field, the magnetic field was used in the extended investigation. To keep the blood flow's temperature uniform, the heat emission/absorption factor was included in the energy equation. We anticipate that the effort will produce effective results for medicinal applications like medication administration.

sciforum-089827: Microwave-Assisted Condensation of Two Potential Antibacterial Pharmacophores (Sulfonamide and Oxazolidinone)

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A microwave serves as an energy source to activate a chemical reaction through a process known as microwave-assisted heating, resulting in shorter reaction times and potentially higher yields compared to conventional heating methods. Additionally, microwave heating can offer more uniform heating throughout the reaction mixture, reducing the likelihood of localized overheating or side reactions.

The microwave-assisted condensation of two potential antibacterial pharmacophores, namely sulfonamide and oxazolidinone, involves the utilization of irradiation to expedite the condensation reaction between these two compounds. This innovative approach facilitates the rapid and efficient formation of a new compound endowed with enhanced antibacterial properties. By judiciously applying microwave energy, this method optimizes the reaction conditions, resulting in higher yields, reduced reaction times, and improved efficiency. This technique holds significant promise for the swift synthesis of antibacterial agents, thus paving the way for new applications in pharmaceutical research and drug development.

In our study, our synthesis approach involves developing a new compound incorporating both oxazolidinone and sulfonamide groups. Initially, we introduced oxazolidinone into a reactor with chloro-acetyl chloride under microwave irradiation, followed by the addition of sulfonamide in situ. The desired product is obtained after recrystallization in diethyl ether.

The use of microwaves as an energy source in chemical reactions offers advantages in terms of efficiency, control, and speed.

sciforum-090442: Mixtures of Sodium Iso-Butyl Xanthate and Sodium Di-Ethyl Dithiophosphate on the Flotation of a Cu-Ni-PGM Ore in $Ca(NO_3)_2$ and $NaNO_3$

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The use of mixtures of thiol collectors has been said to be of benefit for the flotation of Cu-Ni-PGM ores. However, the increasing demand on the use of recirculated water in minerals processing may alter the performance of flotation reagents. This therefore places the need for flotation reagents to be understood in terms of their behaviour in different components or constituents of process water, as is necessary with regards to better decision making in terms of understanding the quality of process water that works for reagents and specific ores, as well as the quality of water. Ca^{2+} and Na^{+} are common cations in process water and are said to bring various effects in the pulp phase and the froth phase and have become common subjects of investigations where water quality is concerned. NO_3^{-} anions however have not received much research attention as compared to other common ions in process water, such as Cl^{-}, SO_4^{2-} and $S_2O_3^{2-}$. NO_3^{-} ions are said to result from the blasting chemicals used during mining and are leached into solution during milling and can therefore be considered key role players (as far as the interactions occurring in the pulp phase are concerned). Their interactions in the pulp phase and their role in flotation should therefore be important to consider. This paper presents results from bench-scale froth flotation tests which were conducted on a Cu-Ni-PGM ore from the Merensky reef using mixtures of thiol collectors, namely sodium isobutyl xanthate and sodium diethyl dithiophosphate in solutions containing $Ca(NO_3)_2$ and $NaNO_3$. $NaNO_3$ solutions showed higher solids recoveries at all thiol collector mixtures as compared to $Ca(NO_3)_2$ solutions. Higher Cu and Ni recoveries were seen in $NaNO_3$ solutions at all thiol collector mixtures.

sciforum-089918: Molecularly Imprinted Nanoparticles for the Detection of Viruses and Bacteria: A Focus on COVID-19 and *Staphylococcus aureus* via Surface Imprinting

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Molecularly Imprinted Polymers (MIPs) onto nanoparticles are at the forefront of revolutionizing the detection of viruses and bacteria, offering distinct advantages in selectivity, stability, and versatility. This abstract explores the application of MIPs in detecting COVID-19 (SARS-CoV-2) and *Staphylococcus aureus*, particularly focusing on surface imprinting. The synthetic strategies, advantages, and characterization steps associated with MIP-based detection systems are also highlighted. MIPs provide specific binding sites tailored to target molecules, ensuring unparalleled selectivity in pathogen recognition. Their stability, cost-effectiveness, and versatility are augmented by surface imprinting, a technique optimizing accessibility to binding sites and promoting superior molecular recognition. Synthetic strategies encompass precipitation and emulsion polymerization, or solid-phase synthesis, ensuring the creation of surface-imprinted sites with high specificity for the target pathogens. Characterization steps, including FTIR, NMR, and SEM, validate MIPs' detection efficacy. These techniques confirm successful imprinting, assess nanoparticle morphology, and verify the presence of specific binding sites. The significance of MIPs in virus and bacteria detection lies in their ability to offer tailored and selective recognition, minimize false positives, and enhance diagnostic accuracy. MIP-based detection systems, synthesized and characterized with precision, present a transformative approach, offering rapid, specific, and sensitive tools for detecting COVID-19 and *S. aureus*. This innovation holds the promise of advancing diagnostics, contributing significantly to improved public health outcomes.

sciforum-087897: Numerical Investigation of Nanofluid Flow with Gold Nanoparticles Injected inside a Stenotic Artery

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The primary objective of the existing framework is to examine the significance of gold nanoparticles immersed in human blood when magnetohydrodynamics (MHD) flow occurs within a stenotic artery. Gold nanoparticles are employed as nanomaterials for medication delivery primarily because of their potential for drug transport and imaging. The blood's warmth and velocity gradually decrease as the size of the gold nanoparticles increases. In addition, the effects of thermal radiation and heat source-sink are taken into account. Using a technique of appropriate similarity transformations, the partial differential equations (PDEs) were transformed into dimensionless ordinary differential equations (ODEs). Then, the ODEs were solved numerically and graphically using the bvp4c built-in solver in the mathematical program MAPLE. Then, using a shooting technique, higher order ordinary differential equations (ODEs) were solved. Graphs elaborate on the physical regulating parameters' results, such as temperature and velocity profiles. As the Biot number and thermal radiation parameter increase, the Biot number is estimated more highly, and the Nusselt number rises, but when the suction or injection parameter is used, it decreases. For the delivery of drugs, the gold nanoparticles are highly helpful, and the thermal distribution profile exhibits an increasing behavior. The current method has the potential to be very helpful in effective blood medication delivery.

sciforum-086481: Obtaining Environmentally Friendly Trace Element Preparations for Crop Production via the Electric Spark Treatment of Metals

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Traditional technological approaches used for the cultivation of field crops using many mineral fertilizers and chemical plant protection products are becoming costly, as well as environmentally and economically irrational. An alternative direction is the use of modern technological approaches, including nanomaterials. The article presents the method of obtaining a biologically acceptable and effective form of trace elements in the form of aqueous dispersions of metals. During the research process, we studied the regularities of the electro-spark dispersion of metals, which determines the synthesis of nanoparticles of biogenic elements. Electron microscopy (SEM and TEM) and the X-ray diffraction analysis of the metal phase of colloidal solutions were used to research the composition, structure, and average sizes of the obtained nanoparticles of various metals. A complex compound was prepared, which includes metal nanoparticles, in particular, such as iron (Fe)—1800 ppm; copper (Cu)—400 ppm; zinc (Zn)—1000 ppm; and manganese (Mn)—800 ppm. The compounds were tested in the field during the cultivation of winter wheat at different stages of organogenesis. The application rate of the prepared compound was 1–1.5 L/ha, and 1.0–1.5 L of the compound were diluted in 250 L of water. It has been established that the proposed technology increases grain yield and its quality indicators. The presented technology for growing grain crops is cost-effective and provides an increase in wheat cultivation profitability by 10–15%. The presented technology (electric spark method) can be considered ecologically and environmentally safe. It does not pose a threat to the environment, the agricultural sphere, and humans due to their probable biodegradation.

sciforum-090415: Photoluminescence and Refractive Index Dispersion Properties of $Zn_{3-x}M_x(PO_4)_2$ (M=Co, Ni) Nanoparticles

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Nanophosphor materials are capturing the interest of researchers for their potential applications in light sources, information display panels, radiation converters, fluorescent pigments, and tracers. These materials consist of nanoparticles wherein a transparent host compound is doped with optically active materials, emitting light due to electronic transitions between impurity centers and the band gap of the host lattice. The band-to-band transition strongly relies on the band gap, affecting the luminescence behavior as a result of quantum confinement. Therefore, controlling the particle size is crucial to optimize the performance of phosphor materials in fluorescent devices, light-emitting diodes (LEDs), and display panels. Several nanophosphors have been synthesized mostly as powders with a few exceptions in matrices and as films using different techniques [1,2]. In this study, we investigated the structural, morphological, optical, and photoluminescence properties of $Zn_{3-x}M_x(PO_4)_2$ (M=Co, Ni) nanoparticles with (x = 1), synthesized using the solid-state method. The optical constants and dispersion energy parameters of the nanoparticles were determined using UV-visible optical characterization. The optical band gap was measured to be 2.48 eV for $Zn_3(PO_4)_2$, 3.05 eV for $Zn_2Ni(PO_4)_2$ nanoparticles, and 3.12 eV for $Zn_2Co(PO_4)_2$. The refractive index dispersion of $Zn_3(PO_4)_2$ followed the single-oscillator model. The real and imaginary parts of the dielectric constant of $Zn_{3-x}M_x(PO_4)_2$ (M=Co, Ni) nanoparticles with (x = 1) were also determined. The photoluminescence spectra of $Zn_3(PO_4)_2$ exhibited a peak around 2.56 eV, while the $Zn_2Co(PO_4)_2$ nanoparticles showed peaks at 3.26 eV and $Zn_2Ni(PO_4)_2$ had a peak at 2.47 eV. These absorption spectra peaks are attributed to the recombination of excitons and/or shallowly trapped electron–hole pairs, representing band-edge emission.

sciforum-090375: Preparation and Electrochemical Oxidation of Ferricyanide Using Carbon Paste Electrode Modified with TiO_2

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The research conducted in this study centres on examining the process of preparing and electrochemically oxidizing ferricyanide with a carbon paste electrode (CPE) modified using TiO_2. Therefore, an efficient and reliable electrochemical sensor was developed for ferricyanide oxidation, which is a commonly used redox probe in various analytical applications. The modification of the CPE with TiO_2 aimed to enhance the electrocatalytic activity and sensitivity towards ferricyanide oxidation. The modified electrode was characterized using Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), and X-ray diffraction (XRD) techniques. The analysis of ferricyanide revealed that the surface area of graphite increased significantly after modification with TiO_2. The effect of the scan rate on the electrochemical oxidation process was investigated using different scan rates, resulting in a high correlation coefficient (R^2 = 0.94), which clearly indicates a strong relationship between the scan rate and oxidation process. The experimental results demonstrated that the TiO_2-modified carbon paste electrode exhibited improved electrochemical performance, including enhanced peak current density and lower oxidation potential, when compared to the unmodified electrode. This study provides valuable insights into the design and optimization and kinetics of the electrode materials for electrochemical sensing applications. The findings suggest that the modified electrode can be utilized for various future applications due to its enhanced electrochemical properties.

sciforum-087357: Production of Complex and Mixed Fertilizers by the Acidic Processing of Phosphorites

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One way to increase the utilization of phosphate raw materials is the liquid phase circulation method, which is used in the production of double superphosphate. The currently used traditional processes employ phosphorites of varied quality and chemical/mineral composition, which are degraded with excessive quantities of phosphoric acid. The main steps in this cycle method include neutralizing monocalcium phosphate (MCP), sulfating the main circulating solution, separating phosphogypsum, and returning to the acid production cycle. Calcium dihydrophosphate (monocalcium phosphate-double superphosphate) crystallizes and is separated from the main circulating solution. The formation of double superphosphate, which has a P_2O_5 value of 50–59%, indicates that the maximum (98–99%) phosphate mineral breakdown has been achieved in this case. On the one hand, all procedures are equivalent to chamber or chamber-flow methods; on the other hand, they use large rates of acidic reagent (300–800%). Like the flow approach, they are all carried out in the liquid phase and all include a significant amount of phosphoric acid. This cyclic method has the advantage of being able to process the selected kind of phosphate raw material with phosphate/sulfuric acid in a single cycle, yielding high-quality double superphosphate.

By processing phosphate raw materials primarily with mineral acids (sulphate, nitric, and phosphate), phosphorus fertilizer with a higher nutritional value is produced. In this article, the effects of phosphorite treatment in an acidic environment on the production of complex and mixed fertilizers are discussed. In addition, a scanning electron microscope was used to examine the surface microstructure.

sciforum-089330: Quantitative Analysis of Vitamins and Amino Acids for Alhagi Maurorum Plant Extract

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This work focuses on the use of high-performance liquid chromatography (HPLC) for the quantitative measurement of vitamins and amino acids found in residue extracts. The goal of the study is to precisely ascertain the quantities of these vital substances in residual samples by utilizing the effectiveness of HPLC. The analytical methodology used in this study offers a reliable way to assess the nutritional value of residues, offering insightful information on their makeup and their uses in a range of disciplines, such as environmental studies, food science, and agriculture. The quantitative analysis results provide a basis for comprehending the chemical composition of the residue, enabling well-informed decision making in both research and industry applications.

Alhagi maurorum is a wild plant that is found in locations with limited water resources. It is a member of the leguminous family. Due to the high value of the vitamins, flavonoids, and amino acids it contains, folk medicine uses it. The initial findings of our scientific investigation on the subject of "Enrichment of food products based on the local Alhagi maurorum plant" are presented in this paper. The plant extract Alhagi maurorum was investigated with high-performance packed-layer liquid chromatography. Amino acids (aspartic acid, glutamic acid, serine, glycine, asparagine, glutamine, cysteine, threonine, argenine, alanine, proline, tyrosine, valine, methionine, isoleucine, leucine, histidine, tryptophan, phenylalanine, and lysine) and vitamin B_2 (riboflavin), B_6 (pyridoxine), and B_9 (folate acid) concentrations in the solution are calculated based on the graphical lines and peaks obtained during the analysis.

sciforum-085574: Recent Advances in Lithium Extraction

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The increasing global demand for lithium, driven by its critical role in battery technology and nuclear applications, necessitates efficient and sustainable extraction methods. Lithium, primarily sourced from brine pools, igneous rocks, and low-grade ores, is extracted through various techniques, including ion exchange, precipitation, electrolysis, and adsorption. This paper reviews the current state of lithium extraction, focusing on the diverse methodologies that are employed to meet the burgeoning demand. Extraction methods exploit the solubilities of salts in brine water, employing techniques like liquid–liquid extraction. Despite their effectiveness, challenges arise from the similar characteristics of lithium and other constituents. Adsorption methods utilize lithium-selective adsorbents, requiring stability and adaptability under varying conditions. Membrane processes, such as electrodialysis and nanofiltration, offer potential for energy-efficient, continuous lithium recovery. Electrochemical processes facilitate lithium intercalation and deintercalation, emphasizing the need for electrode optimization. This review further delves into emerging technologies like electrosorption and ionic pumps, highlighting their roles in lithium recovery. Challenges such as temperature dependency, impurity influence, and initial concentration are discussed, underscoring their impact on lithium recovery efficiency. Finally, the paper identifies research gaps and future directions, emphasizing the need for cost-effective, high-performance electrode materials and systems. It concludes that enhancing lithium recovery and separation techniques, particularly in electrochemical Li extraction, is crucial for sustainable lithium production in response to the global demand.

sciforum-085466: Recent Advances in Membrane Technologies for Biogas Upgrading

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The pressing environmental and energy challenges of today are driven by the depletion of fossil fuels and a surge in greenhouse gas emissions, particularly carbon dioxide. This situation highlights the critical need for sustainable energy solutions. While carbon capture and storage (CCS) technologies offer hope, they face economic challenges at the scale needed to significantly reduce carbon dioxide emissions. Biogas, produced mainly via the anaerobic digestion of various biomass sources like agricultural waste, municipal solid waste, and wastewater, presents a renewable alternative. Composed largely of methane and carbon dioxide, biogas can be upgraded to bio-methane, serving as an eco-friendly replacement for natural gas. Technological advancements, particularly in membrane separation, have made biogas purification more efficient and cost-effective. Anaerobic digestion, a key process in biogas production, breaks down organic matter into simpler compounds, which are then transformed into gases like methane and carbon dioxide. The composition of biogas depends on the feedstock and digestion conditions, with methane being a valuable but challenging component to separate due to its greenhouse gas properties. Several purification technologies have been developed, including absorption, adsorption, cryogenic separation, and membrane separation, each with unique benefits and drawbacks. Membrane separation is particularly promising for its environmental benefits and scalability. However, the biogas industry faces challenges, especially in developing countries, due to high costs and limited research and development. Overcoming these obstacles requires collaboration among various stakeholders. Looking ahead, the future of biogas technology is bright, with advances in membrane materials and integrated refining processes. Integrating biogas into sectors like waste management and agriculture is crucial for its development and for meeting global renewable energy goals. Biogas technology not only reduces dependence on fossil fuels but also plays a vital role in the transition to sustainable energy.

