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ABSTRACTS

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A. OPTIMIZATION OF MANUFACTURING PROCESSES AND SYSTEMS & COMPUTER AIDED DESIGN AND MANUFACTURING

A.1. STUDY OF AN OPEN-CIRCUIT HYDROSTATIC SYSTEM: ANALYSIS, PARAMETERS AND ELECTRICAL CONTROL

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Abstract. Hydrostatic systems are a category of drive systems used in industry, based on the transmission of energy through fluids under pressure. They are distinguished by high precision, large developed forces and the possibility of fine control of movement, being used in a wide range of technical applications. The paper presents the structure and operation of an open-circuit hydrostatic system, used to drive a linear hydraulic motor. The component elements of an open-circuit hydrostatic system are analyzed, as well as the way in which the hydraulic characteristics of the linear hydraulic motor are changed in value, taking into account its constructive parameters. The paper also includes a description of the electrical control system, presenting the starting diagram of the asynchronous motor that drives the hydraulic pump, the electrical control panel and the operation of the control and protection elements.

Keywords: open- circuit, hydraulic pump, hydraulic motor, electric control

A.2. MECHANICAL BEHAVIOR OF 3D-PRINTED WOOD-FIBER BIOCOMPOSITE LATTICE STRUCTURES: EFFECT OF MODELING STRATEGY

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Abstract. The same gyroid triply periodic minimal surface (TPMS) lattice in fused deposition modeling (FDM) can be produced either through slicer-based infill or through parametric implicit surface generation. This study quantifies the mechanical difference between the two approaches using BioFil Wood, a commercial wood-fiber biocomposite filament. The filament was characterized by DSC and optical microscopy. Printing parameters were optimized on a Prusa i3 MK3S (190 °C, 100 mm/s, 0.88 mm line width). To characterize the material across infill topologies, three slicer-generated patterns (Gyroid, Grid 0°, Grid 45°) at 20% density were tested under compression and flexural loading. In tensile testing (ASTM D638 type IV), build orientation produced anisotropy: the longitudinal orientation reached a Young's modulus of 4087 MPa and tensile strength of 23.58 MPa, decreasing to 3666 MPa and 19.11 MPa at 45°, and 3537 MPa and 12.78 MPa transverse. In compression, Grid 0° produced the highest Young's modulus (110.01 MPa), maximum stress (1.81 MPa), and force-to-mass ratio (45.54 N/g). Grid 45° gave 44.44 MPa and 1.31 MPa with greater deformation before failure. Under flexural loading, Grid 45° produced the highest flexural modulus (123.22 MPa) and maximum stress (7.95 MPa). Grid 0° recorded the lowest values (30.96 MPa and 4.11 MPa). Tensile testing yielded a Young's modulus of 4087 MPa and a maximum stress of 23.58 MPa. The cross-tool comparison required a pattern reproducible by both methods. Of the three, only the gyroid has an implicit surface equivalent: it was generated parametrically in nTopology (nTopology Inc.) by adjusting unit cell dimensions to match the mass of the corresponding PrusaSlicer sample (5.29 g for compression, 16.76 g for flexural testing). In compression, the nTopology gyroid reached a Young's modulus of 70.70 MPa and a maximum stress of 1.40 MPa, against 31.49 MPa and 0.79 MPa for the PrusaSlicer gyroid (124% and 78% increases). Under flexural loading, the nTopology gyroid

produced a flexural modulus of 81.70 MPa and a maximum stress of 5.39 MPa, against 77.15 MPa and 4.30 MPa for the PrusaSlicer gyroid (6% and 25% increases). The cross-tool gains stem from a parameter unique to parametric generation: the unit cell aspect ratio can be elongated along the loading axis, aligning the geometric anisotropy of the cell with the load direction. The slicer reproduces the gyroid as a sinusoidal toolpath whose only adjustable parameter is infill density, applied isotropically.

Keywords: fused deposition modeling (FDM), wood-fiber biocomposite, triply periodic minimal surface (TPMS), lattice structures, mechanical properties, infill patterns

A.3. MULTI-OUTPUT MODELING AND GENETIC ALGORITHM OPTIMIZATION OF ELECTRODEPOSITED Ni-P-Y₂O₃ COMPOSITE COATINGS

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Abstract. Composite coatings are widely employed in engineering applications due to their superior mechanical performance. Nevertheless, predicting the behavior of their manufacturing processes remains challenging because of the complex interplay between processing parameters. In this study, Ni-P-Y₂O₃ composite coatings were produced via a cathodic electrodeposition process using sulfate-based baths. A multi-input–multi-output modeling approach based on multiple linear regression was developed to assess the effect of electrodeposition parameters on coating quality. A genetic algorithm was then employed to optimize these parameters with the goal of achieving enhanced micro-hardness and improved cathodic current efficiency. The developed model exhibited strong predictive capability, with deviations between predicted and experimental values generally below 2%. Optimization results indicated that the coatings could reach a micro-hardness of approximately 590 HV, while maintaining a high electrodeposition efficiency under the determined optimal conditions.

Keywords: Ni-P-Y₂O₃ composite coatings, electrodeposition process, micro-hardness, Multi-output modeling, Genetic algorithm optimization

A.4. POROSITY AND TOPOGRAPHY OF BICOMPONENT 3D PRINTED SAMPLES

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Abstract. Bicomponent 3D printed parts made of UltraFuse PLA and PLA/PHA were characterized using 3D topography and X-ray tomography (micro-CT), both non-destructive methods. 3D topography, measured with a Zygo profilometer using coherence scanning interferometry (CSI, a technique that scans a surface with different wavelengths of light to measure height variations with high precision), provided nanometric vertical resolution (<1 nm, or less than one billionth of a meter) and micrometric lateral resolution (4.2 μm, or 4.2 millionths of a meter, at 10X magnification). This enabled evaluation of surface texture near material interfaces—specifically, T (straight), dovetail (interlocking), U (curved), and semicircle (half-circle) shapes—and identification of void depths and discontinuities. Micro-CT, a method that uses X-rays to create detailed three-dimensional images of internal structures, was used to analyze

porosity in relation to mechanical properties. Combining these techniques yielded a comprehensive analysis that highlighted surface quality, internal structure, and the relationships between printing parameters and the final properties of bicomponent 3D-printed parts.

Keywords: additive manufacturing, two-component 3D printing, porosity, topography, interface

A.5. A STUDY OF OXIDATIVE STABILITY OF WASTE COOKING OIL USED AS DIELECTRIC IN EDM OF C120 HEAT-TREATED TOOL STEEL

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Abstract. The rapid growth of global food consumption, driven by population increase, urbanization, and rising incomes, has led to the generation of millions of tons of waste cooking oil (WCO) annually from households, restaurants, and food processing facilities. Currently WCO is identified as a dual environmental problem, i.e., disposal pollution and mineral oil overuse, which make it one of the most pressing by-product management challenges facing the food industry. The problem could be addressed by converting WCOs into bio-based lubricants or green dielectrics. Their biodegradability, high kinematic viscosity, high oxygen concentration and high flash/fire points are attractive properties that would make them suitable for this purpose. The aim of the current study is to investigate the oxidative stability of WCO used as a dielectric in electrical discharge machining (EDM) of C120 tool steel samples under intensive working regimes. The resistance of WCOs to degradation when exposed to heat, oxygen, and metal contaminants is a critical factor influencing their performance during long or intensive machining cycles. The findings of this study contribute simultaneously to two fields: the valorization of food industry by-products and the advancement of sustainable EDM machining strategies.

Keywords: EDM, intensive regimes, WCO, oxidative stability, circular economy

A.6. COMPARATIVE ANALYSIS OF METALLIC MATERIALS UNDER SALINE AND MICROBIOLOGICAL CORROSION

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Abstract. The study provides new evidence that saline and microbiological corrosion not only alter the surface morphology of aluminium alloys but also significantly intensify tensile residual stresses throughout the material's thickness, thereby increasing susceptibility to cracking and compromising dimensional stability. The research examines the modifications induced by corrosive processes on surface roughness, texture, and the residual stress state across the thickness of metallic sheets, with the objective of assessing the risk of structural degradation and premature

failure. Experimental results show that exposure to corrosive environments for 30 days produces significant alterations both at the surface and within the depth of the materials. For the aluminium alloy, the differences between corroded and uncorroded samples are considerably more pronounced, with substantially higher residual stresses in the material affected by microbiological corrosion, suggesting an increased susceptibility to cracking. The roughness analysis reveals distinct behaviours depending on the material and the type of corrosive agent. The aluminium alloy transitions from a relatively smooth surface to a rough one under saline exposure, and mould is the only microbiological agent that produces visible changes in surface microgeometry. Across all analysed materials, corrosion induces tensile residual stresses with higher magnitudes than those observed in uncorroded samples, which may accelerate crack initiation and propagation. Stress differences between the two faces of the sheet can lead to elastic springback, affecting the dimensional stability of metallic components. The study demonstrates that both saline and microbiological corrosion have a significant impact on the integrity of metallic materials, simultaneously influencing surface roughness and the distribution of residual stresses. These findings are relevant for evaluating the durability of metallic structures exposed to aggressive environments and for optimising anticorrosive protection strategies.

Keywords: saline corrosion, microbiological corrosion, surface roughness, residual stresses, aluminium alloy

A.7. INFLUENCE OF MILLING PARAMETERS ON SURFACE TOPOGRAPHY AND RESIDUAL STRESSES IN Ti-6Al-4V ALLOY

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Abstract. Titanium alloy Ti-6Al-4V is widely used in aerospace, biomedical, and high-performance engineering applications due to its excellent strength-to-weight ratio, corrosion resistance, and biocompatibility. However, it has poor machinability. This is due to low thermal conductivity, high chemical reactivity, and a strong tendency for tool wear. These issues make achieving high surface quality and controlled subsurface integrity particularly challenging. Understanding the influence of milling parameters on surface characteristics and residual stresses is essential for optimizing machining performance and ensuring the functional reliability of components. This study investigates the effect of key milling parameters on the surface quality and subsurface state of Ti-6Al-4V alloy. The experimental program focuses on cutting speed (V_c), feed per tooth (f_z), spindle speed (S), and depth of cut (a_p). Radial engagement remained constant at 12 mm. A Zygo optical profilometer was used to evaluate surface topography, with an emphasis on the S_a roughness parameter. Residual stresses in the superficial layer were also analyzed to assess the mechanical state induced by the machining process. Three distinct cutting regimes were tested. These combined low, medium, and high cutting speeds (40–80 m/min) with varying feed rates and depths of cut ($a_p = 1$ mm and $a_p = 2$ mm). The results indicate a strong dependency of surface roughness on both feed rate and depth of cut. Lower feed rates ($f_z = 0.03$ mm/tooth) significantly improved surface quality, resulting in S_a values as low as ~ 0.6 μm . In contrast, higher feeds ($f_z = 0.18$ mm/tooth) increased roughness, exceeding 4 μm in some cases. Increasing the depth of cut generally led to a deterioration of surface finish. Comparative analysis showed that Ti-6Al-4V consistently exhibited higher roughness values than steel under similar cutting conditions. This confirms its more difficult machinability. The selected cutting parameters also influenced the magnitude and distribution of residual stresses. Process optimization is important to avoid detrimental tensile stresses in the surface layer.

Keywords: Ti-6Al-4V alloy, milling process, surface integrity, S_a parameter, residual stress, cutting regime, optical measurement, Zygo profilometer

A.8. RECENT DEVELOPMENTS IN JET ELECTRODEPOSITION: MECHANISMS, PERFORMANCE, AND COMPUTATIONAL APPROACHES

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Abstract. Jet electrodeposition (JE) is an advanced coating technique in which a high-velocity electrolyte is projected onto a conductive substrate while an anode is positioned nearby. Since its development by Fletcher and Oliver in 1972, JE has emerged as a promising method for enhancing mechanical, tribological, and electrochemical properties of coatings, particularly when combined with auxiliary techniques. Coating performance strongly depends on electrical (current density, voltage, current mode), hydrodynamic (jet velocity, pressure, nozzle-substrate distance), chemical (electrolyte composition, pH, temperature, additives), and mechanical factors (scanning speed, deposition time, substrate roughness). Numerical modeling and optimization enable precise control of these parameters, predicting coating characteristics such as thickness, adhesion, porosity, surface roughness, and mechanical resistance. Furthermore, computational optimization informs JE equipment design, improving nozzle geometry, flow configuration, and operating conditions to enhance efficiency, reduce energy consumption, and minimize wear, ultimately enabling more reliable and high-performance coatings.

Keywords: jet electrodeposition, coating performance, mechanical properties, process optimization, numerical modeling

A.9. EFFECTS OF EMULSION CONCENTRATION USED IN MQL LUBRICATION SYSTEM APPLIED TO MILLING THIN-WALLED PARTS MADE BY ALUMINIUM ALLOYS

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Abstract. The influence of emulsion concentration used in minimum quantity lubrication (MQL) systems is critical in milling thin-walled parts, where the low rigidity of material makes parts vulnerable to vibrations, thermal distortion, and dimensional deviations. This paper aims to present the findings of a study that examined the effects of MQL emulsion concentration during the milling of thin-walled parts made from two aeronautic aluminum alloys. The study focused on cutting force, surface roughness (Sa), and the residual stress state in the surface layer of the machined parts. A T-cantilever geometry was employed, along with three different emulsion concentrations for testing. The results indicated that both the lowest and the highest emulsion concentration resulted in increased cutting forces and elevated residual stresses. In certain machining regimes, these stresses shifted from compressive to tensile in the surface layer of parts. Additionally, the two concentrations negatively impacted the surface quality of the machined parts, leading to greater roughness.

Keywords: AA6061-T651, AA7075-T651, thin-wall milling, cutting force, surface finishing, residual stress

A.10. INFLUENCE OF FRICTION MATERIAL COMPOSITION ON BRAKE PAD WEAR BEHAVIOR: A ZYGO-BASED SURFACE TOPOGRAPHY STUDY

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Abstract. Brake pad performance is primarily determined by the chemical composition of friction materials, which governs wear behavior, thermal stability, and surface integrity during operation. Understanding the evolution of these materials under real operating conditions is essential for enhancing durability and braking efficiency. This study examines the influence of friction material composition on the time-dependent behavior of brake pads through a comparative experimental analysis. Two commercially available brake pad types were selected and evaluated. The initial surface condition was characterized using Zygo optical profilometry, enabling high-resolution, non-contact measurement of surface topography parameters. The evolution of surface characteristics was monitored at progressive mileage intervals of 500, 1000, 3000, 5000, and 10,000 km. The experiments were conducted under two distinct operating conditions: urban (city driving) and extra-urban (highway/outside-city driving), to isolate the effects of the braking regime and thermal load. The results demonstrate a strong dependence of surface degradation on the operating environment. A substantial increase in surface deviation from flatness was observed under urban conditions, reaching approximately 3.5 times the value measured in extra-urban settings. This increase is attributed to frequent braking cycles, repeated thermal loading, and intensified frictional interactions. Additionally, volumetric material loss occurred at a significantly higher rate in urban conditions, with a reduction approximately 5.5 times greater than that observed for extra-urban driving. Comparative analysis of the two brake pad types revealed similar wear trends and surface evolution, despite potential differences in chemical composition and design. These findings suggest that operating conditions exert a dominant influence on long-term performance, potentially overshadowing compositional variations within the tested range. Zygo optical profilometry was used in order to observe the evolution of surface topography and quantify degradation. These results highlight the critical impact of real-world operating conditions on wear and stability. In urban environments, where wear progresses most rapidly and surface instability is prevalent, careful selection of brake pad materials will be essential.