sciforum-085468: Recent Advances in the Colloidal Stability of Nanoparticles

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This paper focuses on the colloidal stability of nanoparticles (NPs), a critical factor in their efficacy and safety in various applications. Nanoparticles, defined as particles with dimensions between 1 and 100 nanometers, exhibit unique physical, chemical, and biological properties due to their increased surface area and quantum effects. These properties have been harnessed in diverse fields, including medicine for therapies, diagnostics, and drug delivery. The colloidal stability of NPs, which determines their behavior in solution, is influenced by their surface chemistry and interactions, such as the adsorption of molecules and directed self-assembly. This paper delves into the colloidal stability of various types of nanoparticles, including polymeric, inorganic, and carbon-based nanoparticles. We explore the stability mechanisms of different nanoparticles like zinc oxide, silver, iron oxide, gold, and diamond nanoparticles in various environments such as in high-ionic-strength mediums. For instance, SDS-modified zinc oxide nanoparticles show improved stability and reduced aggregation compared to their unmodified counterparts. Similarly, gold nanoparticles stabilized with specific ligands demonstrate enhanced colloidal stability. This paper also identifies several research gaps, including the need for long-term stability studies, and an understanding of environmental impacts, the interactions between different NP types, and the influence of solvents and pH on NP stability. This paper underscores the importance of surface modifications and coatings in improving colloidal stability. The colloidal stability of nanoparticles is paramount for their effective application across various domains. Future research directions include developing nanoparticles with precise stability profiles, sustainable synthesis methods, and advanced characterization techniques, and exploring their environmental and health implications. The potential for nanoparticles in medicine, renewable energy, and advanced materials is vast, contingent upon our understanding and manipulation of their colloidal stability.

sciforum-086334: Recent Trends in Azeotropic Mixture Separation

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In chemical and process industries, different techniques are implemented to enable the separation of azeotropic mixtures. These separation methods are broadly classified as azeotropic distillation procedures, which employ the use of an entrainer, and membrane-based processes, which mainly use semi-permeable membrane materials. This paper seeks to examine the current trends employed in separation procedures for azeotropic mixtures in industry, particularly the techniques and methods applied in the actual processes. Additionally, this paper also outlines the common components encountered in the current setups for the separation of azeotropic mixtures. Several studies show that in comparison to conventional separation techniques, the application of alternative distillation methods and advanced membrane-based techniques for the separation of azeotropic mixtures results in a better separation efficiency and a reduced energy consumption while also maintaining the cost-effectiveness of the overall process. In addition to this, advancements in the available techniques for separation would also improve the viability and ensure the long-term sustainability of the proposed developments, addressing the current gaps in knowledge while ensuring that the existing challenges in the procedures, like membrane fouling and limited scalability, are properly addressed. Furthermore, this paper also highlights the outlook in research of the processes involved in the separation of azeotropic mixtures.

sciforum-090249: Recovery of Valuable Metals from Copper Tailings of the III and IV Regions of Chile, through Leaching Processes and the Use of Surfactancts

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Chilean Nuclear Energy Commission

Chile is the world leader in the production of copper. It has the largest stock of copper, with almost 21% of worldwide reserves. Chilean mining exports accounted for 5.4 million MT in 2023, representing more than half of the national export value. Chile's production accounted for 30 percent of the global production in 2023. Chile's national massive mine cadaster shows that the mining industry generated 758 tailing deposits from copper mining operations located in ten regions. They account for 26.3 billion of authorized tonnes of mine tailings. The general geochemical registry of tailing deposits in Chile consists of rock forming minerals, like SiO_2 and Fe_2O_3, and trace elements. The primary goal of any remediation project for mining residues is the recovery of valuable metals, and in this case, Cu and Fe for the Chilean ores. The most difficult task involved in tailing reprocessing is the chemical dissolution of the ores into an aqueous solution, because of the refractory nature of the sulfides against acids. Several attempts have been made to recover valuable metals, proposing possible improvements to be used on the leaching techniques, but none of them have been successful until now. For this reason, we propose to improve the leaching process using surfactant agents to improve the hydrophilicity of mineral and tailing surfaces, by using hydrophilic groups in the leaching of sulfide ores. This will improve the surface wettability of minerals, and enhance the leaching effects.

sciforum-088202: Residual Dewatering Aids in Process Water on the Depressant Adsorption and Zeta Potential of Plagioclase

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The separation of sulfide minerals from non-sulfide gangue minerals using froth flotation necessitates the utilisation of thickeners and filters to dewater concentrates and tailings. To facilitate the dewatering of flotation products, namely, concentrates and tailings, chemical reagents such as flocculants and coagulants are utilised in thickeners to increaseefficacy. However, residual amounts of these chemical reagents can be found in the clear supernatant and filtrate resulting from the dewatering process. Considering that the water recovered from dewatering unit operations is recycled back into milling and flotation, it is crucial to understand how the chemistry of these dewatering chemical agents may impact the behaviour of the pulp phase. Possible interactions may occur at the mineral surface between the flotation reagents, residual flocculants/coagulants, and inorganic electrolytes present in the recovered and recycled process water. Surprisingly, there is a lack of information in the existing literature regarding the influence of flocculants and coagulants on the adsorption of depressants such as carboxy methyl cellulose onto non-sulfide gangue minerals. Therefore, the primary objective of this study was to investigate the impact of flocculants and coagulants on the adsorption of depressants onto non-sulfide gangue minerals using plagioclase as a proxy for the non-sulfide gangue typically present in sulfide mineral flotation. The results from the adsorption and zeta potential studies showed that the presence of a residual coagulant concentration in recycled water was favourable and increased the adsorption of CMC onto plagioclase. However, the presence of a flocculant in recycled water may be detrimental as CMC adsorption onto plagioclase significantly decreased. This implies that sulfide mineral flotation plants which recycle and reuse water from dewatering processes may need to carefully monitor and control residual dewatering aids in recycled water as these species may have a significant bearing on flotation performance.

sciforum-089793: SSynthesis and Characterization of In_2O_3-ZnO Nanostructures via the Precipitation Method

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Nanocomposites, through their synergetic interaction between components, lead to integrated compatible structures, which opens new horizons for their application as materials in the realization of sensors. In_2O_3-ZnO, nanostructures exhibit a large bandgap, high optical transparency, electrical conductivity, uniform surface, chemical and thermal stability in different environments, and excellent photoelectrocatalytic performance, which can be attributed to the enhanced absorption of photons in the visible range and the effective separation of charge carriers at the interface, which makes them interesting for biomedical applications. To obtain these types of materials, the synthesis methods play a fundamental role, influencing the characteristics of the individual components, the bonds formed between them, size, degree of distribution, interface interactions, performance criteria, etc.

In the present paper, for the synthesis of In_2O_3-ZnO composites, the wet chemical method was used, followed by the steps of maturation, aging, and filtration, drying, and, finally, heat-treatment steps. To obtain the desired properties of the synthesized composites, it was ensured that the process parameters (reaction temperature, rate of addition of reactants, concentration, etc.) were precisely controlled, because they have a direct effect on the size and morphology of the particles. Methods for investigating the structure, morphology, and wetting capacity are consistent with the physical–chemical properties. Thus, using SEM, equipped with EDX, the morphology and size of the particles were investigated, and microanalysis of the chemical composition of the composite structures was carried out. FTIR spectroscopy was used for the structural characterization of the samples, indicating the presence of the characteristic In-O and Zn-O bonds, and by means of X-ray diffraction structures of high crystallinity and purity. The study of the wetting capacity highlighted composites with a strong hydrophilic character.

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sciforum-090459: Separation Possibility Evaluation of the Tetrachloromethane–1,2-Dichloroethane–Trichloroethylene Mixture by Extractive Distillation

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One of the most important processes in organic synthesis is the production of vinyl chloride using a balanced method. The reaction mixture formed during the pyrolysis stage of 1,2-dichloroethane (DCE) contains, besides vinyl chloride and unreacted DCE, several by-products, including tetrachloromethane (TCM) and trichloroethylene (TCE). An alternative to the existing method for purifying recycled DCE from impurities may be one that eliminates the chlorination step and is based on extractive distillation (ED) to obtain high-purity DCE. The aim of this study is to find out the potential separating agents for the extractive distillation of the tetrachloromethane–1,2-dichloroethane–trichloroethylene mixture.

We conducted a computational experiment using the Aspen Plus®v.10.0 software package. The Non-Random Two-Liquid (NRTL) equation is used for mathematical modeling of the vapor–liquid equilibrium (VLE).

Based on experimental VLE data, the parameters of the binary interaction of the TCM-DCE-TCE system's components are estimated. The error in describing experimental data was 3%. VLE modeling in the TCM-DCE-TCE system at a pressure of 760 mm Hg revealed that the binary TCM-TCE mixture is characterized by a similar volatility of components, while the TCM-DCE and DCE-TCE systems contain positive azeotropes. The structure of the VLE diagram of the separable system excludes the possibility of complete separation of the TCM-DCE-TCE mixture by conventional distillation. Therefore, special separation methods, such as ED, are necessary. In the search for potential separating agents (SAs), 76 substances used in the chemical industry as solvents and SAs were considered. Substances satisfying the requirements for SAs were selected, and VLE modeling was performed in derivative TCM-DCE-TCE-SA systems. The coefficients of the relative volatility of components in the presence of various SAs and the selectivity of each were calculated.

We noticed some of the most selective SAs are furfural (increases the volatility of TCM relative to DCE and TCE) and toluene (increases the volatility of DCE relative to TCE).

sciforum-090173: Surface Area Enhancement through Electrochemical Oxidation of Ferricyanide at a Carbon Paste Electrode Modified with Zr-Based MOF

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This study investigates the surface area enhancement achieved through the electrochemical oxidation of ferricyanide at a carbon paste electrode (CPE) modified with a Zr-based metal/organic framework (MOF). The utilization of MOFs in electrode modification has gained significant attention due to their unique properties, such as a high surface area, tunable pore size, and excellent stability. In this research, a Zr-based MOF was synthesized and characterized for its structural and morphological properties. The MOF-modified CPE was prepared by incorporating the synthesized MOF into a carbon paste matrix. The electrochemical behavior of ferricyanide at the MOF-modified CPE was investigated using cyclic voltammetry. The results showed an enhanced electrochemical response compared to the unmodified CPE. The increase in the surface area of the MOF resulted in higher analyte accessibility and improved electron transfer kinetics. The electrochemical oxidation of ferricyanide at the MOF-modified CPE exhibited well-defined oxidation peaks with higher current densities and lower peak potentials, indicating enhanced electrocatalytic activity. The enhancement of the surface area achieved through the incorporation of MOFs into electrode materials has significant implications in various electrochemical applications. The reported approach can improve the sensitivity and selectivity of electroanalytical techniques, as well as the performance of energy storage devices, and enable efficient catalysis for different chemical reactions.

sciforum-088648: Synthesis of *N*-Flurbiprofen-Substituted 1,2,3,4-Tetrahydroisoquinolines

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Isoquinoline alkaloids constitute a substantial category of natural products, among which 1,2,3,4-tetrahydroisoquinoline (THIQ) holds significance. THIQ-based compounds, whether natural or synthetic, showcase a wide array of biological activities, demonstrating efficacy against diverse infectious pathogens and neurodegenerative disorders. Consequently, THIQ heterocyclic structures have garnered considerable interest within the scientific realm, driving the exploration and synthesis of novel THIQ derivatives with notable biological potential.

In contrast, flurbiprofen falls under the category of nonsteroidal anti-inflammatory drugs (NSAIDs) and demonstrates both antipyretic and analgesic effects. Its potential extends beyond mere pain relief; it has been suggested for both local and systemic applications, such as inhibiting colon tumor growth and platelet aggregation.

In our research, we focus on synthesizing novel *N*-flurbiprofen-substituted 1,2,3,4-tetrahydroisoquinolines. We explore novel methods for the amide cyclization, investigating the feasibility of utilizing new environmentally friendly reagents. Specifically, we examine the efficacy of strong protic acids that are immobilized on a silica gel as heterogeneous acid catalysts in intramolecular α-amidoalkylation reactions. These acid-supported silica gel systems are pivotal in acid-catalyzed synthetic processes, emerging as preferred options for producing novel organic compounds, aligning with eco-friendly practices. Our interest lies in applying this heterogeneous acid system on a silica gel as a "heterogeneous catalyst" to synthesize isoquinoline derivatives of flurbiprofen and elucidate the relationship between their structure and activity. When investigating the intramolecular α-amidoalkylation reaction, we conduct multiple experiments to determine the ideal reaction conditions. This involves altering solvents and acid reagents while considering the acid-catalyzed nature of the reaction.

The novel compounds were successfully synthesized through an intramolecular α-amidoalkylation reaction. This synthesis method involved heating the reactants at 80 °C in dichloroethane, supplemented with a heterogeneous acid catalyst, PPA/SiO_2. The obtained compounds underwent full spectral characterization using ^{1}H and ^{13}C NMR, IR spectroscopy, and mass analysis.

sciforum-087377: Synthesis of Benzene-1,2,3-triyl tris(2-(2-Hydroxyacetyl)Acetate) and Benzene-1,2,4-triyl tris(2-(2-Hydroxyacetyl)Acetate)

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The potential for triatomic phenols to significantly advance organic chemistry and other domains makes their chloroacetylation and synthesis based on chloroacetyl products relevant. The creation of novel materials, medicines, and specialized compounds is made possible by this variety. Chloroacetylation yields functional groups called chloroacetyls, which can be used as adaptable building blocks for further alterations. It offers a methodical approach to the synthesis of complicated compounds, enhancing the arsenal of tools available to synthetic chemists. Researching novel synthetic routes frequently yields surprising findings and novel ideas. Through the discovery of novel reaction processes, reactivity patterns, and applications, the study of chloroacetylation in the context of triatomic phenols can foster scientific creativity.

In analytical chemistry, phenols and oxycarboxylic acids are employed to identify and measure metal ions. We therefore made the decision to link these two categories of chemicals. With synthesis, a vast array of substances with distinct structures and qualities may be produced.

The syntheses based on the topic "Chloroacetylation of *trihydroxybenzenes* and Syntheses Based on Chloroacetyl Compounds" are described in this article. *O-chloroacetylation reactions were carried out in the presence of trihydroxy-benzenes: benzene-1,2,3-triol, benzene-1,2,4-triol and chloroacetyl chloride.* Benzene-1,2,3-triyl tris(2-chloroacetate) and benzene-1,2,4-triyl tris(2-chloroacetate) were produced as a consequence of the nucleophilic exchange of chlorine atoms. The sodium salt of tartaric acid (sodium (2S,2R)-3-carboxy-2,3-dihydroxypropanoate) was present during the procedure. The solvent that was employed was dimethylformamide. Using contemporary physicochemical techniques, the structure of the substance that was produced as a result of the reaction was examined. Both the reaction's mechanism and methods were examined.

sciforum-090386: Synthesis of Transition Metal Complexes Containing Thiosemicarbazone Ligand and Their Biological Activity

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In the fields of medicinal chemistry and drug development, metals have been shown to be very beneficial. Currently, the main goal of bioinorganic chemistry is the design and synthesis of novel metal-based complexes and metal ion binding substances for the treatment of human diseases. The present paper summarizes the synthesis of transition metal complexes containing thiosemicarbazone ligand and their biological activity. Transition metals and their complexes play an important role in materials chemistry and metal catalysis. These metals are crucial in medicine and pharmaceutical sciences due to their coordination, redox and catalytic properties. Transition metal/TSC complexes have pertinent biological significance. TSCs are one of the important Schiff base ligands formed by the condensation of an aldehyde or ketone and thiosemicarbazide. When combined with metals, they have been shown to be effective antibacterial, antioxidant and anticancer agents. The synthesis of Zn, Co, Fe, Cu, Mn and Cr complexes with Benzaldehyde-N (4)–phenyl SCs have been reported and these complexes are known to exhibit antibacterial activity. Zn and Cu complexes with quinoxaline–TSC ligands were also reported and exhibited antidiabetic activity. Ni and Cu complexes with Cinnamaldehyde and cuminaldehyde thiosemicarbazne are known to exhibit antileukemic activity. The synthesis of Pt and Pd complexes containing 3,5-diacetyl-1,2,4-triazol mono(4-phenylthiosemicarbazone) ligand has been reported, and these complexes are known to exhibit anticancer activity. Cd with 4-benzyloxy-benzaldehyde-4-methyl-3-thiosemicarbazone (BBMTSC) has also been reported to exhibit anticancer activity. Over the past decade, the literature was examined and taken from prominent indexing databases to investigate the synthesis of transition metal complexes using thiosemicarbazone ligands. Transition metal/TSC complexes open new opportunities for future interdisciplinary studies and research aimed at comprehending the biochemistry of these complexes.

sciforum-089525: The Effect of Deposition Cycles on the Morphological Properties of Bismuth Ferrite Nanostructured Thin Films

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Bismuth ferrite ($BiFeO_3$, abbreviated as BFO) has great potential for environmental applications. It performs well in the remediation of pollutants from the environment, for example as a toxic gas sensor or a photocatalyst for the degradation of dyes. Moreover, it presents a strong photovoltaic effect [1,2]. The topography and surface area of a material significantly affect its properties. Thus, it is of significance to study the surface characteristics of the material.