Keywords: brake pads, wear behavior, friction materials, Zygo profilometry, surface integrity, urban vs. extra-urban conditions

A.11. INFLUENCE OF MQL LUBRICANT QUANTITY ON AIRBORNE PARTICULATE EMISSIONS AND SURFACE QUALITY IN MILLING OF AL 6061-T6

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Abstract. Minimum Quantity Lubrication (MQL) is recognized as a sustainable alternative to conventional flood cooling in machining processes, providing reduced fluid consumption and enhanced environmental performance. Nevertheless, the atomization of lubricants during MQL can generate airborne particulate matter (PM), which raises concerns regarding operator health and process optimization. This study examines the effect of lubricant quantity in MQL on

airborne particle emissions (PM1, PM2.5, and PM10) and surface quality during the milling of aluminum alloy 6061-T6. Experimental tests were conducted under varying cutting conditions, with cutting speeds between 50 and 150 m/min. The MQL system supplied a vegetable-based lubricant (sunflower oil) at flow rates corresponding to the 1/10 and 2/10 settings, representing incremental increases in lubricant supply. Airborne particle concentrations (PM1, PM2.5, PM10) were monitored in real time, and surface quality was assessed based on measured roughness characteristics. The results demonstrate a direct relationship between lubricant quantity and airborne particle generation. Increasing the lubricant from the 1/10 to the 2/10 setting resulted in a marked rise in particulate emissions across all monitored fractions (PM1, PM2.5, and PM10). This increase is attributed to greater atomization and dispersion of oil droplets at higher flow rates, which elevates the concentration of suspended particles in the machining environment. Surface quality analysis indicated that lower lubricant levels (1/10) produced a superior surface finish compared to higher levels (2/10). This finding suggests that excessive lubricant can hinder chip evacuation or create unstable lubrication regimes, thereby negatively impacting final surface integrity. Overall, the findings demonstrate a trade-off between lubrication efficiency and environmental impact in MQL-assisted machining. The study underscores the importance of optimizing lubricant dosage to minimize airborne particle emissions while maintaining or enhancing surface quality. These results provide practical guidance for selecting MQL parameters in aluminum machining and have significant implications for both process performance and occupational health.

Keywords: Minimum Quantity Lubrication (MQL), Al 6061-T6, milling, airborne particulate matter, PM1, PM2.5, PM10, lubricant flow rate, surface quality, surface integrity

A.12. THE IMPACT OF NEW CNC TECHNOLOGIES ON INDUSTRIAL PRODUCTIVITY

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Abstract. This paper analyzes how recent advancements in Computer Numerical Control (CNC) technology are transforming manufacturing processes, with a particular focus on increasing operational efficiency and output within the context of Industry 4.0. The study explores the integration of innovations such as real-time monitoring, IoT-based predictive maintenance, and artificial intelligence algorithms to optimize cutting tool paths.

The research highlights that adopting modern machining centers significantly reduces cycle times and human error, ensuring superior precision and repeatability. Furthermore, the paper evaluates the benefits of CAD/CAM/CNC system interoperability and the impact of digitalization on the flexibility of small and medium-batch production. The results indicate that investing in cutting-edge CNC technologies not only accelerates time-to-market but also contributes to process sustainability by optimizing resource and energy consumption. The paper concludes that the smart integration of these systems is a vital pillar of enterprise competitiveness in today's industrial environment.

Keywords: CNC technology, industrial productivity, Industry 4.0, automation, process optimization, IoT

A.13. OPTIMIZATION OF ELECTRICAL DISCHARGE MACHINING (EDM) PARAMETERS FOR METALLIC MATERIALS: INFLUENCE ON MATERIAL REMOVAL RATE AND SURFACE ROUGHNESS

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Abstract. Electrical Discharge Machining (EDM) is extensively utilized for processing hard-to-machine metallic materials, providing high precision and the ability to generate complex geometries regardless of material hardness. The performance of EDM is significantly affected by the selection of process parameters, which directly influence both machining output and surface integrity. This study investigates the optimization of EDM parameters for metallic materials, focusing on their effects on material removal rate (MRR) and surface roughness (Sa). Experiments were conducted on high-quality carbon steel and a copper-based alloy (OLC45 and C120T). Two tool electrode materials, pure copper (Cu 99.9%) and tungsten (W), were used to assess their impact on machining performance. The primary process parameters analyzed included peak current (Ip), pulse-on time (Ton), and pulse-off time (Toff). Surface characterization employed the areal roughness parameter Sa to provide a comprehensive evaluation of surface topography. Results indicate a strong dependence of MRR on the selected electrical parameters. Specifically, material removal rate increases with higher peak current (Ip) and pulse-on time (Ton) due to greater energy input during discharge. In contrast, pulse-off time (Toff) exerts a minimal effect on MRR, resulting in only a slight decrease. The type of machined material (OLC45 versus C120T) exhibited a negligible influence on MRR. Among the electrodes tested, pure copper (Cu 99.9%) achieved the highest material removal rate, indicating superior productivity. In terms of surface quality, surface roughness parameter Sa increased with higher peak current (Ip) and pulse-on time (Ton), which is attributed to the formation of larger discharge craters and greater thermal impact on the machined surface. Overall, the study highlights the trade-off between productivity and surface quality in EDM processes. The findings provide practical guidelines for selecting machining parameters that balance high material removal rate with enhanced surface integrity.

Keywords: Electrical Discharge Machining, material removal rate, surface roughness

A.14. INFLUENCE OF ABRASIVE WATER JET CUTTING PARAMETERS ON SURFACE QUALITY OF COPPER, BRASS AND BRONZE ALLOYS

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Abstract. Abrasive Water Jet (AWJ) cutting is an increasingly significant non-conventional machining process for metallic materials, especially for alloys such as copper, brass, and bronze, which present challenges in conventional machining due to their ductility and thermal properties. Surface quality is highly dependent on the selection and optimization of process parameters. This study provides a comprehensive analysis of the effects of key AWJ parameters on the surface quality of copper-based alloys. The experimental investigation examined primary process variables, including jet pressure, traverse speed, abrasive flow rate, stand-off distance (nozzle-to-workpiece distance), material thickness, and chemical composition. Results indicate that jet pressure, traverse speed, and stand-off distance have the greatest influence on surface quality.

Analysis of pressure effects identified two distinct operating regimes: low-pressure conditions (110–150 MPa) and high-pressure conditions (200–300 MPa). Superior surface quality was achieved when material thickness was limited to approximately 10 mm under low-pressure conditions, while acceptable quality was maintained up to approximately 18 mm under high-pressure conditions. Surface quality was evaluated along both linear and circular cutting paths (internal and external contours), facilitating the identification of key dimensional deviations, such as kerf width at the jet entry and exit, deviation from perpendicularity, and jet inclination angle. Surface roughness was assessed using both direct measurements and image analysis, which revealed characteristic defects associated with the AWJ process, including micro-chipping and striation patterns. In the final stage, statistical analysis using Pearson's correlation was conducted to evaluate the influence of each process parameter on surface quality. Advanced optimization techniques, including artificial neural networks, the Taguchi method, and the Petrovic Sladjana–Radovanovic method, were employed to determine optimal processing conditions. Experimental validation confirmed the effectiveness of these optimization approaches. This study offers valuable insights into the relationship between AWJ process parameters and surface integrity, providing practical guidelines to enhance machining performance and ensure high-quality surface generation in copper-based alloys.