In this work, we prepared a set of pure BFO nanostructred films deposited on glass via the spin-coating-assisted sol–gel method, using bismuth nitrate pentahydrate ($Bi(NO_3)_3{\cdot}5H_2O$) and iron nitrate nonahydrate ($Fe(NO_3)_3{\cdot}9H_2O$) as starting materials and ethylene glycol as solvent, with a different number of deposition cycles in order to investigate its effect on morphological properties.

The atomic force microscopy AFM confirmed this effect, and showed that the root mean square (Rq) of the surface roughness increases after increasing the number of cycles (from 3 to 10 cycles) reaching a value of $\approx$6 nm. Based on AFM surface topography maps, we found that the median grain sizes also increase from $\approx$35 nm to $\approx$55 nm. However, both the dislocation density and the specific surface area (SSA) decrease.

This showed that the sample with a higher number of cycles exhibits the highest median grain size and surface roughness value, as well as the lowest dislocation density and specific surface area. These results are important in order to identify the optimum layer number needed for the formation of BFO thin films exhibiting an improved SSA, which plays a key role in gas sensing.

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sciforum-080574: The Effect of Metal Halides and Metal Chalcogenides, such as Iron Chloride, Cobalt Chloride, and Bismuth Telluride, on the Morphology and Electronic Properties of Single-Walled Carbon Nanotubes

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The loading of single-walled carbon nanotubes (SWCNTs) is very important for applications. Loading methods include loading from the gas phase, as well as the liquid phase—melted compounds and solutions. It was demonstrated that the incorporated substances form new, interesting properties and phases inside SWCNTs. Spectroscopic techniques, such as Raman spectroscopy, X-ray photoelectron spectroscopy (XPS), optical absorption spectroscopy (OAS), and near-edge X-ray absorption fine structure spectroscopy (NEXAFS), were utilized. It was shown that the incorporated substances may cause the p- and n-doping of the SWCNTs. I have encapsulated new compounds, such as iron chloride ($FeCl_2$), cobalt chloride ($CoCl_2$), and bismuth telluride (Bi_2Te_3), inside SWCNTs. The loading was investigated by high-resolution transmission electron microscopy (HRTEM), and it was proven that the interior space within the SWCNT walls was loaded. The incorporated substances formed crystalline phases inside the SWCNTs. The spectroscopic investigations showed that iron chloride and cobalt chloride led to p-doping of the SWCNTs. This was observed as the changes in the shapes of the Raman modes, shifts in the C 1s XPS on the lower-binding-energy side, the appearance of additional peaks in the C 1s NEXAFS, and the disappearance of peaks in the OAS spectra.

sciforum-088983: Two-Phase Electrocoagulation with Organic Medium and Electrolyte System for Volatile Compound Profile Identification in Commercialized Perfume

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An Electrocoagulation (EC) approach was developed utilizing two aluminum electrodes and a two-phase medium consisting of an aqueous solution of electrolyte and hexane (referred to as two-phase-EC). This method facilitated the electrochemical treatment of odor-active compounds present in commercialized perfume extracts. The samples, both before and after two-phase-EC treatment between the two electrodes, after the reaction was left for equilibrium as post-treatment, were analyzed using headspace-solid-phase microextraction (HS-SPME) coupled with multipurpose auto sampler, gas chromatography–mass spectrometry (GC-MS). This analytical approach allowed for the identification of volatile compound profiles in each sample by comparing them with mass spectra and the retention index of the National Institute of Standards and Technology (NIST) library database.

The post-treatment of the perfumes exhibited volatile compound profiles through the two-phase electrolyte system, which was demonstrated to alter the odor characteristics of perfumes, resulting in fresher, sweeter, and more floral smells, with the lower characteristics of woody, green, leathery waxy smells, corresponding to variations in the types and quantities of odor-active compounds.

Major odor-active products, obtained primarily at the 2-phase-EC system, included benzaldehyde, methyl benzoate, 2-phenylethanol, limonene and phenylmethanol, which were the corresponding products after the EC reaction with the range of chromatogram area percentage of 1.3 ± 0.6 to 2.4 ± 2. The investigation also revealed the enrichment of several compounds at each cathode and anode electrode without undergoing electrochemical reactions, such as linalool and ethyl benzoate.

This two-phase-EC approach, combined with the analytical methodology, shows promise for future applications in the field of electrochemical reactions in organic media.

sciforum-090155: Utilizing Deep Eutectic Solvents to Extract Polyphenols from Green Coffee

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Deep eutectic solvents (DESs) offer a reliable and environmentally friendly method for extracting polyphenols from medicinal plants, which are known for their health benefits. Traditional extraction methods can be expensive and involve hazardous solvents. Choline chloride-based DES formulations are commonly used. However, acetylcholine, a derivative of choline, has received little attention. Therefore, our current study explores the potential of acetylcholine-based DESs for extracting polyphenols from green coffee. To achieve this, we synthesized a DES comprising acetylcholine chloride and citric acid in a 1:1 ratio (ACCH:CA = 1:1) using ultrasound and microwave radiation.

To reduce the high viscosity, 20% water was added to the total mass of the deep eutectic solvents (DESs). Both variants of DESs were then utilized in ultrasonic extraction processes to extract polyphenols from green coffee at a bath temperature of 50 °C. The polyphenolic content of the green coffee extracts was analyzed using HPLC-PDA. To assess the efficiency of polyphenol extraction using DESs, a standard extract was prepared using 70% methanol. The analysis revealed the presence of caffeoylquinic acids (CQAs), including mono-CQA, di-CQA, and feruloylquinic acid (FQA), in the green coffee samples. The results showed that DESs synthesized via microwave radiation extracted higher amounts of polyphenols from green coffee compared to those obtained through ultrasound. The extraction yields using DESs with an ACCH:CA ratio of 1:1 ranged from 50% to 85%, while ultrasound-derived DESs resulted in yields of approximately 30% to 75%. These findings highlight the effectiveness of an acetylcholine-based DES as a natural solvent for extracting health-promoting bioactive components. Moreover, the method of DES synthesis significantly impacts its performance.

sciforum-088050: The Effect of a Hardener on the Characteristics of a Polyester-Based Coating

Irina Vikhareva

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Coatings based on polyester resins are a sought-after material and, when cured, have high hardness, wear resistance, and no toxic emissions during operation.

The variety of compositions and structures of saturated polyester resins contributes to the use of a wide range of materials in their production. Monomers for polyesters can be obtained from renewable raw materials, which are promising as sustainable materials.

As a result of combining polyester resins with blocked polyisocyanate resins, epoxy resins, and siloxane resins, materials with excellent properties can be obtained.

Polyester with sebacic acid, ethylene glycol, and glycerin was obtained under acid catalysis by polycondensation. After isolation, the ester was a paraffin-like mass of light gray color. The main characteristics of the polyester were studied: the acid number (mg KOH per 1 g of polyester) was 10, the mass fraction of hydroxyl groups (%) was 7.1, and the mass fraction of water (%) was 0.1. The structure of the polyester was confirmed by IR spectroscopy: there was a wide absorption band with a characteristic peak for the OH group in the region of 3450 cm^{-1}.

Then, in order to develop cold-cured polymer coatings with high adhesion and increased weather resistance and water resistance, compositions based on the resulting polyester and epoxy resin were compiled. Several amine compounds were tested as hardeners: polyethylene polyamine; a polyamide hardener—the product of the interaction of the polymerized fatty acids of vegetable oils and polyethylene polyamines; and aliphatic amine—the product of the interaction of phenol and ethylenediamine in formaldehyde. As a result of the experiments, a coating formulation was determined that has high physical and mechanical characteristics and increased water resistance and adhesion. The tested amines exhibit different curing rates of the compounds, which are determined by the purpose of the composition.

Abstracts

Session E. Process Control and Monitoring

sciforum-090007: Enhancing Process Control through Collaborative Filtering in Product Recommendation Systems

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Context

In an online marketing scenario, there are a lot of choices to select from for any user. So, the need for a recommender system is increasing, as this can help the customers shop on these e-commerce websites. This recommender system uses different algorithms to analyze customers' behavior and interests, which can be used with the historical data of purchases of products to personalize the product suggestions for individual customers.

Objective

The objective of this article is to develop an efficient recommendation system that caters to the needs of the customers and provides them with a unique and personalized experience on the e-commerce platform. This project aims to suggest relevant products to the customers based on their past interactions and interests and the behaviors of similar customers. This project seeks to improve the customers' satisfaction and loyalty towards the e-commerce platform through this unique and personalized experience.

Materials/Methods

In this article, we have used collaborative filtering algorithms and content-based filtering techniques to recommend the product, as well as proposed a hybrid algorithm which is a combination of Apriori and FP-Growth. Apart from these, we also used the machine learning algorithm to improve the recommendation accuracy.

Conclusions

After the implementation of the Apriori and FP-Growth algorithms in the recommender system, it was found that the FP-Growth algorithm has better support for the frequent item sets from the data. A hybrid of the two algorithms can give better support. This enables the model to offer accurate suggestions according to historical data. This approach can cater to the diverse needs of the customers and offer them a personalized experience on an e-commerce website.

sciforum-090279: A Mechanism to Detect Food Safety Threats Using IoT and C-LSTM: An Enhanced Approach for Farmwork

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This research aims to explore the potential of machine learning techniques in enhancing the productivity of high-quality food products. By integrating machine learning algorithms into food production processes, this study seeks to optimize efficiency, minimize waste, and improve the overall quality of food items. Through the utilization of predictive analytics, anomaly detection, and optimization algorithms, the research endeavors to enhance production output, reduce costs, and meet the demands of consumers for premium food products. The incorporation of machine learning in food manufacturing holds promise for transforming production practices, ensuring consistency in product quality, and fostering innovation within the industry.

The proposed system utilizes a diverse range of sensors and Internet of Things (IoT) devices to monitor the entire food supply chain, from the farm to the consumer′s plate. These sensors collect various data elements, such as temperature, humidity, and other environmental conditions that may impact the quality and safety of the food. Subsequently, this gathered information is fed into a Convolutional Long Short-Term Memory (Convolutional-LSTM) machine learning model, which employs multiple algorithms to analyze the data and identify any potential threats to food safety. Moreover, the model has the capability to predict the likelihood of food contamination and spoilage based on various criteria, including temperature, duration, and storage conditions. In times of a pandemic, this proposed system could aid food safety authorities in promptly recognizing and responding to any threats to food safety, thereby safeguarding the integrity of the food supply chain and upholding its high standard of quality.

sciforum-089963: Applying Machine Learning for Sustainable Farm Management: Integrating Crop Recommendations and Disease Identification into Process Control and Monitoring

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Context

The integration of machine learning into sustainable agriculture holds immense potential for addressing the challenges faced by modern farming practices. By combining techniques for crop recommendations and disease identification, farmers can make informed decisions that not only enhance productivity but also minimize the impact of crop diseases on agricultural output.

Objective

This article aims to present a unified approach for recommending crop systems and identifying plant diseases in agricultural settings. By leveraging machine learning algorithms, the objective is to provide farmers with accurate recommendations for optimal crop selection and the timely identification of plant diseases.

Materials/Methods

Data collection for this study was facilitated using IoT sensors, including NPK sensors, DT11 sensors, and other environmental sensors, providing essential information on soil nutrients, temperature, humidity, and other environmental factors crucial for crop selection. Novel machine learning and deep learning algorithms were employed to recommend suitable crops and identify relevant plant diseases. For disease identification, real-time data from IoT sensors and high-resolution images captured by cameras were utilized. State-of-the-art convolutional neural networks (CNNs), including VGG16, ResNet50, and EfficientNetV2, were employed to accurately classify plant diseases based on visual cues such as leaf color and texture.

Results

Experimental results demonstrate that the efficacy of the proposed recommendation system utilizing CNN achieved an accuracy of 99.98%. The disease identification system, CNN, achieved a commendable accuracy of 96.06%. Subsequently, it was further deployed on cloud infrastructure, ensuring scalability and accessibility. Performance metrics such as accuracy, precision, recall, F1 Score, and AUC-ROC were used to evaluate the models' performance, with CNN exhibiting an accuracy of around 99.98%.

Conclusions

This research contributes to the advancement of sustainable farm management practices. The adoption of machine learning techniques empowers farmers to make data-driven decisions, optimize crop selection, and mitigate the impact of crop diseases, ultimately leading to improved agricultural productivity and sustainability.

sciforum-089869: Automated Extraction of Geographic Locations from Natural Language Text: Implications for Process Control and Mechanism

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Context

Natural Language Processing (NLP) techniques, along with database management tools and fuzzy string-matching libraries, play a pivotal role in automating the extraction of geographic locations from textual data. They can be applied in various fields such as geographic information systems and data mining, facilitating efficient data analysis and decision-making.

Objective

This article presents a comprehensive approach for the automated extraction of geographic locations from natural language text. The primary objective is to utilize NLP techniques, including Named Entity Recognition, in conjunction with database management, using SQLite3 and fuzzy string matching with the FuzzyWuzzy library, to accurately identify and extract place names from textual data. Additionally, this study aims to investigate this approach in decision-making processes.

Methods

Our methodology integrates NLP techniques, SQLite3 for database management, and the FuzzyWuzzy library for fuzzy string matching. Initially, NLP techniques, particularly NER, are employed to identify potential place names within the text. Subsequently, the identified entities are stored and managed in a SQLite3 database, enabling efficient retrieval and organization of geographic information. Finally, the FuzzyWuzzy library is utilized for fuzzy string matching to ensure accurate matching of extracted entities with known geographic locations.

Results

Our approach has been validated against existing datasets and benchmarks, demonstrating high accuracy and precision in geographic location extraction. Performance metrics such as precision, recall, and F1 score have been calculated to assess the effectiveness of our method. The methodology has shown promising results, achieving robust performance in identifying and extracting place names from textual data.

Conclusions

The automated extraction of geographic locations from natural language text holds significant implications for various sectors, including geographic information systems, travel planning, urban development, and disaster response. By streamlining workflows and improving the accuracy of geographic data analysis, our methodology contributes to enhancing decision-making processes and improving the efficiency of tasks reliant on geographic information.

sciforum-090214: Comprehensive Analysis of Maternal and Newborn Health: Factors, Risks, and Interventions

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Context

Pregnancy represents a critical period in a woman's life, where her health significantly impacts the well-being of both herself and her newborn baby. This abstract summarizes a comprehensive analysis of the health status of pregnant women and newborn babies, aiming to identify key factors influencing maternal and newborn health outcomes.

Objective

The main objective of our project is to determine whether a newborn baby is safe or not by diagnosing the health of the mother by examining important features such as Age, Systolic BP, Diastolic BP, Body Temperature, and Heart Rate, along with the Risk Level, according to health records based on previous patients. Early detection of diseases to enable timely interventions and improve treatment outcomes; accurate risk assessment for individuals based on medical history and lifestyle factors; and personalized strategies and treatment plans for individuals based on reports are important. Breastfeeding: The analysis will discuss the numerous benefits of breastfeeding for both mother and baby, including the improved infant immunity and reduced risk of chronic diseases. Strategies for promoting and supporting breastfeeding will be explored. The impact of postpartum depression on both mothers and newborns will be addressed. The importance of mental health screening and providing mothers with the necessary support will be emphasized.

Materials and Methods

In this article, we have used statistical analysis techniques to analyze the collected data. Machine learning algorithms were utilized to identify patterns and relationships between maternal health factors and newborn outcomes. Feature selection methods were applied to determine the most significant predictors of maternal and newborn health.

Conclusions

This comprehensive analysis sheds light on the critical factors influencing maternal and newborn health outcomes during pregnancy. Promoting and supporting breastfeeding emerge as crucial strategies for enhancing the health and well-being of both mother and baby.

sciforum-089582: Data Mining Approach for Early Student Performance Prediction Using Machine Learning: Process Control and Mechanism

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Context

Our research activities aim to bridge the gap between traditional process/system-related fields and the innovative application of process systems engineering principles in education through the lens of data mining. By leveraging machine learning techniques, particularly in early student performance prediction, we aim to showcase the relevance and potential of process control and mechanisms in optimizing educational systems. Specifically, our study demonstrates how concepts such as feature selection, model evaluation, and performance metrics, commonly used in process systems engineering, can be applied to educational data mining.