Keywords: abrasive water jet (AWJ), copper alloys, brass, bronze, surface quality, process parameters, jet pressure, traverse speed, surface roughness, process optimization

A.15. COMPARATIVE STUDY OF FILLING SHAPES AND 3D PRINTING PARAMETERS ON THE PERFORMANCE OF PLA SAMPLES

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Abstract. In engineering design, 3D-printed polymer parts are often used as preliminary functional prototypes before the final component is manufactured from metal. Their role is essential in validating geometry, assembly, and behavior in real mechanisms under operating conditions. Therefore, obtaining mechanically resistant printed parts is necessary to ensure reliable experimental testing prior to final metal production. This study investigates the influence of internal infill geometry, infill density, and printing speed on the mechanical performance, material consumption, and surface quality of polylactic acid (PLA) components produced using fused filament fabrication (FFF). Three infill patterns (triangular, concentric, and gyroid), four infill densities (15%, 30%, 60%, and 90%), and two printing speeds (50 mm/s and 100 mm/s) were experimentally analyzed. A total of 24 specimens were manufactured using an Ultimaker S5 printer and tested through tensile experiments, mass measurements, and non-contact optical profilometry. The results indicate that infill density is the dominant parameter affecting tensile strength, explaining approximately 70% of the observed mechanical variation. Tensile strength increases consistently with higher material volume fraction, reaching maximum values at 90% infill density. Among the investigated internal architectures, the concentric infill pattern demonstrated the highest structural efficiency, achieving the best strength-to-weight ratio and the highest tensile strength across most experimental conditions. In contrast, the triangular pattern generally exhibited the lowest mechanical performance, while the gyroid structure provided intermediate results due to its continuous internal geometry. Printing speed showed a secondary influence on tensile strength, with lower speeds slightly improving interlayer adhesion and mechanical resistance. However, higher printing speed contributed to improved surface uniformity and reduced surface deformation, particularly at low infill densities. Statistical analysis using ANOVA confirmed the dominant role of infill density, followed by infill pattern, while printing speed showed limited statistical significance within the investigated range. Overall, the study demonstrates that optimized internal architecture and density are key factors for improving the mechanical efficiency of FFF-printed PLA components. The best balance between strength, material consumption, and manufacturing efficiency was achieved using

concentric infill combined with medium-to-high infill densities. These findings contribute to the optimization of additive manufacturing parameters for lightweight and mechanically efficient polymer components.

Keywords: PLA, FFF, 3d-print, strenght

A.16. STUDIES CONCERNING USING ARTIFICIAL INTELLIGENCE IN TECHNICAL HIGHER EDUCATION

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Abstract. This paper investigates the integration and impact of Artificial Intelligence (AI) within technical higher education, focusing on engineering, computer science, and other technology-driven disciplines. It reviews recent studies and practical implementations of AI tools—such as adaptive learning platforms, intelligent tutoring systems, automated assessment, and predictive analytics—aimed at enhancing both teaching and learning processes. The paper examines how AI can personalize educational pathways, provide real-time feedback, simulate complex technical scenarios, and support instructors in curriculum design and student evaluation. Additionally, it addresses challenges including ethical concerns, data privacy, algorithm bias, and the necessary digital competencies for educators and students. Based on a synthesis of existing research and illustrative case studies, the article proposes a framework for effective AI adoption in technical higher education and outlines future directions for sustainable, human-centred AI integration.

Keywords: Artificial Intelligence, technical higher education, adaptive learning, intelligent tutoring systems, automated assessment, predictive analytics, engineering education, educational technology, AI ethics, digital competencies

A.17. LEAN AND INDUSTRY 4.0 PRINCIPLES TOWARD INDUSTRY 5.0: A CONCEPTUAL FRAMEWORK AND EMPIRICAL INSIGHTS FROM MANUFACTURING INDUSTRY- A LITERATURE REVIEW

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Abstract. This article explores the integration of Lean management and Industry 4.0 technologies as complementary pathways toward the emerging paradigm of Industry 5.0. While Lean focuses on waste reduction, continuous improvement, and value creation, Industry 4.0 contributes digitalization, automation, and data-driven decision making. Design/methodology/approach – First, a literature review was conducted to define a comprehensive framework to understand how Lean fits into the Human-Centric (HC) paradigm of Industry 5.0. Second, a case study was employed to give empirical insights and identify practical initiatives that brands can pursue, involving manufacturing factory from Bacau County. The paper proposes a conceptual framework that synergizes these two approaches to support the transition to Industry 5.0, which emphasizes human-centricity, sustainability, and resilience. Based on empirical insights collected from manufacturing companies, the study identifies key enablers and barriers for combining Lean and digital tools, such as value stream mapping integrated with IoT, AI-based waste detection,

and collaborative robotics. The findings highlight how human-machine collaboration, workforce empowerment, and sustainable production can be achieved by merging Lean principles with Industry 4.0 technologies. The proposed framework offers practical guidance for manufacturers aiming to align their operations with Industry 5.0 goals while maintaining efficiency and adaptability.

Keywords: Lean management, Industry 4.0, Industry 5.0, human-centric manufacturing, sustainability, resilience, digital transformation, conceptual framework, empirical insights

A.18. OPTIMIZING THE DESIGN OF AN ORTHOSIS FOR SMARTPHONE USERS. INVESTIGATION OF BIOMECHANICAL SUPPORT NEEDS OF AFFECTED PATIENTS WITH PAINFUL HAND CONDITION

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Abstract. Smartphone users often complain that experienced a painful hand condition on the radial side of their wrist, particularly that involve twisting the wrist and extending the thumb. One of the conservative treatments prescribed for this hand condition is splinting. Splinting as a form of treatment can help patients to stabilize their injured wrist and aid the healing process of the inflamed tendons and sheaths by supporting the thumb and minimizing hand movement. This study has explored the ergonomic shape of the thumb and wrist, and investigated the different curvatures along the radial side of the hand by using part-by-part measurements based on three angles. The quantification of the curvatures of the hand may enhance the knowledge of clinicians on the shape of the hand with pain. The fit of the splint is a critical element that may affect the treatment compliance rate and wear comfort. To fabricate a splint with well-fitting properties, exploring the biomechanical shape of the hand is essential. In general, a literature study points more prevalent at higher risk of such pain are registered among females than males - 1.3% of women who suffer from pain versus 0.5% of men, including women in their postpartum period or those in their forties to sixties. In this study, 11 female patients are recruited for three-dimensional hand scanning and investigation of their thumb curvatures. All are left-handed and their left hand is officially diagnosed by a professional clinician. The majority have experienced pain in the injured area for 5 months to approximately 1 year. However, 1 of the patients has suffered from wrist pain for more than 6 years. The measured angles which show the different curvatures along the thumb are discussed. As a result, it can be able to fabricate splints that better support the thumb with a more accurate fit. To further explore the biomechanical support needs of affected patients, recruiting a larger sample size for a database of images scanning and more data about angles of the thumb hand are recommended for future studies.

Keywords: ergonomic shape, left hand biomechanics, Splinting treatment

A.19. FLUID FLOW ANALYSIS OF COOLING SYSTEMS EMPLOYING VARIOUS NOZZLE GEOMETRIES IN CUTTING OPERATIONS

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Abstract. Cooling systems play a critical role in machining processes, as they ensure thermal stability and prevent the excessive temperature rise that commonly results from high rotational speeds and intense friction at the tool–workpiece interface. During cutting operations, the surfaces of machining tools are subjected to substantial thermal loads, which can accelerate tool

wear, induce dimensional deviations, and negatively impact the quality of the manufactured components. To mitigate these effects, cooling systems are designed to extract heat from the machining zone through the continuous supply of a cooling medium-typically water, oil, or emulsions. This coolant is circulated by means of a pump through a network of pipes and nozzles that direct the fluid toward the cutting region. By absorbing and transporting the generated heat away from the tool and workpiece, the coolant helps maintain operational temperatures within a safe and controlled range. The effectiveness of such systems depends on maintaining adequate coolant flow and ensuring a sufficient volume of cooling fluid within the circuit. Inadequate flow can lead to overheating, tool degradation, and potential damage to the machined parts. Furthermore, regular maintenance of the cooling infrastructure is essential to prevent the accumulation of debris or deposits that may impair circulation and reduce overall system efficiency. Minimum Quantity Lubrication (MQL) represents an alternative cooling-lubrication strategy that employs very small quantities of lubricant to reduce friction and tool wear during machining. The optimal lubricant dose depends on factors such as the material being processed, the cutting parameters, and the characteristics of the lubricant itself. Although typical MQL consumption ranges from 20 to 100 ml/h, the precise quantity must be tailored to the specific machining conditions to balance effective lubrication with minimal waste, cleaning challenges, and operational costs. Consulting the guidelines provided by machine tools and lubricant manufacturers, it is recommended to determine the appropriate lubrication rate for a given application. The objective of the present study is to perform a numerical simulation and comparative assessment of different nozzle geometries used in cooling systems for machining processes. The analysis aims to identify configurations that maximize cooling efficiency and improve thermal management in cutting operations.

Keywords: fluid, flow, nozzle, cooling, cutting

A.20. THE CURRENT STATE OF EDM: AN OVERVIEW OF TECHNOLOGICAL INNOVATIONS, SUSTAINABILITY AND DIGITALIZATION

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Abstract. This review provides a comprehensive overview of the current state of electrical discharge machining (EDM), analyzing the major research and development directions that are redefining this unconventional process. In the context of the increasing demand for the machining of advanced materials – nickel-based superalloys, titanium alloys (Ti-6Al-4V), metal matrix composites (Al-SiC), and reticular structures obtained through additive manufacturing –, EDM technology has evolved from a niche method to a central pillar of high-precision manufacturing. The analysis of the recent literature highlights four fundamental trends. First, innovation in electrode engineering and micromachining plays a crucial role. The use of composite electrodes and microelectrode arrays facilitates the mass production of complex microstructures, transforming the phenomena of tool wear into a controlled mechanism. Secondly, the development of hybrid EDM/ECM processes (Electroerosion combined with Electrochemical Machining) using tubular electrodes offers remarkable solutions for removing the recast layer and obtaining micro-holes with high aspect ratios, ensuring defect-free surface integrity. A third critical direction is process sustainability. The transition from polluting hydrocarbon-based dielectrics to environmentally friendly fluids, such as vegetable oils added with copper nanoparticles, demonstrates a drastic reduction in CO₂ emissions and toxicity risks, while maintaining optimal material removal rates. Finally, digitization through Machine Learning algorithms and statistical optimization (RSM, ANOVA, NSGA-II) revolutionizes real-time quality monitoring, allowing prediction and compensation of geometric errors without laborious manual intervention. In conclusion, the current state of EDM is characterized by a strong synergy between new tool architectures, process hybridization, green manufacturing practices, and artificial intelligence, providing robust solutions to modern technological challenges.

Keywords: electrical discharge machining (EDM), review, micro-machining, hybrid processes, sustainability, Machine Learning

A.21. RESEARCH ON SOLVING A TECHNOLOGICAL MANUFACTURING PROBLEM OF THE EXHAUST PROTECTION SYSTEM FOR THE S-70M BLACK HAWK HELICOPTER ENGINE

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Abstract. This paper presents the results of applied research aimed at identifying and solving a technological problem that arose during the manufacturing process of the exhaust protection system for the S-70M Black Hawk helicopter engine. This system plays an essential role in ensuring the protection of adjacent components, increasing operational safety, and reducing the aircraft's thermal signature. The first part of the paper analyses the functional and structural requirements of the exhaust protection system, as well as the severe operating conditions imposed by the helicopter engine's duty cycle. The materials used, the geometric particularities of the assembly, and the technological constraints associated with the manufacturing processes are highlighted. The applied part of the research focuses on the causal analysis of the manufacturing issues, employing engineering methods of technological analysis. Alternative technical and technological solutions are proposed and evaluated, aimed at improving the manufacturability, quality, and reliability of the analysed component. Finally, conclusions are drawn regarding the effectiveness of the adopted solutions and their impact on the manufacturing process and on the performance of the exhaust system.

Keywords: exhaust protection, helicopter engine, S-70M Black Hawk, manufacturing, technological analysis, structural solutions, operational safety

A.22. A REVIEW REGARDING NON-DESTRUCTIVE EVALUATION OF METALLIC SURFACES USED IN ELECTRONIC CIRCUITS BY X-RAY METHODS

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Abstract. The reliability and performance of electronic circuits depend significantly on the quality and integrity of metallic surfaces within conductive paths, solder joints, and interconnections. As electronic components decrease in size and increase in complexity, advanced inspection techniques become essential. This paper provides a concise review of X-ray-based non-destructive evaluation (NDE) methods for assessing metallic surfaces in electronic circuits. X-ray inspection techniques allow visualization of internal features without causing damage to components, making them well-suited for detecting hidden defects such as voids in solder joints, cracks, delaminations, inclusions, and structural discontinuities. This review highlights the advantages of X-ray methods over other non-destructive testing (NDT) techniques, particularly regarding penetration depth, resolution, and the capability to analyze multilayer structures such as printed circuit boards (PCBs). Recent advancements in digital radiography and computed tomography (CT) are discussed, with emphasis on their roles in enhancing defect-detection accuracy and enabling three-dimensional reconstruction of complex electronic assemblies. These innovations contribute substantially to quality control, failure analysis, and predictive maintenance strategies in electronics. The review emphasizes the importance of optimizing inspection parameters and integrating X-ray NDT methods into manufacturing environments aligned with Industry 4.0 principles. Overall, X-ray-based evaluation offers a

robust and reliable approach for ensuring the structural integrity and functional performance of metallic surfaces in electronic circuits. in electronic circuits.

Keywords: X-ray NDT, electronic circuits, metallic surfaces, radiography, computed tomography, defect detection, quality contro

A.23. QUALITY CONTROL OF PLASTIC WATER STORAGE TANKS FOR POTABLE WATER APPLICATIONS

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Abstract. Plastic water storage tanks designed for potable water applications are required to meet stringent quality and safety standards to maintain water integrity and ensure long-term operational reliability. This paper provides a concise review of quality control methods relevant to plastic reservoirs, with an emphasis on materials selection, manufacturing processes, and inspection techniques aimed at preventing defects and contamination. The study underscores the significance of selecting suitable food-grade polymers, such as high-density polyethylene (HDPE), which provide chemical stability, corrosion resistance, and adherence to drinking water standards. Principal manufacturing processes, including rotational molding and extrusion, are examined for their impact on wall thickness uniformity, structural integrity, and surface quality. A range of inspection and testing methods is discussed, including visual inspection for surface defects, leak testing for verifying tightness, and non-destructive testing (NDT) techniques such as ultrasonic testing for evaluating wall thickness and detecting internal discontinuities. Furthermore, mechanical testing and pressure-resistance assessments are identified as essential for validating tank performance under operational conditions. The review highlights the importance of standardized procedures and regulatory compliance in ensuring product safety and durability. In addition, the adoption of advanced monitoring and quality assurance systems is recognized as a critical factor in enhancing manufacturing consistency and promoting sustainable water storage solutions. In summary, robust quality control of plastic water tanks plays a vital role in safeguarding public health and ensuring the reliability of water supply systems.

Keywords: plastic tanks, potable water, HDPE, quality control, non-destructive testing, leak testing, ultrasonic testing, surface integrity

A.24. INTELLIGENT OPTIMIZATION OF ABRASIVE WATER JET MACHINING PARAMETERS USING ARTIFICIAL NEURAL NETWORKS

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Abstract. Abrasive Water Jet Machining (AWJ) is extensively employed for processing diverse materials because of its versatility, lack of thermal effects, and ability to machine complex geometries. The quality of machined surfaces and process efficiency are significantly affected by various interdependent technological parameters. This study introduces a neural network-based method for optimizing critical AWJ process parameters. Experimental investigations involved varying jet pressure (700, 1000, and 1500 bar), stand-off distance between the nozzle and workpiece (0.2, 0.5, and 1 mm), and abrasive flow rate (10 g/min, 50 g/min, and 250 g/min). The effects of these parameters on output responses, including surface roughness and cutting performance, were analyzed. An artificial neural network (ANN) model was constructed to capture the nonlinear relationships between input parameters and output characteristics. The results indicate that jet pressure and abrasive flow rate have a substantial impact on material

removal efficiency, whereas stand-off distance is crucial for surface quality. The trained ANN model served as an effective predictive tool, facilitating the identification of optimal parameter combinations that balance productivity and surface integrity. The proposed approach demonstrates the potential for integrating intelligent modeling techniques into AWJ process control, thereby enhancing performance and supporting the transition to data-driven manufacturing systems consistent with Industry 4.0 principles.