Objective

Our objective is to demonstrate the significance and possibilities of process management and mechanisms in enhancing educational systems through the utilization of machine learning techniques, specifically in the early student performance prediction domain. We focus on early student performance prediction using machine learning and aim to show how ideas from process systems engineering, such as feature selection, model assessment, and performance metrics, may be effectively applied in educational data mining.

Materials and Methods

Using a data mining technique, our research presents a cross-disciplinary examination of the use of process control and mechanisms in education. Our work emphasizes the applicability of process systems engineering principles across several domains, such as chemistry, biology, materials science, energy, environmental science, food technology, and engineering. Our extensive dataset includes student performance scores over several semesters. Through meticulous feature selection and rigorous evaluation methods, we obtained promising results, including an accuracy of 99% and an R-squared value of 1.00.

Conclusions

Our interdisciplinary approach offers valuable insights into the current state, challenges, and opportunities within both educational research and process systems engineering. By showcasing the cross-disciplinary implications of our work, we aim to contribute to the advancement of process systems' engineering principles in diverse domains, including education.

sciforum-085871: Design of Fuzzy Type-1 and Interval Type-2 Fuzzy-Based Harmonic Search Optimization Algorithms for Uncertain Systems: Fault-Tolerant Control Utilization

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Dharmsinh Desai University

The purpose of this study is to enhance the efficacy of the harmonic search (HS) algorithm with dynamically changing evolutionary optimization method parameters utilizing fuzzy type-1 (FT1) and interval type-2 fuzzy systems (IT2FS). We previously examined both types of fuzzy schemes in a number of benchmark tasks and determined that combining the fuzzy logic scheme with the harmonic search method gives a prominent outcome. Many of the scientific research studies clearly show that the proposed method outperforms other algorithms statistically. In this example, the harmony memory (HMR) variable is dynamically adjusted throughout the evolution procedure using FT1 and IT2FS. The primary contribution of this work is the ability to determine the two forms of the fuzzy inference scheme used in the harmonic search approach, which delivers superior consequences via experimentation in a benchmark control problem. This is because there has been no previous research that uses and compares type-1 and interval type-2 fuzzy systems. Additionally, three types of uncertainty are used to assess the performance of both fuzzy systems in the standard coupled tank-level control system, which simulated the perturbation that may exist in reality and thus permitted statistical verification if there were significant variances among FT1 and IT2FS. The statistical results were produced and compared with other recent techniques and found that the proposed fuzzy-based technique gives superior performance under perturbation.

sciforum-090471: Detecting Epileptic Seizures by Analyzing Brain Waves with Long Short-Term Memory Networks

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Estimations indicate that epilepsy is a disorder affecting over 50 million people worldwide, according to the World Health Organization (WHO). Electroencephalogram (EEG)-based seizure classification not only aids in diagnostics but also greatly contributes to epileptic management. However, the task of feature extraction and classification is the most challenging, specifically in detecting seizure periods (ictal) and non-seizure periods (interictal). This paper is devoted to exploring the effects of seizures on brain waves at different ranges of frequencies, including alpha, beta, delta, theta, and gamma. By applying a Finite Impulse Response (FIR) filter followed by an Independent Component Analysis (ICA) algorithm, we ensure that all the extracted features are independent, facilitating the classification of clinical disorders using Long Short-Term Memory (LSTM). The proposed diagnostic system yields promising results, with an average class accuracy interval ranging from 96.65% to 99.69% for the MIT dataset. Additionally, the mean squared error (MSE) value is recorded as 0.0057, indicating the superior performance of our model, while the signal-to-noise ratio (SNR) measures 18.78 dB, indicating a relatively strong signal-to-noise ratio. This research sheds light on the intricate dynamics of EEG signals during epileptic seizures, offering insights into the development of effective classification methodologies for improved epilepsy diagnosis and treatment. Notably, the features utilized in our study include EEG signals encompassing various frequency ranges, and our classification model aims to distinguish between seizure and non-seizure periods, comprising two output classes for effective seizure detection.

sciforum-090207: Integrating Machine Learning for Process Control in Object Detection and Sampling within the Defense Sector

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Context

Object detection and sampling projects in the defense sector employ modern technologies to detect and identify various objects, including vehicles, weapons, and personnel. These initiatives are integral to enhancing surveillance, reconnaissance, force protection, border security, and asset protection measures. By integrating advanced sensors, cameras, artificial intelligence, and data analytics, these projects provide real-time insights and actionable intelligence to defense and security personnel, thus improving situational awareness and operational effectiveness in diverse environments.

Objective

The objectives of the proposed system are to differentiate between our soldiers and enemy soldiers in a close combat situation by implementing a sensor or chipset in our soldiers headset/war helmet; to detect the enemy soldiers and shoot them down only via a drone equipped with weapons; to prevent casualties of our soldiers or friendly persons/objects; and to prevent mass destruction by harming only the needed area/enemy.

Materials and Methods

Utilization of YOLOv5 Model for object detection; implementation of Centroid Tracking for object tracking; integration of OpenCV and Numpy for image processing and analysis; and development of a Tracker Class for efficient object tracking.

Results and Performance Metrics

The object detection and sampling system achieved significant performance metrics, including high detection accuracy, rapid processing speed, and robust operation in varied environmental conditions. The system demonstrated a detection accuracy of [95%+], with an average processing speed of [less than 0.5 s]. Furthermore, it exhibited resilience in challenging environments such as low-light conditions, adverse weather, and cluttered backgrounds. Comparison with Current Systems: In comparison with existing object detection and tracking systems utilized in the defense sector, our system showcases notable advancements and improvements. Detection range: Depends upon the camera vision and quality (as far as the camera can see).

Accuracy

Depends upon the camera stability (More than 95%). Differentiation: By implementing a sensor or chipset in the helmet of our soldier, it can classify between our soldiers and enemy soldiers, and will also be able to only shoot down the enemy soldiers in a close combat situation via drone technology (it will require a high level of coding and equipment).

sciforum-089975: Integrating Machine Learning for Process Monitoring and Control in Wearable Health Analysis

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Context

This research project aims to analyze valuable data gathered from wearable devices like fitness trackers and smartwatches. We are specifically interested in personal attributes like age, body mass index (BMI), and everyday activities tracked by these devices.

Objective

The main objective of this article is to know the health conditions of a person using wearable devices like smartwatches.

Material/Method

Initially, we collected data from Apple Watch and Fitbit data, which had 6400 records. We employed advanced computer algorithms (logistic regression, KNN, SVC, Random Forest) to uncover patterns hidden within the health data. By linking various health factors, we gained insights into how they impact your well-being. Our approach encompasses all aspects of your health to paint a comprehensive picture, unlike fragmented views that focus solely on isolated data points. We have created a user-friendly tool that combines collected health data and offers practical advice. Finally, our proposed model recommends personalized health advice based on the data inside it, which it analyzes properly. Among all the classifiers, SVC outperformed the others with 98.12% accuracy.

Conclusions

This article aims to enhance our health awareness through machine learning. It offers personalized insights and actionable guidance based on your health data, empowering you to make informed lifestyle choices and prioritize preventive care. Our system evaluates your health status as “healthy”, “healthy but with scope for improvement”, or “requiring medical attention”, providing tailored recommendations for optimal health outcomes. Our experimental work shows that the SVC classifier outperforms the others, i.e., with 98.12% accuracy.

sciforum-086794: Integration of IoT and Machine Learning for Real-time Monitoring and Control of Heart Disease Patients

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Context

In the 21st century, the integration of IoT and AI plays a vital role in the real-time monitoring and control of heart disease. As per the records, cardiovascular diseases persist as a significant global health challenge, impacting the lives of over half a billion individuals worldwide.

Objective

The main objective of this paper is to predict heart disease using deep learning techniques.

Materials/Methods

We have considered the performance metrics of deep learning algorithms (Artificial Neural Networks (ANNs), Long Short-Term Memory (LSTM), Multilayer Perceptron (MLP), and Convolutional Neural Networks (CNNs)) achieving accurate and efficient monitoring outcomes through accuracy, precision, recall, and F-measure. We have proposed one model that uses a deep learning algorithm.

Results

Our experimental result reveals that the deep learning algorithm CNN outperforms in comparison to other algorithms and it has achieved 96% accuracy. Another algorithm, ANN, achieved 92% accuracy indicating a balanced precision–recall tradeoff. We further compared our work with the state of the art, and CNN provides a promising result.

Comparison of the proposed work with existing state-of-the-art approaches.

Conclusions

We have collected the IoT sensory data from different patients and integrated them with the machine learning algorithms for real-time monitoring and control for heart disease patients. Our integration approach reveals that CNN is the best classifier that handles multidimensional data.

sciforum-090068: Leveraging Machine Learning for Process Monitoring in Environmental Impact Tracking

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Context

The Environmental Impact Tracker is an application designed in such a way that it will monitor and visualize the data of an individual or an organization that will help them to know about their day-to-day activities that create an impact on the environment. This will elevate individuals and organizations to make and take informed decisions that promote sustainability.

Objective

Traditional methods of environmental monitoring can be time-consuming, resource-intensive, and limited in scope. Therefore, to effectively address these complex problems, we need accurate and efficient methods to assess and track environmental impact. In simple words, we will analyze data from different sources and quantify the environmental impact of human activities or an organization.

Materials and Methods

Starting from the collection of the data from the various sources and after collecting the data, we will clean the data and make it suitable for ML algorithms. Then, different types of learning algorithms based on their purposes will be tested on the prepared data, for example, regression algorithms like linear and random forest regression, classification algorithms like SVMs and random forest classifications, clustering algorithms like K-Mean and Hierarchical Clustering and CNNs; these algorithms will identify the relation between the activities and environmental parameters. The trained model will identify the trends in environmental data and predict future impacts based on current activities and trends.

Conclusions

This project uses the power of machine learning to create a complete system to keep an eye on our environment. It helps common people, organizations, and the government understand the impact of their actions on the environment. This allows us to make decisions that are good for the environment, prevent problems before they arise, and choose the right ways to move forward. This project shows that as we progress, we can also use technology to protect the environment.

sciforum-089979: Machine Learning-Enabled Process Control and Monitoring for Deepfake Recognition Systems

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Context

Deepfake technology has rapidly evolved, generating hyper-realistic videos and audio recordings that are often impossible to differentiate from genuine content. Deep learning is a type of computer learning where machines are trained to recognize patterns in data, like images or videos. It is like teaching a computer to see and understand what is real and what is fake in videos or images. In a Deepfake Recognition System, deep learning helps the system to learn and identify the differences between real and fake images and videos by analyzing lots of examples. It is like giving the computer lots of examples of real and fake data so that it can learn what to look for and tell them apart. Deep learning is important for detecting deepfake data because it allows the system to learn from lots of data and become better at spotting fake content, helping to protect people from being tricked or misled by manipulated videos online.

Objective

The primary goal of a Deepfake Recognition system is to preserve the authenticity and trustworthiness of digital content. By accurately identifying manipulated content, these systems help keep people safe from lies and tricks online. It also makes sure that what we see on the internet is true so that we can trust it more.

Materials and Methods

In this article, we have used machine learning and deep learning techniques to detect the deepfake images. Apart from this, we have also used MTCNN, Facenet_pytroch and InceptionResnetV1.

Conclusions

In conclusion, the Deepfake Recognition System is a valuable tool that helps keep the internet safe by identifying fake content. These videos or images, called deepfakes, look real but are actually made using special technology to manipulate images and sounds.

sciforum-087471: Modeling and Control of Hydrogen Production Systems through Water Electrolysis and Res Power

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The increased consumption of fossil fuels has led to scientific interest in establishing a hydrogen-based infrastructure. Currently, there are different electrolysis technologies for H_2 production: (i) PEM, (ii) alkaline (AFC) and (iii) solid oxide (SOEC). PEM electrolysis uses a hydrated polymer membrane, with an operating temperature window of 45–85 °C and reaching power capacities of >500 kWs. AFC electrolysis uses a caustic solution as an electrolyte with operating temperatures in the range of 65–220 °C and can also reach high power capacities. Finally, SOEC units use a ceramic electrolyte with an operating temperature of 600–1000 °C and power capacities that can reach several MWs (including thermal exploitation). In terms of costs, PEM and AFC are currently the most economical and flexible solutions.

The aim of this study is the dynamic modeling and control of an electrolysis system. The modeling module is based on submodels that use a combination of electrochemical, thermal, and mass transport equations to fully describe the system operation (see Figure 1). The electrical model takes as input the electrolyzer temperature and the applied current for the voltage calculation. In the mass transfer model, the molar flows/concentrations of water, hydrogen and air (oxygen and nitrogen) are based on the provided electric current. Finally, the thermal model simulates the dynamics of heat and temperature variations as it is provided by the V-I electric model and the applied cooling utilities.

Feedback controllers will be designed for the (a) regulation of the hydrogen production by manipulating the applied electric current and (b) regulation of the temperature by the manipulation of a coolant flowrate. Conventional P/PI/PID controllers, model-based controllers and optimal controllers are evaluated towards enhanced disturbance rejection and set-point tracking. Performance criteria such as ISE, IAE, ITAE and ITSE will be evaluated for the best controller selection, also based on low power consumption and high efficiency.

sciforum-090481: Process Control and Monitoring in Social Network Analysis: Leveraging Insights for Enhanced Connectivity

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Context

Social networks serve as valuable platforms for studying human interactions and social dynamics. This project conducts an in-depth analysis of an educational system, focusing on the structure of friendships within our class and the dynamics of information propagation.

Objective

The primary objective is to introduce the fundamentals of network analysis, particularly emphasizing the basics of drawing a network diagram. This includes understanding the significance of network analysis, its applications, limitations, and terminologies, along with the rules and traditions associated with drawing network diagrams.

Materials/Methods

This study deals with a large and intricate dataset comprising 330 rows and 2 columns, representing connections between entities. Each edge is represented by a new row, with 'start name' and 'end name' columns. The dataset contains 328 edges and 102 nodes, illustrating a complex network structure that may be challenging to interpret. To simplify the analysis of complex social networks, the dataset was divided into smaller subsets, each containing 10 rows, to facilitate easier comprehension of relationships. By breaking down the dataset, users can navigate and interpret the social network more effectively.

Result

Two algorithms, namely the Random Layout Algorithm and the Spring Layout Algorithm, were employed to visualize the graph of the network. Additionally, Centrality Measure and Clustering Algorithms were utilized to identify correlations betweennetworks. After applying the Random Layout and Spring Layout Algorithms to visualize the network graph, it was observed that the division of the dataset into smaller subsets significantly enhanced the interpretability of the relationships between nodes. This result demonstrates the practical utility of the proposed method in facilitating effective navigation and interpretation of complex social networks, thereby contributing to enhanced connectivity and communication within educational environments.

sciforum-090484: Process Monitoring and Control in Dermatological Diagnosis: A Deep Learning Approach Using Python, NumPy, Pandas, Keras, and TensorFlow

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Context

This paper delves into integrating machine learning techniques into dermatological diagnostics, specifically focusing on identifying and evaluating skin diseases. The aim is to revolutionize dermatology by leveraging AI algorithms and image recognition methods to enhance the accuracy and efficiency of dermatological analysis, ultimately improving patient outcomes.

Objective

The primary goal of this article is to develop an AI-driven tool for rapid and precise skin condition diagnostics. By harnessing machine learning and image analysis, we aim to redefine dermatological diagnostics and enhance patient care.

Materials/Methods

Using the HAM10000 dataset comprising 10,000 dermatoscopic images of various skin lesions, we employed a pre-trained convolutional neural network (CNN) model, refined through transfer learning. Data preprocessing involved normalization and scaling, with model training conducted using Keras with a TensorFlow backend. Evaluation metrics like F1 score, recall, accuracy, and precision were used. An intuitive online interface facilitated seamless image input, and robustness testing was performed through validation using unseen data. The entire process adhered to dermatological and machine learning best practices, ensuring accurate disease classification.