Keywords: abrasive water jet machining, AWJ, neural networks, process optimization, surface roughness, stand-off distance, jet pressure, abrasive flow rate

A.25. EFFECT OF RASTER ANGLE ON THE MECHANICAL BEHAVIOR OF 3D PRINTED THERMOPLASTIC POLYURETHANE

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Abstract. In this work, a thermoplastic polyurethane (TPU), commercially known as NinjaFlex with a Shore hardness of 85A, is mechanically characterized to extract its stress-strain behavior. The characterization is performed using additively manufactured (i.e., 3D printed) specimens with different infill orientations (i.e., 0°, ±45°, and 90°) to investigate the effect of raster angle on the mechanical properties of the material. Based on the experimental data, a hyperelastic material model is developed and implemented for use in finite element modeling (FEM) simulations. Experimental validation using a 3D printed soft pneumatic actuator showed strong agreement with numerical predictions in terms of bending deformation and force output. These results confirm the reliability of the proposed FEM framework in capturing the bending deformation and force output of TPU-based soft pneumatic actuators used in various applications within the soft robotics field.

Keywords: Additive manufacturing, finite element modeling, hyperelastic material modeling, raster angle effects, soft pneumatic actuators, thermoplastic polyurethane, 3D printing

A.26. EVALUATION OF CUTTING TEMPERATURE IN THE MILLING OF Ti48Al2Cr2Nb ALLOY USED FOR AERONAUTICAL APPLICATIONS

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Abstract. The measurement of cutting temperature is essential to properly justify the influence of cutting conditions on aspects such as tool wear and the surface integrity of the machined workpiece. In machining processes in which the tool does not move, such as turning, thermocouples can be placed close to the cutting zone or techniques such as infrared thermography can be used. However, these methodologies require the cutting temperature to be inferred through simulation, since the measurements are not performed directly at the tool-workpiece contact.

In milling operations, the aforementioned techniques are difficult to apply because the main or cutting motion is performed by the tool, resulting in intermittent contact with the workpiece. Temperature measurement using thermocouples can be carried out by fixing them to the workpiece; however, the temperature obtained, even when inferred through simulation, is unreliable. Likewise, infrared thermography does not allow adequate focusing on the tool-workpiece contact. In the present work, a methodology based on the natural thermocouple is proposed for measuring the cutting temperature in milling operations of the Ti48Al2Cr2Nb alloy.

The method is based on the calibration of the Ti48Al2Cr2Nb/WC pair, which is carried out by prolonged heating of the junction area using a flame, obtaining the corresponding voltage-temperature curve up to 1000 °C, since the tool structure becomes unstable at higher temperatures. In the milling operations considered, much higher cutting temperatures are reached; however, the contact time at such temperatures is very short due to the intermittent nature of the contact, without tool degradation. The results obtained allow the cutting temperature to be determined as a function of cutting speed and workpiece feed rate.

Keywords: Ti48Al2Cr2Nb, milling, cutting temperature, natural thermocouple

A.27. EXPERIMENTAL STUDY ON THE EFFECT OF BALL BURNISHING ON SURFACE QUALITY AND CORROSION RESISTANCE

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Abstract. AISI 1045 steel is widely used in general mechanical applications due to its good mechanical strength; however, it is susceptible to corrosion, particularly in humid or saline environments. Burnishing, as a surface treatment process, is known to improve surface finish and enhance the aesthetic appearance of metallic components, while also providing a certain level of corrosion protection. Nevertheless, the effectiveness of burnishing in improving the corrosion resistance of AISI 1045 steel has not yet been fully quantified. This study aims to evaluate the influence of burnishing on surface quality and corrosion resistance of AISI 1045 steel. Surface quality is assessed through surface roughness measurements, while corrosion behavior is evaluated using the mass loss method. The results provide a quantitative assessment of the relationship between burnishing-induced surface modification and corrosion performance.

Keywords: AISI 1045 STEEL, Burnishing, Corrosion, Roughness

A.28. INTEGRATION OF ARTIFICIAL INTELLIGENCE IN THE COMPUTER-AIDED DESIGN PROCESS

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Abstract. The rapid advancement of artificial intelligence technologies is transforming engineering design practices. In this context, engineers are required to adapt their working methods and integrate artificial intelligence-based tools into the computer-aided design (CAD) process. Consequently, the role of the engineer is evolving from manual modelling toward defining design requirements, evaluating automatically generated alternatives, and making decisions based on technical and economic criteria. This paper investigates the integration of artificial intelligence into the CAD process to support the automatic generation of design concepts in the early stages of industrial system development. The proposed approach is based on parametric modelling and CAD automation, enabling the generation and modification of 3D models and assembly configurations. Artificial intelligence generates the code required for modelling or parameter modification. This code is executed in a programming environment communicating with the CAD system through automation interfaces, based on design

requirements defined by the engineer. The results highlight the potential of artificial intelligence to support engineering design and improve decision-making processes.

Keywords: artificial intelligence, computer-aided design, CAD automation, decision support

A.29. SYNTHESIS ON THE CONSTRUCTION AND CONTROL OF TECHNOLOGICAL PARAMETERS IN RECIRCULATING AQUACULTURE SYSTEMS

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Abstract. Recirculating aquaculture systems (RAS) are innovative and sustainable technologies developed for intensive fish production while minimizing water consumption and environmental impact. As the demand for fish products continues to grow and natural aquatic resources decline, RAS has become an effective alternative to conventional aquaculture systems. These systems operate by continuously treating and reusing water through mechanical, biological, and chemical filtration processes, ensuring stable and controlled environmental conditions for aquatic organisms. The paper presents the construction of RAS includes essential components such as culture tanks, mechanical and biological filters, oxygenation units, pumps, heating or cooling systems, and monitoring devices. Effective management of technological parameters, including dissolved oxygen, temperature, pH, ammonia, nitrite, and carbon dioxide, essential for maintaining fish health and production efficiency, is detailed. Modern RAS increasingly incorporate automation and digital monitoring systems that improve operational control, reduce labor requirements, and enhance safety are presented. A discussion about energy consumption as one of the major economic challenges associated with RAS operation is made. Despite high investment and energy costs, RAS provides major environmental, economic, and sustainability advantages for future aquaculture development.

Keywords: recirculating aquaculture systems, fish production, digital monitoring systems, water treating

A.30. STUDY OF MATERIAL FORMABILITY AND SURFACE ROUGHNESS OF SPIF-ED PARTS MADE BY TITANIUM ALLOY

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Abstract. Forming titanium alloys at room temperature presents significant challenges due to their inherent properties, such as poor formability (low ductility), high yield strength, and a high strength-to-modulus ratio. To overcome these difficulties, warm/hot single point incremental forming (SPIF) emerges as a versatile and effective alternative to specialized techniques like

superplastic forming, especially suited for small-batch production and non-structural applications. This approach eliminates the necessity for costly die tooling, thereby significantly reducing the manufacturing costs of prototypes and customized components (e.g., medical implants). The aim of this paper is to present findings from a study that investigated the effects of forming temperature and size of the vertical tool step on the formability of Ti6Al4V metal sheets, as well as the surface roughness (Sa) of the finished parts. A funnel geometry and a spherical-head tungsten carbide tool was employed for testing. The results indicate that increasing the forming temperature from 300 to 500°C enhances material formability and reduces surface roughness by up to 30%. Conversely, an increase in the vertical step of tool from 0.25 to 0.75 mm resulted in decreased material formability and increased surface roughness by up to 12%.

Keywords: emerging technologies, SPIF, Ti6Al4V, formability, surface finishing

A.31. RESEARCH ON PHYSICAL PROPERTIES OF 3D PRINTED PARTS

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Abstract. This article reviews and synthesizes recent research on the physical properties of parts manufactured through additive manufacturing (3D printing). It focuses on key property categories including mechanical (tensile strength, hardness, fatigue resistance, impact behavior), thermal (conductivity, heat deflection temperature), dimensional (accuracy, surface roughness, porosity), and microstructural characteristics. The paper examines how different 3D printing technologies (e.g., FDM, SLA, SLS) and process parameters (layer height, infill density, printing orientation, nozzle temperature, print speed) influence the final physical properties of printed components. Material-specific behaviors are discussed for thermoplastics, photopolymers, metals, and composites. The article also highlights common characterization methods (tensile testing, DSC, SEM, CT scanning) and addresses challenges such as anisotropy, interlayer adhesion, and repeatability. Finally, it outlines research gaps and future directions toward optimizing 3D printed parts for functional, load-bearing, and end-use applications.

Keywords: 3D printing, additive manufacturing, properties, dimensional accuracy, process parameters, material characterization

A.32. STRUCTURAL ANALYSIS OF BIODEGRADABLE POLYESTER ELEMENTS MANUFACTURED BY FDM

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Abstract. This study investigated the use of biodegradable thermoplastic polyester, derived from renewable resources such as corn starch, for the manufacture of integrated strength elements in mechatronic system assemblies. The main objective was to assess the viability of this polymeric material in the context of industrial sustainability and structural integrity under static loads. The analysis of stiffness and fatigue resistance was performed by implementing the Finite Element Method (FEM), using the Ansys Static Structural numerical computing environment to simulate the distribution of unit stresses and deformation fields. The methodology involved the rigorous definition of material properties specific to the additive manufacturing process. Following processing by fused deposition modeling (FDM) technology, high dimensional stability was found, characterized by negligible volumetric shrinkage and the absence of the phenomenon of deformation of the basal layers (warping), aspects that allow the elimination of technical requirements for thermostatic enclosures or heated construction platforms. This polymer has been

shown to have universal compatibility with existing FDM terminals, including entry-level units. From the comparative analysis of experimental and numerical results, a favorable structural rigidity was observed, but a higher fragility was identified compared to conventional technical polymers, such as acrylonitrile-butadiene-styrene (ABS) or glycol-modified polyethylene terephthalate (PETG). The conclusions of the study highlight the fact that mechanical properties and geometric stability are compromised at operating temperatures exceeding the critical threshold of 60°C. It was established that the use of this type of polyester is contraindicated for functional components subject to intense thermal stress or for prolonged exposure in outdoor environments under the direct action of solar radiation, requiring a rigorous selection of applications depending on the thermal regime and the degree of mechanical resilience required.

Keywords: additive manufacturing (FDM), biodegradable polyester, finite element analysis (FEM), dimensional stability, structural integrity

A.33. THE INFLUENCE OF ROLLING TECHNOLOGICAL PARAMETERS ON THE PERFORMANCE OF THE SURFACE LAYER OBTAINED BY BURNISHING – A REVIEW

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Abstract. This paper presents a comprehensive analysis of burnishing, a rolling process applied to external surfaces, emphasizing its impact on metal processing as a critical operation for optimizing mechanical properties. Burnishing, a phenomenon that strengthens the surface layer through cold plastic deformation, significantly enhances the wear resistance, fatigue strength, and corrosion resistance of machined parts. This technique is widely used across industries, including automotive, aerospace, and machine manufacturing. The primary objective of this review is to examine the fundamental mechanisms of burnishing, its effects on metallic surface properties, and the influence of key technological parameters on the process. The analysis focuses on the relationship between burnishing and surface-layer characteristics, with particular attention to microstructural modifications, residual-stress distributions, and improvements in the mechanical properties of machined components. The methodology involves synthesizing specialized literature on burnishing theories, stress- and deformation-analysis models, and experimental techniques for surface-layer characterization. Additionally, the review evaluates the applicability of burnishing across various manufacturing processes and compares its efficiency with other finishing and mechanical treatment methods. The results demonstrate that burnishing substantially increases surface hardness and reduces surface roughness, thereby improving the mechanical performance of machined parts. Furthermore, the compressive residual stresses generated by burnishing enhance fatigue resistance and durability in service. Compared to alternative finishing methods, burnishing offers significant advantages in terms of production costs and process sustainability. The conclusions underscore the need to optimize burnishing process parameters to achieve superior surface characteristics. Future research should prioritize the development of advanced predictive models and the integration of modern technologies for real-time monitoring and control of the burnishing process.

Keywords: burnishing, cold plastic deformation, surface finishing, residual stresses, hardness, metal processing

A.34. ANALYSIS OF THE CURRENT STATE AND PERFORMANCE OF BUILDING-INTEGRATED SOLAR THERMAL SYSTEMS

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Abstract. This paper presents a synthesis of contemporary solar thermal technologies, evaluating the diversity of energy harvesting solutions and their integration methods within the built environment. The primary objective is to analyze the operational performance of the main collector types: flat-plate (glazed and unglazed), evacuated tube (U-Pipe and Heat-Pipe configurations), and transpired solar air systems. The study investigates the heat transfer mechanisms specific to each technology, highlighting niche solutions such as concentrating solar systems for high-temperature applications and unglazed collectors designed for low-temperature regimes. Critical aspects regarding operational safety are evaluated, focusing on the DrainBack system as an effective protection method against thermal stagnation and freezing. Furthermore, the paper analyzes sectoral opportunities and challenges in developing solar heating and cooling projects, correlating the national solar irradiance potential with the requirements for domestic hot water and space heating. The results emphasize that optimizing the solar fraction depends on the rigorous selection of technology based on the building's purpose, representing a strategic direction for achieving energy efficiency and decarbonization goals in the built environment.

Keywords: Building-Integrated Solar Thermal (BIST), transpired air collectors, concentrating systems, Heat-Pipe, DrainBack system, operational performance

A.35. ANALYSIS OF THE EFFECTS OF THE MACHINING PARAMETERS ON THE CUTTING FORCES DURING FACE MILLING OF A MAGNESIUM ALLOY

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Abstract. Magnesium alloys are a feasible choice when weight reduction is critical and the demand for structural strength is moderate, especially in industrial sectors such as automotive, aerospace, consumer electronics or sports equipment. These materials offer a good machinability, an excellent strength to weight ratio, and can be up to 75% lighter than steel and 33% lighter than aluminum equivalent parts. Even more, magnesium alloys are biocompatible and naturally degrade into the living tissues, thus making them usable as temporary implants and eliminating the necessity of removal surgery. However, machining magnesium alloys is associated with risks due to flammability, dust hazard and corrosive chemical reactions. Fine chips, dust or magnesium powders are highly flammable, burn with high temperature flames (approximately 3100°C) and require special fire extinguishing agents. Adhesion is another issue that must be taken into account in magnesium alloys machining. Built-up edge and adhered layers are favored by the low melting point, the smearing instead of clean shearing behaviour, and the chemical affinity to iron-based materials. Temperature and cutting forces must be strictly controlled to prevent the adhesion phenomena. The current paper analyses the influence of the machining parameters and conditions on the cutting forces using a design of experiments methodology.