Conclusions

In summary, this skin detection and analysis project holds promising prospects for dermatological experts and individuals alike, signifying a significant advancement in dermatological diagnosis. Leveraging AI and image recognition technology, this innovation has the potential to revolutionize skin health assessment and treatment, leading to improved healthcare outcomes. Through continuous research and development, it can empower individuals to take proactive measures for their skin health.

sciforum-090479: Production Process of Eco-Friendly Building Material Units: An Application of the Circular Economy Concept

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The environmental impact of resource utilization has been identified as one of the most significant challenges facing society in the past few decades. With the increase in global population, the utilization of plastic material has a direct impact on waste production and the environment. However, the utilization of waste materials as construction materials has a significant positive impact in the construction industry. This study explores the use of melted plastic waste and sand in the production of sustainable masonry bricks. The product was developed in the form of small blocks connected in layers. Moulds were prepared in the form of brick block patterns, and these blocks could be interlocked to develop structural units. The produced bricks were tested for various bonding and compressive strength parameters. The results revealed that the manufacturing of sustainable masonry bricks using plastic waste and sand resulted in a good-quality block unit. It had a bond shear strength of 2.59 MPa and a compressive strength of 11.23 MPa, and was compatible with existing brick masonry units. This study demonstrated a practical strategy to convert plastic waste into eco-friendly building material units.

sciforum-080575: Spectroscopy Insight in the Nickel Catalyst State in Carbon Nanotube Growth inside Metallic Single-Walled Carbon Nanotubes

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The catalyst state in carbon nanotube growth can be caused by metal or metal carbide. It is important to investigate the chemical state of catalysts. The applications of carbon nanotubes (CNTs) require detailed investigations of the structures and properties of catalysts. A novel factor of this work is that the chemical and physical properties of nickel catalysts in the growth of single-walled carbon nanotubes (SWCNTs) inside metallic SWCNTs were investigated. The difference to other works is that metallicity-sorted metallic SWCNTs were used as templates. The growth of carbon nanotubes was monitored in the outer template metallic SWCNTs where metallocenes served as catalysts and sources of carbon. This system provided as best as possible control over the synthesis conditions, and the processes of metallocene catalyst decomposition and metal carbide/metal formation were traced by X-ray photoelectron spectroscopy (XPS). This paper found that the positions of Ni 2p XPS were tracked after heating metallocene-filled metallic SWCNTs. All states of nickel were studied in detail with increasing annealing temperature. We found that chemical reactions of molecules, metal carbides, and metals occurred inside metallic SWCNTs upon heating. First, at low annealing temperatures, metastable nickel carbides were formed. Second, at higher annealing temperatures, nickel carbides were transited into metallic nickel. Third, at high annealing temperatures, nickel was removed from SWCNTs.

sciforum-090212: Utilizing Machine Learning for Language Prediction and Text Emotion Analysis

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Context

In this study, we developed a robust model for the classification of user input text data into language and emotion classes. Language and emotion classification are pivotal tasks in various domains.

Objective

Our objective was to precisely categorize text data into specific language and emotion classes using supervised learning algorithms.

Methods

For language classification, we employed the Multinomial Naive Bayes (NB) algorithm due to its effectiveness in multi-class classification. This algorithm outperformed other classifiers such as Support Vector Machine (SVM) and Random Forest Classifier, particularly in handling large and sparse feature spaces inherent in text data.

For emotion classification, we utilized a Neural Network Model, specifically a Sequential Model, known for its efficiency in capturing complex patterns in textual data, thereby enabling granular emotion classification. By leveraging layers of interconnected neurons, Neural Networks can effectively capture the latent structure of emotional expressions embedded within text.

Additionally, feature selection techniques including Count Vectorizer, label encoding, and performance metrics evaluation were employed to assess model accuracy, precision, F1 score, and recall.

Results

Our results demonstrated an accuracy of 95.32% in Language Classification and 83% in Emotion Classification, which represents a significant improvement compared to other classification techniques. The choice of using a Neural Network for emotion classification was justified by its ability to discern detailed patterns in text, facilitating precise emotion categorization. Count Vectorizer, a widely used feature extraction technique in natural language processing tasks, was employed for its simplicity, efficiency, and effectiveness in converting text documents into a matrix representation of token counts.

Conclusions

In conclusion, our developed model provides a reliable tool for language and emotion classification tasks. By leveraging supervised learning algorithms such as Multinomial NB and the Neural Network Model, the model achieves high accuracy. Furthermore, feature selection techniques and performance metrics evaluation ensure robustness and generalization across diverse datasets.

sciforum-087669: ^{137}Cs Accumulation by Plants of Floodplain Ecosystems

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The analysis of ^{137}Cs accumulation by plants of forest, marsh, meadow, psamophytic, and ruderal communities in the Dnipro River floodplain (Ukraine) was carried out. It was established that plants of psammophytic and ruderal habitats are characterized by insignificant ^{137}Cs pollution (from 334 to 16.2 Bq/kg) and a low radionuclide accumulation coefficient (from 0.04 to 0.82). This primarily concerns such species as *Berteroa incana* (L.) DC., *Calamagrostis epigejos* (L.) Roth, *Tanacetum vulgare* L., *Echium vulgare* L., *Oenothera biennis* L., *Artemisia absinthium* L., *Verbascum lychnitis* L., *Melilotus albus* Medik., *Helichrysum arenarium* (L.) Moench, *Cichorium intybus* L., *Achillea millefolium* L., *Hypericum perforatum* L., and *Thymus serpyllum* L. In the plant samples taken from the meadow and the swamp ecosystems, the ^{137}Cs content did not exceed the permissible level (370 Bq/kg). Exceeding the normative indicator for ^{137}Cs was detected in the forest ecosystem plant samples. Among such economically valuable plant species are *Chelidonium majus* L., *Convallaria majalis* L., *Quercus robur* L., *Rubus idaeus* L., and *Calluna vulgaris* (L.) Hill. In addition, the ^{137}Cs accumulation coefficient of certain perennial species of mossy, herbaceous, and dwarf shrub layers (*Pleurozium schreberi* (Willd. ex Brid.) Mitt., *Convallaria majalis*, and *Calluna vulgaris*) exceeds this value for the woody plant species. The intensity of radionuclide uptake by plants is determined both by the biological characteristics of the species and by the soil and the cenotic habitat conditions. The species specificity of radiocesium accumulation by plants of specific biotopes and the direct dependence of the plant accumulation coefficient on the density of biotope contamination with radionuclides were confirmed. The conducted studies illustrated not only interspecies differences in the intensity of ^{137}Cs accumulation in one type of local habitat, but also variations in the accumulation of radionuclides in different systematic groups and life forms.

sciforum-086166: A Comprehensive Study on Diabetic Retinopathy Detection and Stage Classification through Deep Learning

Maheswara Kishore Kumar, Mondeddu Radhika, Narendra Babu Pamula, Sowmya Damalapati and Sanjeev Ganesh Kollu

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Introduction

Diabetes, or more accurately, Diabetes Mellitus (DM), is a metabolic disease that results from elevated blood sugar levels. Diabetes eventually results in diabetic retinopathy (DR), an eye condition that significantly impairs vision. Diabetic retinopathy is one of the most serious retinal disorders that can cause blindness. Thus, obtaining a timely diagnosis of the illness is essential. This research introduces an advanced system for categorizing diabetic retinopathy (DR) by utilizing deep learning (DL) techniques, including convolutional neural networks (CNN), VGG-16, ResNet-50, and other related methodologies in deep learning. The suggested system can help ophthalmologists reach a preliminary decision by classifying patients as having no DR, mild DR, moderate DR, severe DR, or proliferative DR.

Methodology

To determine the degree of diabetic retinopathy severity level, we have employed deep learning classification algorithms, Convolutional Neural Network (CNN), VGG-16, and ResNet50 using transfer learning. This includes the process of data collection, preprocessing steps including data augmentation and normalization, the selection of the ResNet-50 model for its deep learning capabilities, transfer learning with pre-trained weights, model training with hyperparameter optimization, validation through cross-validation techniques, and interpretability analysis for clinical insights.

Results

Our model, which we trained using many retinal images taken using fundus photography from the APTOS 2019 Blindness Detection dataset, achieves 96.93% training accuracy and 93.59% test accuracy for the ResNet-50 model. Using the VGG-16, we achieved an accuracy of 67%.

Conclusions

The results of this extensive study are intended to provide a substantial contribution to the field of diabetic retinopathy diagnosis by providing a reliable, scalable, and automated approach. The use of deep learning methodologies in retinal image processing has promise for transforming the initial identification and categorization of diabetic retinopathy. This would enable prompt intervention and avert irreversible visual impairment in individuals with diabetes.

sciforum-088418: Advancements in Air Quality Monitoring: The Role of Drone Technology

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This paper explores the integration of drone technology into air quality monitoring, highlighting its potential to revolutionize environmental data collection.

Introduction

Traditional methods of air monitoring are often limited by spatial coverage and accessibility. Drones, with their mobility and advanced sensor capabilities, present a novel approach to overcoming these limitations.

Methods

We conducted a series of field experiments using drones equipped with various air quality sensors to measure pollutants across different urban and rural settings. Data collection protocols, sensor calibration, and flight patterns were meticulously designed to ensure accuracy and comprehensiveness.

Results

The drones successfully captured high-resolution, spatially diverse air quality data, revealing pollution hotspots and temporal variations previously undetected by stationary monitoring stations. Comparative analysis demonstrated the drones' capability to provide rapid, accurate assessments of air quality, offering invaluable insights into environmental health and pollution dynamics.

Conclusions

Drone technology represents a significant advancement in air quality monitoring, offering enhanced data precision and spatial resolution. Its flexibility and efficiency enable more effective environmental policy formulation and public health interventions. For widespread adoption, however, challenges related to regulatory frameworks, privacy concerns, and the standardization of data collection methods must be addressed. This study underscores the transformative potential of drones in environmental monitoring and the necessity for interdisciplinary collaboration to fully leverage this technology for sustainable development.

sciforum-090434: Advancements in Process Control and Monitoring for Enhanced Efficiency and Quality

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Introduction

Process control and monitoring are indispensable for ensuring efficiency and quality across diverse industrial applications. This session delves into recent advancements aimed at optimizing processes, enhancing product quality, and minimizing resource consumption.

Methods

Drawing upon a multidisciplinary approach, this study integrates principles from control engineering, data science, and industrial automation. Advanced control algorithms such as model predictive control and adaptive control are deployed to regulate process variables and enhance system performance. Real-time data acquisition is facilitated through sensor technologies like IoT devices and wireless sensor networks, while statistical process control methods are utilized for quality assurance and anomaly detection.

Results

The research yields significant advancements in process control and monitoring. The implementation of advanced control strategies results in improved process stability, reduced variability, and enhanced production efficiency. Real-time monitoring enables the early detection of process deviations, leading to proactive maintenance and minimized downtime. Statistical process control techniques ensure product quality consistency and compliance with regulatory standards, resulting in cost savings and heightened customer satisfaction. Significant advancements are achieved. The implementation of advanced control strategies resulted in a 20% reduction in process variability and a 15% increase in stability. Production efficiency improved by 10%, reducing cycle times and increasing throughput. Real-time monitoring led to a 30% reduction in unplanned downtime. Statistical process control reduced product defects by 25%, ensuring quality consistency and compliance. These improvements led to an estimated USD 1.5 million annual cost reduction.

Conclusions

This session underscores the critical role of process control and monitoring in achieving operational excellence and competitiveness in contemporary industries. Through the integration of advanced technologies and analytical tools, continuous improvement and innovation can be achieved, fostering sustainable growth and resilience in dynamic market environments.

sciforum-090439: Advancements in Real-Time Monitoring and Control for Enhanced Process Efficiency

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Introduction

Real-time monitoring and control are critical components of modern industrial processes, enabling operators to optimize production efficiency, ensure product quality, and minimize operational costs. This session focuses on the latest advancements in real-time monitoring and control technologies, aiming to enhance the efficiency and reliability of processes across various industries.

Methods

Utilizing state-of-the-art sensors, data acquisition systems, and control algorithms, this study explores innovative approaches to real-time process monitoring and control. Advanced process models and machine learning techniques are employed to predict process behavior and identify optimal control strategies. The integration of the Industrial Internet of Things (IIoT) platform into these models enables the remote monitoring and control of processes, enhancing their flexibility and scalability.

Results

This research yields significant advancements in real-time monitoring and control. The implementation of advanced sensing technologies enables high-resolution data acquisition, facilitating real-time process monitoring and anomaly detection. The integration of predictive analytics and control algorithms enables the proactive adjustment of process parameters to optimize performance and prevent disruptions. Case studies demonstrate the practical application of real-time monitoring and control techniques to improve productivity, reduce waste, and ensure regulatory compliance across diverse industrial sectors.

Conclusions

In conclusion, this session highlights the transformative impact of real-time monitoring and control on industrial processes. By harnessing the power of advanced technologies and analytics, we can achieve greater operational efficiency, sustainability, and competitiveness in today's dynamic market environment.

sciforum-088696: Agricultural Pest Classification Using Transfer Learning: A Process Control and Monitoring Perspective

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Context

Insect pests are insects that destroy or harm crop plants by cutting their roots, stems, and leaves, and they also absorb the plant's cell sap from its diverse parts, impacting the crop's basic health as well as its productivity.

Objective

The main objective of this article is to develop a robust model that is capable of accurately classifying and identifying different types of insect pests from images. The ultimate goal of this article is to help and aid in pest detection and management. In this article, we not only classify the pests through transfer learning but also manage and control the agricultural processes to minimize pest infestation. The process control includes crop rotation, integrated pest management (IPM), etc. During monitoring, we also estimate the severity level of the pests using different sensors.

Dataset Description

In this article, we have used the dataset from Kaggle, which consists of 12 folders of different types of insect pests. They are ant—Formicidae (498), bee—Apis (500), beetle—Coleoptera (421), caterpillar—Lepidoptera (454), earthworm—Lumbricina (323), earwig—Dermaptera(466), grasshopper—Caelifera (484), moth—Lepidoptera (496), slug—Gastropods (389), snail—Gastropoda (499), wasp—Hymenoptera-Apocrita (997), and weevil—Curculionoidea (487).

Methods and Materials

The given image classifier model is trained using different convoluted neural network architectures such as inceptionV3, vgg 16, and Resnet50, where the accuracy of the inceptionV3 transfer learning model is greater than that of the other two transfer learning models. In the trained model, the dataset consists of 5494 images belonging to 12 different classes.

Results

Here, we have not used the first and last layer of the inceptionV3 architecture, so we are flattening the downloaded inceptionV3 architecture. Dense is used to customize the number of output nodes. We have multiple categories, so we are keeping the activation as softmax and the trained dataset is rescaled. While compiling the model, the optimizer is adam, and the accuracy is 93% with a value loss of 57% and a value accuracy of 97%.

sciforum-090004: AgroAdvisor: A Machine Learning-Enabled Process Control and Monitoring System for Crop Prediction

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Context

Recognizing the important role of technology in modern farming practices, we aimed to create a solution that could assist farmers in making informed decisions about crop selection and cultivation methods.

Objective

The primary objective of our project is to design and implement a robust machine learning model capable of accurately predicting crop yields based on various environmental and agricultural factors. It leverages historical data and advanced predictive analytics techniques like the mineral content of the soil along with the parameters N-P-K, pH, temperature, rainfall, and humidity.

Materials and Methods

To achieve this objective, we gathered a diverse dataset comprising information on weather patterns, soil characteristics, crop types, and agricultural practices from different regions. We then implemented various machine learning algorithms, including DT, RF, and SVM, LDA, LR, GNB, SVC, and KNN, to train and evaluate the predictive models. To improve the standalone model's performance, we have proposed one ensemble learning technique. We also used the ensemble learning algorithm to increase the performance of the model.

Results

In this paper, we have used several machine learning classifiers for crop recommendation, and these are DT, GNB, SVM, LR, and RF. We also measured their performances (accuracy, Precision, F1-Score, and Recall) and found their accuracy (90%, 99%, 97%, 95%, 98%).

Conclusions

In this article, GNB's accuracy outperforms, i.e., by 99%, the other mentioned classifiers in recommending crops.

sciforum-084736: An Affordable IoT System for Weather Monitoring and Emergency Assessment in a Confined Space: A Case Study of Muang-On Cave, Northern Thailand

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Currently, many high-level technologies exist that give humans opportunities to access, explore, or even work wherever they wish. One example of this is confined spaces, such as tourism to undiscovered caves, tunnelling construction, and underground storage on any scale. However, these limited-in-space areas pose challenges, as there are limited numbers of entrances and air circulation. Monitoring systems that can automatically report the weather situation and provide an emergency signal at a particular time are necessary tools, despite their high prices and unfamiliarity.

This study proposes a cost-effective automatic system to detect the weather in a confined space named the Muang-On Cave, located in Chiang Mai, Thailand. The system also provides an emergency alerting signal in this cave. A three-dimensional model of the cave has been produced as a monitoring point reference. We applied and integrated a technology using a low-cost microcontroller called the Internet of Things (IoT). The system consists of four ground wireless stations with 11, 31, and 43 m of spacing. The distance of the final station from the cave entrance is approximately 85 m. Each station is responsible for (1) weather monitoring in terms of temperatures (°C), humidity (%), carbon dioxide content (ppm), and total organic volatile content (ppm) and (2) emergency detection, which will only work when required. After 17 days of the system working, the weather data from the monitoring session are uploaded into the cloud system through a chain-like data transferring pattern. The emergency session is set on the cloud system through the registration of cave visitors, as they can hit the virtual emergency button on their mobile device screen. The total cost of this system is below USD 200. Our findings suggest that this system appears to be suitable for environmental hazard monitoring and may need further development.

sciforum-090449: Bio-Impedance Analysis of Human Upper Limbs Based on Transient Simulation Using the Finite Element Method

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Introduction

Upper-limb loss results in significant functional impairment and a reduced quality of life. A human–machine interface (HMI) using surface electromyography (sEMG) establishes a link between the user and a hand prosthesis to recognize hand gestures and motions. Bio-impedance analysis (BIA) is a non-invasive way of assessing body composition and is adapted for hand motion interpretation with promising results. However, an optimized BIA recording strategy has not yet been achieved due to various parameters (e.g., the large scale of the neuromodulator settings and variations in the tissue dielectric properties). This paper investigates the impact of the dielectric properties of the tissue layers on the bio-impedance variation based on different simulation frequency spectra using the transient modeling method. The model can provide helpful insight into the effect of dielectric properties on the impedance variation of the upper limbs, which is otherwise challenging to investigate in practical studies.

Methods

The 3D realistic human upper arm model was developed based on the image data set. The dielectric properties of each tissue layer were attained based on each frequency level and the time-based current pulse was applied. The electrical potential variation for each frequency level was recorded to calculate impedance variation based on the applied current level. The unseen current distribution across the upper arm's fat, muscle, and bone layers under the skin was also simulated to aid in selecting the most responsive area for BIA towards an optimal simulation frequency level. The results were obtained based on 10 Hz, 1 kHz, 10 kHz, 100 kHz, 500 kHz, and 1 MHz levels.

Results

The results show that the frequency-based dielectric properties of the tissue layer have a significant impact on impedance variation.

Conclusions

In this study, a 3D bio-computational model of the human arm was developed to investigate the impact of dielectric properties on impedance. The results of the study may provide helpful insight into an optimized BIA recording strategy.

sciforum-090275: BMLFTS: A Novel Approach to Process and Track of Food Quality Data Using Blockchain and Machine Learning

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A relatively new piece of blockchain-based software called a food monitoring system seeks to aid in the fight against fraud. In terms of utility, flexibility, and reliability, a large number of the systems now in use in the food processing industry are insufficient. This supply chain link therefore requires a lot of time because it adds more complexity. Blockchain technology offers a new concept that is crucial to resolving the previously described issues when it comes to the supply chain system that is presently being built and used.

The model presented in this abstract combines state-of-the-art advancements in blockchain machine learning (ML) with a fuzzy logic monitoring system that is layered on top of ashelf-life management system to create a blockchain- and machine learning-based food tracing system for handling perishable food. In this instance, the method would be applied to identify potentially contaminated food products. The suggested solution uses blockchain technology to help solve a number of issues, including bulk condensation loss, storage area requirements, and transit times. AI can manage the intricacy of product monitoring as data will be transferred across a network securely. Finally, the supply chain can make use of a precise and trustworthy data management chain to lengthen the entire flow of the system.

sciforum-086581: Comparing the Effects of Material Parameters on Drapability Using the VStitcher Simulation Program

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The mechanical deformation behavior of textiles can be divided into drape and drapability, both of which affect the overall appearance, aesthetics, and fit of garments. In garment simulation, this behavior must be reproduced as realistically as possible in order to provide a meaningful evaluation of the design and construction. Understanding how material parameters impact simulation results is crucial. By systematically varying and comparing material parameters, a deeper understanding of their influence can be gained, leading to more accurate simulations and better insights into the real-world behavior of the fabric. This study investigates and compares real and simulated textile falls. The drop coefficient serves as a numerical measure. Three cotton fabrics of varying weave constructions are thoroughly studied. Real textile drop according to Cusick and simulated textile drop are determined in two experiments using the VStitcher simulation program. A subjective image comparison evaluates the simulation quality, analyzing material parameter variations step by step. The results indicate that bending in the VStitcher simulation program significantly influences the virtual textile behavior and simulation outcomes. Moreover, the study highlights the potential deviations from actual draping behavior, particularly with regard to the anisotropy of the material. Further research should focus on developing simulation algorithms that take into account the anisotropic nature of textiles, ensuring that the simulations accurately represent the behavior of the fabric in different directions. This study highlights the notable deviation between simulated and real fabric behavior when adjusting material parameters in a 3D representation, which is crucial for fit analysis, optimization, and 3D image generation. Establishing standardized data acquisition methods and accessible simulation algorithms is essential for advancing the adoption of simulation in the garment industry. A coordinated effort to define these standards and best practices will facilitate collaboration and enable more accurate and reliable simulations across different organizations and platforms.

sciforum-090328: Deformation Mechanism and Strength Behavior of Ag-Ni Bilayer

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In this investigation, we utilize molecular dynamics (MD) simulations to model the nanoindentation process, specifically focusing on the deformation mechanism and strength behavior of a Silver (Ag) coating film on a Nickel Ni(111) substrate. Our study examines how both the orientation of Ag film and indentation velocity affect the mechanical properties of the Ag-Ni bilayer. In this simulation, three distinct configurations of Ag film were used: Ag(100), Ag(110), and Ag(111). Our findings reveal that the Ag(111)/Ni(111) bilayer experiences higher forces during the nanoindentation process compared to the Ag(100)/Ni(111) and Ag(110)/Ni(111) bilayers. This observation suggests that interfaces with a smaller mismatch in crystal plane orientation between Ag and Ni exhibit greater hardness. Additionally, we investigate the relationship between indentation velocity and interface properties by considering various indentation velocities (ranging from 90 m/s to 200 m/s) on the Ag(111)/Ni(111) bilayer. Notably, variations in indentation velocity can significantly influence the mechanical properties of the Ag(111)/Ni(111) bilayers. Both force and hardness values exhibit substantial increases as indentation velocity rises, implying that the strength of Ag/Ni bilayers becomes more pronounced at higher indentation velocities. These trends are attributed to defect and dislocation formation at the interface, as confirmed via dislocation extraction analysis (DXA).

sciforum-090222: Developing an Earthquake Detection Model Based on P-Waves Using Machine Learning

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Earthquake detection is a vital part of seismology, which allows for the establishment of early warning systems and prompt response measures to mitigate potential harm and protect lives. This research presents an innovative method for earthquake detection by analyzing P-waves using machine learning techniques. P-waves, also known as primary waves, provide vital information on the initial stages of earthquakes, which makes them an appropriate signal for detection algorithms.

Our model uses a dataset of seismic waveforms obtained from several seismic stations in Nepal. We perform data preprocessing to extract relevant properties from P-wave signals, such as amplitude, frequency, and temporal characteristics. The provided attributes are used as inputs for our machine learning models, which are specifically trained to differentiate seismic events from background noise.

We test the efficacy of various machine learning techniques, such as support vector machines, random forests, and neural networks, in classifying P-wave signals. The experimental results substantiate the efficacy of the suggested method, attaining a notable level of precision in earthquake detection while minimizing the occurrence of false positives.

In addition, we investigate how various ways of representing features and model architectures affect the overall performance of the detection system. In the future, we will analyse the capacity of the suggested model for expansion and its ability to be used in real-time situations in seismic monitoring networks.

To summarize, the proposed earthquake detection model presents a hopeful resolution for improving early warning systems and seismic monitoring efforts. By using machine learning methods to analyse P-wave signals, we can enhance the precision and effectiveness of earthquake detection, thereby aiding in disaster preparedness and response measures.

sciforum-090418: Developments in the Field of Textile-Based Sensors: An Overview

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Textile-based sensors have a broad application potential in technical textiles, e.g., for measuring temperature, strain, humidity, pressure, etc. Moreover, textile-based sensors represent a promising class of sensor technologies that open up new possibilities for applications in health monitoring, sports, wearables, and smart clothing by integrating sensor technology into textiles. These sensors utilize flexible and stretchable materials to enable their seamless integration into garments, allowing them to be worn comfortably and unobtrusively. Their appeal lies in their breathability, stretchability, flexibility, and comfortable feel, along with an easier fabrication process compared to traditional rigid sensors. The growing importance of flexible, thin, and lightweight sensors in electronic wearables is increasingly being researched, which is reflected in the growing number of publications. By using different fibres and coatings, textile-based sensors can detect a variety of physiological parameters such as heart rate, respiratory rate, muscle activity, and posture. In general, the integration of textile-based sensors into technical textiles allows for the creation of intelligent and functional materials that offer a wide range of applications. This incorporation is critical for the functionality of products, enabling them to sense, respond, and adapt to external stimuli. The evergrowing demand for smart textiles creates an increase in expectations for the range, accuracy, and stability of sensor measurements. The properties of both the textile and conductive components, alongside the level of mechanical impact that they are subjected to during use, significantly influence the overall reliability and durability of the electronic textiles. So far, only few solutions have passed durability tests, which has resulted in products that appear promising for marketable product solutions. This article gives an overview of the current research on textile-based sensors for various applications in technical textiles and smart clothing, as well as the materials and fabrication techniques used. Furthermore, it addresses challenges in sensor performance and future advancements in materials and technologies.

sciforum-090466: Direct Flux-Vector Control of Stand-Alone DFIG-Based Wind Energy Conversion System

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This article presents direct flux-vector control (DFC), a new control strategy based on direct torque control (DTC), for a doubly fed induction generator (DFIG) driven by wind, feeding AC loads without grid access. For this type of application, the amplitude and frequency of the stator voltage must be rightly controlled. In the proposed topology, two separated closed loops are employed, containing a proportional–integral (PI) controller and a hysteresis controller in which the amplitude and frequency of the stator voltage are controlled by adjusting the magnitude and angle of the rotor flux, respectively. This method boasts an uncomplicated implementation, does not require a rotor position/speed sensor or any reference-frame transformation, and only requires knowledge of the rotor resistance. The Dynamic performance of direct flux-vector control is tested in Matlab/Simulink under different sudden load and wind speed conditions. The results demonstrated the high performance of the method, the amplitude and frequency of the stator voltage were precisely adjusted, and the controller was not affected by parameter variations. Furthermore, the proposed control operates in both subsynchronous and supersynchronous speed modes and no shaft-mounted speed sensors or speed estimators were required. The new control DFC was shown to be robust and effective.

sciforum-090198: Do Plastic Packages Provide Sufficient Photoprotection for Moisturizing Creams?

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Background

The effect of creams depends on their appropriate quality and stability, ensuring safe use. Since active cosmetic substances are often characterized by low stability, solar radiation has a particular impact on the durability of creams, and hence the photoprotective properties of their packaging are extremely important. Thus, to limit the negative impact of the microclimate on cosmetics, manufacturers should select packaging that ensures protection against radiation, moisture, and air movements. The study aimed to evaluate the photoprotective properties of selected plastic packaging for moisturizing creams using the hemispheric directional reflectance method.

Methods

The measurements of total hemispherical directional reflectance (THR) were performed with a 410-Solar Reflectometer (USA). This apparatus is equipped by the manufacturer with the ability to measure reflectance within seven spectral ranges from 335 nm to 2500 nm (i.e., 335–380 nm, 400–540 nm, 480–600 nm, 590–720 nm, 700–1100 nm, 1000–1700 nm, and 1700–2500 nm). Thus, the beam of radiation emitted by the reflectometer includes the ranges of UVA, visible, and infrared light. In the study, 24 plastic packages, divided into two categories depending on the color of the plastic material, i.e., white and blue plastic, were tested.

Results

The blue plastic showed a greater mean THR value than the white plastic in the 335–380 nm range only (0.216 vs. 0.090, respectively, p 0.001). In turn, significantly higher THR was shown for the white plastic than for the blue ones in the remaining wavelength ranges, i.e., 400–540 nm (0.809 vs. 0.577, respectively), 480–600 nm (0.827 vs. 0.383, respectively), 590–720 nm (0.812 vs. 0.325, respectively), 700–1100 nm (0.744 vs. 0.530, respectively), 1000–1700 nm (0.559 vs. 0.352, respectively), and 1700–2500 nm (0.181 vs. 0.115, respectively) (p 0.001 each).

Conclusions

The best protection against visible and infrared radiation is provided by white plastic packages, while blue plastic packages showed better protection against UVA radiation.

Funding: The study was funded within the project PCN-1-058/K/2/O.

sciforum-087062: Eco-Friendly Methods of Bioindication and Biotesting in the Training of Postgraduate Biologists (Using the Example of the T.H. Shevchenko National University “Chernihiv Colehium”, Chernihiv, Ukraine)

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All the methods of biological analysis can be classified into two main groups: bioindication and biotesting (bioassay). Bioindication and biotesting are actively used as part of a system of measures to assess the quality of aquatic and terrestrial ecosystems. The aim of this study was to generalize the approaches to the process of training of postgraduate student biologists studying eco-friendly methods of bioindication and biotesting during the war in Ukraine at the T.H. Shevchenko National University “Chernihiv Colehium”. Based on the methods of theoretical research of available information, analysis of scientific and methodical sources on the given problem, empirical method for accumulating facts, and the argumentation method for proving one’s own judgments, the course program “Bioindication of aquatic and terrestrial ecosystems” was developed. Three types of distance learning technologies are used in the process of teaching graduate students: network technology, television-satellite technology, and case technology. The specified discipline ensures the acquisition of additional professional competencies when mastering the cycle of professional training disciplines, in particular, the acquisition by students of competencies and competency in biological indication, its organization and implementation in modern conditions, the main methodological criteria, and approaches used in solving bioindicative tasks at various levels. The course has two content modules: (1) General aspects and an integrative approach. (2) Bioindicators and test organisms in use. An educational and methodological set of didactic materials from the course was created. Thus, the application of distance education using information and communication technologies in the teaching process of the course “Bioindication of aquatic and terrestrial ecosystems” ensures mastering by postgraduate biologists of eco-friendly methods of bioindication and biotesting, which are widely used for observation, assessment, and forecasting of anthropogenic processes.

sciforum-090087: EcoSense: A Smart IoT-Based Digital Twin Monitoring System for Enhanced Farm Climate Insights

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The convergence of digital technology and agriculture has given rise to innovative solutions aimed at augmenting productivity, sustainability, and efficiency in agriculture. One transformative idea that has garnered significant attention is the "Digital Twin" (DT), transcending boundaries and finding applications in various sectors, including agriculture. This contribution introduces the design and implementation of a Smart IoT-Based Digital Twin Monitoring System that gathers real-time Total Volatile Organic Compounds (TVOC), signifying the total concentration of volatile organic compounds present in the air, contributing to indoor air pollution. Equivalent Carbon Dioxide (eCO_2) provides an indication of the amount of CO_2 in the air. Noise pertains to unwanted or disruptive sound in the environment. Humidity denotes the amount of water vapor present in the air. Temperature is a measure of the warmth or coldness of the air, water, or any substance. Its monitoring is crucial in various applications, including climate studies, weather forecasting, and industrial processes. Air Quality pertains to the state of the air in the environment concerning the presence of pollutants, particulate matter, and other substances. Its monitoring is essential for public health and environmental protection. The collected data are sent to the cloud for storage and analysis. This climate information is indispensable for the farmer to make informed decisions at the opportune moment, take actions based on the gathered data, and predict crop yield. Our intelligent system has the potential, in the future, to make decisions and manage automatic irrigation using solenoid valves based on the real-time collected data.

sciforum-090237: Educational Data Mining For Personalized Learning: A sentiment Analysis and Process Control Perspective

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Context

Educational data mining (EDM) is a growing field that utilizes machine learning, statistics, and data mining to analyze data from educational settings. Its applications include classifying and predicting students' performance and dropouts, predicting teachers' performance, and improving the learning process. A crucial aspect of EDM is student sentiment analysis, which involves analyzing digital text to determine the emotional tone of messages.

Objective

This article aims to leverage data mining techniques and algorithms to analyze educational data and identify trends and insights that can enhance personalized learning experiences. Specifically, the objective is to analyze students' sentiments based on their semester grades, providing valuable insights into their emotional state and learning experiences.

Materials/Methods

In this study, machine learning classifiers are employed to measure the sentiment of students. Various algorithms, including simple linear regression, multiple linear regression, ridge regression, lasso regression, elastic net regression, polynomial regression, and support vector machine algorithms, are utilized for sentiment analysis.

Conclusions

Our research contributes to the field by integrating the principles of process control into educational data mining and sentiment analysis, which is a novel approach in the context of personalized learning. By incorporating process control methodologies, we dynamically monitor and regulate the learning process based on student sentiments. Through meticulous data analysis and algorithm selection, our study provides insights into the relationship between student emotions, learning behaviors, and academic outcomes. This work underscores the significance of leveraging data mining techniques to enhance personalized learning experiences, offering tailored recommendations and interventions to foster improved academic outcomes and engagement.

sciforum-088529: Educational Simulator of Smart Grids

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This paper presents a new power system analysis tool named Educational Simulator of Smart Grids (SESG) for isolated, connected, and interconnected nanogrid and microgrid systems. The SESG is a simulation tool launched through a Matlab application. It is based on theoretical concepts, enabling the modeling of various systems and the implementation of management and optimization techniques for different renewable energy system topologies. The simulations are performed using MATLAB software, where models are developed and simulated. Furthermore, a developed manager is offered to enhance the value of the SESG application in terms of the software, incorporating the creation of a 3D environment. As a result, the observation and management interface will serve as a link between these two aspects. Our work focuses on the optimal management and load balancing of nanogrids connected to Electric Vehicle (EV) stations, and we will integrate all the results into the SESG simulation tool. We introduce the overall graphical interface that we have developed within the SESG application. In addition, we integrated a microgrid system into the SESG simulator to visualize and analyze the dynamic behavior of frequency and power transfer for an isolated and interconnected system with hybrid storage. Our work was based on two topologies: isolated and interconnected.

sciforum-088342: Electric Vehicle Controlled by Field-Oriented Control Using Dual Permanent Magnet Synchronous Motors and Eps Filter

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This paper introduces a ground-breaking approach to Field-Oriented Control (FOC), tailored specifically to Electric Vehicles (EVs) that are equipped with an electrical differential system, eliminating the need for conventional differential gears. In this configuration, each EV is fitted with two Permanent Magnet Synchronous Motors (PMSMs), dedicated to powering individual tires, thereby enabling autonomous torque and speed control at each wheel and significantly enhancing safety and stability on the road.

The proposed system ideally utilizes onboard sensors, such as wheel speed sensors or dedicated speed sensors, to measure the vehicle's speed. These data are, crucially, fed into the control system, serving as a pivotal input parameter for dynamically adjusting the torque and speed for each wheel, thereby improving traction and stability during various driving maneuvers.

The primary focus of this study revolves around enhancing the driving experience in general, with a particular emphasis on improving safety and stability, especially during maneuvers and at high speeds. While constraints limit the immediate implementation of onboard sensors, the proposed traction control system still represents a significant advancement in electric mobility. Through meticulous simulations, the system's feasibility is thoroughly evaluated, demonstrating its effectiveness in reducing wheel slip and ensuring a smoother and safer driving experience for both the driver and passengers. This solution marks a pivotal step toward the advancement of electric propulsion systems, reinforcing their viability in modern transportation landscapes.

sciforum-089973: Enhancing Process Control in Agriculture: Leveraging Machine Learning for Soil Fertility Assessment

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Context

In agriculture, the main role is to access soil fertility which determines crop suitability and optimizes yields. Soil fertility is the foremost criterion to decide whether a crop can be grown on a certain type of soil or not. Farmers often struggle to find which crop to grow when they have a variety of choices. We have to provide soil data which will play a major role in deciding whether the soil is fertile or not.

Objective

The main objective of this research work is to check whether the soil provided is fertile enough to cultivate our desired crop or not. The data provided should contain basic deterministic features such as pH value, electric conductivity, and Nitrogen (N), Phosphorus (P), Potassium (K), Sulphur (S), Zinc (Zn), Iron (Fe), Copper (Cu), Manganese (Mn) and Boron (B) content ratios or values. We can only predict the approximate fertility rate with the help of one or more machine learning algorithms. Their accuracy will be displayed in percentage.

Materials and Methods

In this work, we have used 21 machine learning classifiers (including SVC, RF, LR, NB, KNN, and DT) to identify the fertility of the soil. From our experimental observation, it is concluded that the Random Forest Classifier and Naïve Bayes Classifier have the highest accuracy compared to the other algorithms.

Result

The nature of the dataset indicates that the result is a binary value, i.e., either “Fertile” or “Non-Fertile”, along with the accuracy percentages of each machine learning algorithm. The accuracy of RF is 95%, which tells us how accurate the output is. We can then decide which crop to grow based on the provided data.

sciforum-090510: Enhancing Structural Stability in Cable Bracing Systems: The Benefits of an Additional Horizontal Member

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This study looks at how cables behave in structures using SAP2000. The research focuses on how cables can act in unexpected ways, introducing a new cable support design that makes buildings more stable and prevents cables from becoming slack. Detailed tests with different tensions and cable sizes were carried out to find the best way to use cables. This investigation focused on determining the optimal height of a horizontal cable member within a single-story frame. The proposed model introduces a novel bracing configuration, incorporating a chevron cable brace with a horizontal member that connects members of the diagonal bracings. Braces affected by the lateral force do not slack and remain permanently in tension. The effect of different pre-stresses, different cable diameters, and different supporting conditions on the axial forces of the cables was investigated. With the modified method, it was noted that all cables are working andeconomically feasible. It was also observed that under the dynamic loading of cable bracing systems, increasing the diameter of the cable and increasing the pre-stress force did not have much effect on the axial forces, but with the changing of the supporting conditions, from the fixed support to the joint support, the axial forces of the cable increased. The position of the horizontal member was examined in the frame. The optimum height and length of the horizontal member were determined by the analyses to be at 16% of frame height and length.

sciforum-090410: Exploratory Data Analysis of the Monkeypox Virus Using Machine Learning

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The paper proposes the exploratory data analysis (EDA) of Monkeypox disease using machine learning approaches. Infection with the Monkeypox virus causes the uncommon illness of Monkeypox. The Monkeypox virus is a member of the Orthopoxvirus genus, which also includes the variola, vaccinia, and cowpox viruses that cause smallpox. To get the most out of the Monkeypox data, there is a need to perform some type of exploratory data analysis (EDA). This is a kind of data analysis that uses visual approaches to examine the data. Statistical summaries and graphical representations are used to detect trends and patterns, or to verify assumptions. In this paper, an exploratory data analysis of Monkeypox cases is performed using machine learning. Firstly, we find the top 10 countries based on confirmed cases, suspected cases, and hospitalized cases. Then, we find the cases with a travel history, cases without a travel history, confirmed Monkeypox cases across the globe, and suspected Monkepox cases across the globe. This will be very helpful for researchers working on machine learning and seeking patterns for Monkeypox to easily predict Monkeypox cases in their country.

sciforum-085110: Forward and Inverse Robotics Kinematics JavaScript-HTML5 Simulator

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The development of technology nowadays, and specifically in the field of robotics, is an increasingly developed field of research and development by the scientific community to optimize its productivity. Although many papers report on software dealing with robots and similar devices, their development is usually through complex and sophisticated software, whereas something simpler at the programming level may be presented. This paper serves as an introduction to robots, introducing fundamental mathematical concepts and exploring related studies. It begins with a brief literature review of related works by analyzing them in some depth about what they address and how they relate to the present work. It then delves into the mathematics behind a 2DOF (degree of freedom) robot, elucidating the principles necessary for its operation through mathematical explanations. The code and some pseudocode are then provided, which is made available as open source code for testing and downloading purposes. Thus, the whole picture of the software created is synthesized. Then, the performance of the software is evaluated and compared with the results obtained from Matlab, for different use cases of the software. The conclusion highlights the possible applications of the software, highlighting its simplicity and high adaptability as well as any limitations it encounters due to the Javascript language. In addition, ideas for future features are outlined that will expand the software's capabilities with new features.

sciforum-085473: From Concept to Creation: Developing a Sugar-Level Adjustable Tea-Making and Vending Solution

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In Sri Lanka, tea is a staple and a highly desired beverage. Recently, the preparation of tea has involved brewing tea dust by hand in boiling water to suit the maker's tastes. On the other hand, customer desires for less sugar play a significant role in modern tea vending.

In response, we present a novel tea-making machine prototype that makes use of a PID temperature controller for accurate heating control and an ATmega2560 64-bit controller. With the help of this automated system, tea preparation may be tailored to the tastes of the customer, taking into account factors like cup size and sugar content. The machine begins boiling water when it is connected to a power source, and an indicator signals when the operation is complete. Customers enter the number of cups they want and the desired sugar level, with three options available: one for minimum, two for medium, and three for high. The machine pours hot water into the strainer, directs the output to the mixing container for blending, and then successively dispenses tea dust from a container into a strainer, sugar into a mixing container, and so on.

After mixing is finished, customers can grab their personalized drink whenever they want. Here, the quality of the tea was defined by its taste and the color of the beverage. The test was performed by giving some sample cups of tea to a group of people and listing out their preferences on the taste and the color of them.

With further development, this automated technology can be extended for versatile beverage preparation beyond tea, accommodating a variety of herbal beverage formulations.

sciforum-090441: Growth Properties of *Pseudomonas putida* in the Presence of Some Heavy Metal Salts

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One of the serious environmental consequences of industrialization is the contamination of soil with heavy metals (HMs), as many of them, such as lead, cadmium and mercury, are hazardous to living organisms. However, some microorganisms are known to be resistant to TM salts, and many of them can utilize metal ions as a component of the electron-transport chain. In perspective, such microbes can be used in bioremediation processes.

The aim of the study was to evaluate the growth properties of Pseudomonas putida strain, designated as KT2442, in the presence of 0.1 M and 1 M solutions of heavy metal salts, at 0.05%, 0.1% and 0.15% of the media volume.

For this purpose, the daily culture was passaged in nutrient medium containing 0.05%, 0.1%, and 0.15% 0.1 M and 1 M solutions of $CuSO_4$-$7H_2O$, $CdSO_4$-$8H_2O$, and $Pb(NO_3)_2$. Incubation was at 30 °C with stirring at 150 rpm, measuring the optical density every 4 h at 600 nm wavelength. Cultures without heavy metal salts served as controls. General parameters and reliability of differences were evaluated by standard methods.

In the presence of 0.1 M 0.05% $CuSO_4$-$5H_2O$ the increase decreased by 32%, in the presence of 0.1 M 0.05% $Cd(NO_3)_2$ by 81%, in the presence of 0.1 M 0.05% $MgSO_4$—25%, in the presence of 0.1 M 0.05% $Pb(NO_3)_2$ by 25%, in the presence of 0.1 M 0.05% NH_4NO_3 the increase decreased by 14%.

All variants were found to reduce growth properties to varying degrees relative to the control. However, in the presence of 0.05% 0.1 M solution, the effect is insignificant. This will make it possible to obtain adapted cultures to the TM content, to evaluate possible mechanisms of strain adaptation to TM in the future, and indicates the potential of using adapted microbial cultures for bioremediation.

Funding: The work was carried out within the framework of the grant FZWG-2023-0007 “Adaptive responses of microorganisms: theoretical and applied aspects”.

sciforum-090278: Harnessing Enabling Technology: Augmented Reality for Innovative Learning Experiences

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This paper confidently delves into the transformative potential of augmented reality (AR) in the field of education, highlighting its unparalleled ability to revolutionize and enhance learning experiences. Augmented reality blends the virtual world with the real world to create immersive and interactive experiences. By using software, applications, and hardware, such as AR glasses, augmented reality overlays digital content onto real-life environments and objects. This research investigates the implications of AR for innovative learning methodologies, highlighting its ability to enhance student engagement, foster critical thinking, and provide personalized, contextually relevant content. This study delves into practical applications of AR across various educational domains, including STEM subjects, language learning, and skill development. Furthermore, this paper addresses potential challenges and considerations associated with the integration of AR in educational settings. The implementation of augmented reality in education poses various challenges. Cost is a significant hindrance, as AR technology can be expensive to acquire and maintain. Despite these challenges, proper planning and support can ensure equitable access and maximize the benefit of AR in education. By examining the current landscape and prospects, this research aims to contribute valuable insights to educators, policymakers, and technology developers seeking to harness the full potential of augmented reality for the advancement of modern education. This study concludes that AR has the potential to transform the learning experience by providing students with an immersive and engaging environment that enhances their understanding of complex concepts. Additionally, AR can facilitate innovative teaching methods that cater to individual student needs and learning styles. Thus, the integration of AR in educational settings has the potential to revolutionize the field of education and prepare students for the challenges of the 21st century.

sciforum-090662: Hybrid Particle Swarm Optimization and Manta Ray Foraging Optimization for Parameter Estimation of Induction Motors

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Induction motors are extensively utilized across industries due to their robust efficiency, versatility, and cost-effectiveness, necessitating the precise parameter estimation of their equivalent circuit for effective operation and maintenance. Recently, metaheuristic algorithms have emerged as a powerful tool for this estimation task, offering advantages such as ease of implementation and rapid convergence to optimal solutions. This paper presents a detailed study employing two advanced hybrid metaheuristic techniques, Particle Swarm Optimization (PSO) and Manta Ray Foraging Optimization (MRFO), to enhance the accuracy of induction motor parameter estimation. These techniques, inspired by natural phenomena—PSO by the collective behavior of birds and MRFO by the foraging strategy of manta rays—are combined in a novel approach to refine the estimation process. The accuracy and precision of these hybrid metaheuristic algorithms are meticulously evaluated against traditional methods, using the sum of absolute deviations (SAD) between the motor's actual outputs and those predicted by the equivalent circuit model. The experimental outcomes demonstrate that the PSO-MRFO hybrid approach significantly surpasses the standalone PSO method, with a remarkably low SAD value of 0.2756, which signals a highly accurate estimation. In contrast, the PSO algorithm alone shows a reasonable but lower accuracy, with a SAD value reaching 0.6004. The findings underline the potential of hybrid metaheuristic algorithms to revolutionize the estimation of induction motor parameters, providing a highly accurate, reliable, and computationally efficient tool that could greatly benefit predictive maintenance and fault diagnosis in industrial applications. This advancement points towards the future of motor management, where sophisticated algorithms could lead to increased operational efficiency and reduced downtime.

sciforum-090460: Implementing Sustainable Development Goals into European Textile Companies

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The European textile industry, with its rich history and innovative production technologies, is in great demand worldwide and is experiencing growth in production and trade. Due to the high demand for resources and the large production volumes, this sector has a very strong impact on the environment. The high pollution of air, water and soil in the production of goods should make the textile industry aware of the need for sustainable use of natural resources. In order to reduce the harmful effects of the production of goods and services on the environment, the United Nations developed a global project to make our world more peaceful, social, healthier and fairer. This project has been adopted by the member states of the United Nations and incorporated into national regulations and guidelines. The 17 Sustainable Development Goals (SDGs) help various organizations draw attention to global problems and promote sustainable production and development. The goals are slated to be achieved by 2030, and companies worldwide have the opportunity to make a contribution to this movement. This review provides an overview of the implementation of these Sustainable Development Goals (SDGs) by European textile and apparel companies. It also gives an update on their commitment to the goals. Statistical data on the situation of the textile industry in the European Union as well as information on the environmental and social impacts provide further facts on this topical issue.

sciforum-090437: Innovations in Process Automation and Adaptive Control for Industry 4.0

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Introduction

Industry 4.0, characterized by the integration of cyber–physical systems, data analytics, and automation, is driving a paradigm shift in process control and monitoring. This session explores the latest innovations in process automation and adaptive control techniques, aiming at enabling agile and responsive manufacturing operations in the era of digital transformation.

Methods

Drawing upon principles from control theory, machine learning, and artificial intelligence, this study investigates advanced process automation and adaptive control strategies. Autonomous control systems, equipped with sensor networks and intelligent algorithms, enable real-time adaptation to changing process conditions and demand fluctuations. The integration of digital twins and simulation-based optimization techniques enables virtual commissioning and predictive maintenance, reducing time-to-market and operational risks.

Results

This research yields significant advancements in process automation and adaptive control. The implementation of autonomous control systems enhances process agility and responsiveness, enabling adaptive production scheduling and resource allocation. The integration of digital twins facilitates the virtual prototyping and optimization of control strategies, reducing commissioning time and improving process reliability. Case studies demonstrate the practical application of adaptive control techniques in improving throughput, quality, and energy efficiency in manufacturing operations.

Conclusions

In conclusion, this session highlights the transformative potential of process automation and adaptive control in enabling agile and intelligent manufacturing systems. By embracing Industry 4.0 principles and leveraging advanced technologies, we can unlock new opportunities for innovation, efficiency, and competitiveness in the digital age.

sciforum-085864: Lévy Distribution Meta-Heuristic Fuzzy-Based Optimization Algorithm for Optimal Framework Design of Type-2 Fuzzy Controller: Subject to Perturbations

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New metaheuristic algorithms have recently been created based on Lévy Flight (LF), drawing inspiration from biological and natural events. Many researchers have adopted this nature-inspired approach to algorithm creation in order to solve optimization challenges. These algorithms have been tested against standard algorithms and have proven to be superior in a variety of complicated problems. One of the most powerful aspects of Cuckoo Search (CS) is the use of Lévy steps to generate fresh possibilities. This approach modifies possible solutions by causing a large number of changes and a few major transitions. As a consequence of this, CS will be able to greatly improve its research skills while also increasing the connection between exploration and exploitation. In this research, the Interval Type-2 Fuzzy Logic Controller (IT2FLC) is introduced to the typical Cuckoo Search Optimization (CSO) algorithm to ascertain the optimal membership function (MF) parameters of Interval Type-2 Fuzzy Logic Systems (IT2FLSs). The investigation considers two types of MFs: triangle and trapezium. Whenever disturbances are used to execute each control issue, the CSO algorithm's performance and efficacy boost dramatically. Two standard control problems are used to evaluate the suggested method: one is a tank level controller and the other is an inverted pendulum controller. The primary purpose is to demonstrate the effectiveness of the CSO algorithm in locating suitable fuzzy controllers for nonlinear plants. All control problems consider two forms of disturbance. The CSO algorithm produces good results in the field of fuzzy logic controllers (FLCs), according to the findings.

sciforum-089602: Mapping, Modeling and Designing of Marble Quarry Using Integrated Electric Resistivity Tomography and Unmanned Aerial Vehicles with CO_2 Sequestration Potential

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Mining activities are under criticism nowadays due to the excessive production of wastes and tailings during the whole mine life. Apart from the production of tailings and wastes, mining activities are also responsible for air pollution in the form of greenhouse gases. For this reason, efficient resource extraction with responsible environmental stewardship is indire need for more sustainable, green, and smart mining. This research investigates a novel approach based on using industrial drones coupled with GIS, as well as advanced geophysics (ERT) synergistically used for the development of comprehensive surface and subsurface models in a marble site of Minapin area, Gilgit-Baltistan, Pakistan. The surface models were used for sustainable optimized preliminary quarry design and planning, while subsurface models were used for CO_2 sequestration. High-resolution images with digital elevation models (DEMs), digital surface models (DSMs), digital terrain models (DTMs), geospatial data, Orthophoto, and 3D virtual area models were acquired by industrial drones. Geophysical prospecting techniques, like vertical electrical sounding (VES), were used to locate geological features such as solid bedrock, fractured rock mass, and iron leaching in the deposit. The test results showed that the marble deposit in the study area was intact throughout the deposit with little iron leaching, indicating the sustainable development of quarry for the extraction of dimensional stones, making it a better option for geological CO_2 sequestration. The total calculated volume and area using GIS tools were about 99,098,571.73 m^3 and 1,674,289.3343 m^2 and the mass of extractable materials was 377,567,682.77 tons. The slope of the ramp was 8.2%, and the haulage road width and length were 6 m and 640 m, respectively. The face angle was kept constant at 90° due hard rock formation. Hence, this research is purely novel in the sense that it extracts material by taking the responsibility of environmental challenges, opening up new avenues for sustainable and green mining.

sciforum-090555: Moisture Absorption Speed of Textiles for Personal Care Use for Developing Re-Usable Products

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Sports apparel, workwear and textile applications for medical and personal care use, as well as some agricultural applications and textiles for seating require, quick moisture transport of liquids with different viscosity levels. For example, reusable menstrual underwear and pads require quick absorption for comfort and high functionality to provide an attractive alternative to single-use products. Often, a multilayer construction is used to keep the surface dry with quick moisture transfer to a second layer that absorbs the liquid. This paper presents the results of investigations of different fabric structures that influence the absorption and transfer of different fluids from the lining layer (the layer closest to the body) to the absorbent layer. We used deionized water and test liquids with higher viscosity, which were prepared with xanthan gum. Properties such as the density, surface tension and viscosity were measured. The different textile samples were characterized using standardized textile testing methods to determine their mass, thickness and mesh density. Using microscopy and digital image processing, the porosity of the textiles was also investigated. In experimental tests, the absorption rate and dimensions of the wetted surface of six different textile structures (lining layer) in combination with an absorbent layer were assessed. A commercially available single-use pad served as a comparison product. The evaluation was carried out by means of video analysis and digital image processing. The results show that a high through-porosity and mass per unit area result in a high absorption speed and rapid transverse liquid transfer to the absorbent layer, even with viscous liquids. In addition, a small wetted area tends to be connected with large through-pores with uniform distribution. The results provide a basis for improving the comfort and functionality of textiles, especially for personal care products and sportswear.

sciforum-090208: Multiple Disease Prediction Using Novel Artificial Intelligence Techniques

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Context

In the healthcare sector, the integration of data mining and machine learning has become increasingly prevalent, offering promising avenues for disease prediction. This article seeks to leverage these technologies to predict multiple diseases by analyzing symptoms, medical history, and lifestyle factors. Recognizing the pivotal role of machine learning in contemporary society, this project was initiated with the aim of saving lives, promoting healthier lifestyles, and reducing healthcare costs. The significance lies in its ability to forecast diseases before they escalate into serious or permanent conditions.

Material/Method

The methodology encompasses data collection, preprocessing, model selection, training, testing, and deployment. Metrics such as the Precision, Accuracy, Recall, F1 Score, AUC-ROC, Specificity, and Sensitivity are employed for evaluating model performance, complemented by visualization techniques including a Confusion Matrix, Box plot, AUC-ROC curve, and Precision–Recall Curve. The dataset, sourced from diverse repositories including research domains and platforms like Kaggle, undergoes thorough preprocessing to eliminate noise and outliers.

Conclusions

The model demonstrates commendable performance in predicting multiple diseases, striking a balance between accurately identifying individuals with disease and minimizing false positives and negatives. This contributes significantly to informed decision making in healthcare settings. Ultimately, the culmination of this project will result in the development of a model and dashboard interface. Users can input their details and symptoms to ascertain whether they are afflicted by any chronic diseases, facilitating prompt diagnoses and treatment recommendations.

sciforum-089927: Navigating Uncertainty: Cutting-Edge Approaches in Process Control and Monitoring for Risk Mitigation in Supply Chain Management

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Risk mitigation in supply chain management refers to the proactive measures and strategies implemented to identify, assess, and address potential threats or disruptions to the flow of goods, information, and finances within a supply chain network, aiming to minimize adverse impacts on operations, costs, and customer satisfaction. In the dynamic supply chain management landscape, mitigating risk has emerged as a paramount concern for organizations seeking to ensure resilience and continuity. This review article delves into contemporary advances in process control and monitoring strategies to fortify supply chains against many uncertainties. By selecting the relevant and recent literature using the keywords “uncertainty”, “supply chain management”, “process control”, and “risk mitigation” from the last fifteen years (2009–2024), covered by reputed databases such as Scopus, Web of Science, and Google Scholar, and by drawing upon comprehensive analyses and industry practices, this study identifies critical methodologies, technologies, and frameworks that empower organizations to manage risks across their supply networks proactively. The current study highlights innovative solutions that enhance supply chain visibility, agility, and responsiveness, from real-time data analytics and predictive modeling to blockchain-enabled transparency and AI-driven decision support systems. Moreover, it is intended to examine the integration of emerging technologies such as IoT sensors, machine learning algorithms, and digital twins, showcasing their transformative potential in enabling proactive risk identification and mitigation. This review provides a comprehensive overview of the current landscape by synthesizing these advancements and challenges. It offers valuable insights for navigating the complexities of modern supply chain risk management and the study’s limitations. This study’s findings have practical applications in the real world, enabling supply chain managers to cultivate a culture of continuous improvement and adaptation within their organizations. Companies can maintain flexibility and adaptability amid changing risks and uncertainties by staying up to date with the latest approaches and industry standards.

sciforum-090400: Nonlinear Identification of the Suction Manifold of a Supermarket Refrigeration System Using Wavelet Networks

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The dynamics of the suction manifold of a high-fidelity simulation benchmark model of a modified supermarket refrigeration system created in MATLAB and Simulink is modeled using a nonlinear system identification technique. The original model consists of a cold storage room, three open display cases, the suction manifold and the compressor rack. Since open display cases are less energy-efficient, they were removed, while the cold storage room with a door was used for simulation. The suction manifold model has two outputs: the suction pressure and the compressor's power consumption; and it has three inputs: the mass flow of refrigerant, the ambient temperature, and the compressor capacity. A fourteen day simulation was carried out, and synthetic data were generated from the input and output data of the simulation model. These data were divided into estimation data and validation data. Wavelet networks were then utilized to estimate and validate a nonlinear ARX model. The comparison between the estimation data and the validation data shows a goodness of fit that is greater than 88%, with a simulation focus. The data-driven identified model of the suction manifold was stable and robust and could handle strong nonlinearities of the input and output variables when used to replace the Simulink model of the suction manifold subsystem in the simulation benchmark. The simulation results clearly demonstrate how complex refrigeration system subsystems can be replaced with simpler and data-compliant data-driven models.

sciforum-090295: Object Detection for Autonomous Logistics: A YOLOv4 Tiny Approach with ROS Integration and LOCO Dataset Evaluation

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This paper presents a novel object detection model for logistics-centered objects deployed and used by autonomous warehouse robots. Using the robust Robot Operating System (ROS) infrastructure, our work leverages the set of provided models and a dataset to create a complex system that can meet the guidelines of the Autonomous Mobile Robots (AMRs). We describe an innovative method, and the primary emphasis is placed on the Logistics Objects in Context (LOCO) dataset. The importance is on training the model and determining optimal performance and accuracy for the implemented object detection task. Using neural networks as pattern recognition tools, we took advantage of the one-stage detection architecture YOLO that prioritizes speed and accuracy. Focusing on a lightweight variant of this architecture, YOLOv4 Tiny, we were able to optimize for deployment on resource-constrained edge devices without compromising detection accuracy, resulting in a significant performance boost over previous benchmarks. The YOLOv4 Tiny model was implemented with Darknet, especially for its adaptability to ROS Melodic framework and capability to fit edge devices. Notably, our network achieved a mean average precision (mAP) of 46% and an intersection over union (IoU) of 50%, surpassing the baseline metrics established by the initial LOCO study. These results demonstrate a significant improvement in performance and accuracy for real-world logistics applications of AMRs. Our contribution lies in providing valuable insights into the capabilities of AMRs within the logistics environment, thus paving the way for further advancements in this field.

sciforum-090230: Object Identification Using Machine Learning

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Context

Computer vision is a multidisciplinary field at the forefront of technology, enabling machines to interpret and comprehend visual information from the world. One of its crucial tasks, object detection, involves identifying and locating objects in images or videos, with applications spanning vehicle detection, security systems, and augmented reality and web image analysis.

Objective

This article aims to develop an advanced object detection system capable of accurately pinpointing and categorizing objects in visual data, facilitating precise machine interpretation and understanding. By leveraging deep neural networks and state-of-the-art architectures like Convolutional Neural Networks (CNNs) and YOLO, the objective is to achieve high accuracy and real-time performance in object detection tasks.

Materials/Methods

The project utilizes annotated image datasets containing bounding boxes around target objects for model training. The architecture of the model, predominantly based on CNNs or advanced frameworks like YOLO, is meticulously designed to accurately identify and localize objects within images. Emphasis is placed on achieving object detection with superior accuracy and real-time processing capabilities.

Conclusions

Our research on object detection has resulted in significant advancements, demonstrating robust performance across various datasets and real-world scenarios. The developed model showcases exceptional accuracy in localizing and classifying objects, thus enhancing the efficacy of computer vision applications. Specific use cases, such as surveillance systems, autonomous vehicles, and industrial automation, highlight the practical value and potential impact of our model in diverse sectors. Through this work, we contribute to the broader adoption of computer vision technologies, paving the way for enhanced efficiency and innovation in numerous fields.

sciforum-089814: Reproduction and Preservation of Albanian Handicraft Accessories through Additive Manufacturing

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The handicraft sector in Albania has been developing since ancient times. The need to create and reproduce traditional objects in 3D form calls for the creation of a new method of cataloging cultural heritage in Albania.

In digital heritage preservation, the geometric shape, shiny and tinny details are the most important elements in various handicrafts.

This paper presents an approach of prototyping traditional accessories by modeling them with 3D software. This forms part of a pilot study for the reproduction of realistic 3D models of some folkloric objects and accessories for the purpose of cataloging them for the needs of IAKSA.

By modeling the objects with the Zbrush software, 3D photorealistic images were obtained, with a high resolution and the real dimensions of the objects, which were sent directly to the 3D printers for the fabrication of the original object.

We used PET software to export the data in standard formats (DXF, STL, CAM, and CAT 3-D) to convert, save or send for reproduction in 3D printers with the real dimensions of objects.

The comparison of this method to the 3D scanning method, even though it requires more time to acquire the object in 3D, shows how inexpensive desktop production equipment with suitable software can provide accurate data, preserving folk accessories at a low cost in design and reproduction.

This method allows original objects to be obtained and preserved at any time, preventing their further damage by visitors, and keeping them safe for future generations.

sciforum-087728: Secured Data Transmission in Wireless Sensor Networks with an Innovative Energy-Saving Substitute Re-Encryption

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Maintaining the integrity of data, privacy, and security against cyber assaults is critical in the world of wireless sensor networks (WSNs). A key component in guaranteeing safe intra-network communication is substitute re-encryption, or SRE. Nonetheless, the ongoing difficulties facing current SRE solutions include processing delays brought on by the need to transport a significant amount of data to the intermediary for re-encryption as well as the computing demands of asymmetric cryptography. In order to improve the secure communication between network nodes and an external data server, this paper presents a novel SRE scheme that is carefully tailored for WSNs. In order to minimize computational costs during SRE operations and conserve energy for resource-constrained nodes, the proposed SRE scheme integrates lightweight symmetric and asymmetric cryptographic algorithms to optimize efficiency. To enable secure key creation and distribution, the scheme also includes advanced handling of keys and digital certificates. This allows for smooth verification and scalable data sharing across the entities in WSN. This technique reinforces the confidentiality and integrity of data by maintaining sensor-node encrypted data and assigning secure re-encryption duties only to cluster heads. Thorough analyses of performance, security, and energy usage confirmed the system's resilience. The findings verify that the suggested SRE scheme greatly improves WSNs' overall network longevity, security, and efficiency.

sciforum-088445: Skills Inventory Analysis: A Tool for Line Balancing in the Garment Industry

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The garment industry in Albania is an important sector in the manufacturing industry. With the evolution of technologies, it is facing different challenges and changes. There are a few companies operating under a full cycle of production, and a great part of them are operating as facon base companies. It has now become a necessity for garment companies to switch to a closed production cycle and to operate with different styles in small quantities.

The main objective of the study is to present and explain, through a case study, a skills inventory sheet as an important tool in line balancing to solve the problem of different styles in a production line. The completion of a skills inventory sheet is one of the main tasks of a production supervisor. It should be completed for each operator within a production line. A skills inventory sheet is important because it provides information on individual operators, the types of machines they can use, and their performance level for each machine. Skills inventory sheets can also identify training needs for individual operators/operations. All the data received from skills inventory help balance all the processes throughout a production line. This sheet should be completed by line managers and analyzed by them in order to obtain a well-balanced production line.

sciforum-085976: Strategic Supply Chain Network Optimization: Integrating Risk Management

Nisrine Rezki

ENSA

In today's increasingly globalized and competitive environment, supply chains (SCs) are susceptible to vulnerability and the occurrence of risk events. Managing the supply chain network design (SCND) efficiently has become crucial in navigating the complexities of the involved network. This paper introduces a mixed-integer linear programming (MILP) model for the SCND problem, addressing economic, environmental, and risk objectives. Economic objectives are considered by minimizing the overall costs of the entire SC. The environmental aspect is integrated by incorporating gas emissions into the SCND, emphasizing sustainability. Given the sensitivity of the network to risks and disruptions, this paper incorporates risk modeling into the SCND model. The objective is to develop a model that strives to find a balance between the total costs associated with the SCN, encompassing disruption risk costs that may occur in one or more nodes of the SCN. To evaluate disruption risks, a Bayesian Belief Network (BBN) model has been developed to predict and assess the marginal probabilities of risk factors and sub-factors. Belief propagation analysis is employed and applied in an automotive case study to derive meaningful managerial insights, identifying the most sensitive factors and sub-factors impacting the SC. The findings underscore the utility of the BBN model in pinpointing factors and their sub-factors with the greatest impact on SC disruption risks. The proposed model serves as a tool for managers to predict disruption risks, formulate mitigation strategies, and develop strategic plans to effectively manage disruption risks and damages associated with SCND.

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