Keywords: face milling, magnesium alloy, cutting forces, machining parameters

A.36. STUDIES AND RESEARCH ON THE USE OF 3D PRINTED BIODEGRADABLE MATERIALS FOR BIOLOGICAL FILTRATION IN RECIRCULATING AQUACULTURE SYSTEMS

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Abstract. Recirculating aquaculture systems maintain their viability by maintaining the balance of dissolved oxygen concentrations in water, ammonium, nitrite and nitrate concentrations at acceptable toxicity levels for the fish biomass present. To this end, the research proposes for analysis a class of 3D printed biodegradable materials with a 3D biofilter role, more specifically polylactic acid PLA and polylactic acid with 8% carbon inserts CF which can have an active role as active support for nitrifying bacteria colonies. The research will focus on evaluating the design and establishing the structure of 3D printed materials suitable for layer-by-layer FDM printing. Also, the research will test the mechanical properties, surface properties (roughness and contact angle) and additionally the imaging analysis of the 3D printed surfaces. We mention that these properties were taken into account in order to have the largest possible lateral surface that can be colonized with bacteria to eliminate the excess concentrations of ammonium, nitrites resulting from the presence of resident fish mass. Acknowledgements: This work was funded by the "Dunarea de Jos" University of Galați, Romania, research grant no. 7949/31.03.2025

Keywords: 3D biofilter, biological filtration, polylactic acid (PLA), PLA + 8% CF composite material

A.37. EXPERIMENTAL RESEARCH ON THE IMPACT OF CUTTING PARAMETERS ON SURFACE QUALITY IN THE MACHINING OF TITANIUM ALLOYS

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Abstract. Titanium alloy Ti-6Al-4V is recognized as a material of strategic importance in high-performance industries such as aerospace, biomedical engineering, and automotive manufacturing due to its exceptional strength-to-weight ratio, corrosion resistance, and biocompatibility. However, Ti-6Al-4V is also difficult to machine because of its low thermal conductivity, high chemical reactivity at elevated temperatures, and tendency to work-harden. These characteristics contribute to rapid tool wear and compromised surface integrity. This study examines the influence of three principal cutting parameters: cutting speed, feed rate, and depth of cut, on the surface roughness (Ra) of Ti-6Al-4V components produced by CNC turning. Although previous research has explored individual parameter effects or focused on tool life optimization, systematic characterization of parameter interactions under varied machining regimes remains limited. The experimental campaign addresses this gap by employing a structured parameter variation approach to identify optimal machining conditions. The results indicate that feed rate has the most significant effect on surface roughness, followed by depth of cut and cutting speed. This trend aligns with findings reported in the literature for other difficult-to-machine alloys. The optimal parameter combination identified—cutting speed of 580 m/min, feed rate of 0.06 mm/rev, and depth of cut of 0.25 mm—produced a superior surface finish and offers practical guidance for industrial process planning. These findings support evidence-based

recommendations for selecting machining parameters for titanium alloys, thereby improving process efficiency, dimensional accuracy, and surface integrity in precision manufacturing.

Keywords: Ti-6Al-4V, titanium alloys, CNC turning, cutting parameters, surface roughness, surface quality

A.38. EXPERIMENTAL ASPECTS REGARDING THE DETERMINATION OF THE RESULTANT OF CUTTING FORCES AND MOMENTS DURING FINISH GRINDING OF HARD MINERAL MATERIALS WITH DIAMOND DISCS

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Abstract. The paper presents the experimental installation for measuring cutting forces and moments in the finishing grinding process of mineral materials. The chosen factorial experimental design is 31×22 . We work with three input variables: cutting speed, longitudinal feed, cutting depth and output variables: cutting force components F_x , F_y , F_z and cutting moments M_x , M_y , M_z . The experimental research conclusions regarding the variation of cutting forces and moments as well as the degree of machinability in the case of mineral materials tested in the finishing grinding.

Keywords: finishing grinding, mineral materials, diamond discs, criterion of cutting forces, factorial experiment, degree of machinability

A.39. RESEARCH METHODOLOGIES FOR INVESTIGATING THE THEORETICAL PREMISES UNDERLYING TECHNOLOGICAL INFLUENCE ON PRESCHOOLERS' PSYCHOSOCIAL DEVELOPMENT

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Abstract. Early childhood education plays a critical role in shaping the foundations of personality, encompassing cognitive, social, and behavioral dimensions. Investigating technical influences on preschool children, as well as strategies to enhance these influences through educational interventions, is essential for improving teaching methods that support holistic personality development. Extending such analyses to primary school students offers a broader perspective on the continuity and evolution of technical behaviors throughout the initial stages of education. This study focuses on assessing children's technical abilities and evaluating the effects of targeted educational interventions. The Technical Abilities Test was administered to a sample of 24 preschool-aged children and to children in the third and fourth grades, enabling comparative analysis across age groups. The objective was to measure both initial and final levels of technical behavior following an intervention period involving engineering-oriented role-play activities. This approach was informed by existing research demonstrating the effectiveness of role-play in fostering empathy, collaboration, and the internalization of social norms. The data indicate an overall improvement in technical behaviors among most participants following the intervention. The activities fostered active engagement, creativity, and structured thinking, contributing to the

development of early technical competencies across all analyzed groups. However, the analysis also identified regression in three evaluated indicators, with some children shifting from positive (YES) to negative (NO) responses between the initial and final assessments. These variations illustrate the complexity and dynamic nature of socio-emotional development, particularly at the preschool level and in early primary education. Behavioral fluctuations may result from factors such as emotional state, motivation, group dynamics, fatigue, and the evaluation context. This variability reflects the developmental instability characteristic of early childhood, where progress is not consistently linear. The evidence underscores the importance of flexible and adaptive pedagogical strategies that consider individual differences and contextual factors. The findings support the use of technical role-play activities as an effective tool in early education and highlight their sustained impact in subsequent stages of schooling.

Keywords: Technical Abilities Test, technical behaviors

A.40. A REVIEW REGARDING ELECTRICAL DISCHARGE MACHINING (EDM) OF TITANIUM ALLOYS

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Abstract. Titanium-based materials possess an excellent strength-to-weight ratio, corrosion resistance, and stability at elevated temperatures, which has led to their widespread application in aerospace, medical, and energy industries. However, their low thermal conductivity and pronounced tendency toward work hardening present significant challenges for conventional machining methods. Electrical Discharge Machining (EDM) offers an effective alternative for processing these hard and difficult-to-machine materials. This paper reviews recent advancements in the EDM machining of titanium alloys, with particular emphasis on the influence of technological parameters on surface quality and process performance. The effects of discharge current, pulse duration, discharge voltage, and dielectric medium are examined in relation to material removal rate (MRR), tool wear rate (TWR), and surface roughness (Ra, Sa). Additionally, emerging research directions are discussed, including the application of composite electrodes, nanoparticle-enhanced dielectrics, and hybrid technologies such as ultrasonic- or magnetic-assisted EDM. These approaches contribute to improved process stability and a reduction in surface defects, including recast layers and microcracks. The reviewed literature underscores the necessity of optimizing the EDM process for titanium alloys to achieve a balance between productivity and surface quality. This analysis provides a foundation for developing efficient technological strategies and for integrating EDM into advanced manufacturing and Industry 4.0 frameworks. In conclusion, the selection of internal printing geometry, especially for additively manufactured titanium components, significantly influences their behavior during Electrical Discharge Machining. Incorporating these considerations during the design phase can enhance product quality and reduce manufacturing costs when EDM is integrated into the production process.

Keywords: titanium alloys, electrical discharge machining (EDM), non-conventional machining

A.41. A RESEARCH STUDY ON OCCUPATIONAL RISK ASSESSMENT AND PREVENTION MEASURES IN INDUSTRIAL ENVIRONMENTS

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Abstract. Occupational health and safety (OHS) management constitutes a fundamental aspect of industrial operations, with the primary objective of preventing accidents and safeguarding employee well-being. This study presents a research-based analysis of occupational risk assessment and the implementation of preventive measures in industrial settings, illustrated by a case study of a workplace accident resulting in permanent disability. The research examines the circumstances and root causes of the accident, identifying deficiencies in risk identification, inadequate safety procedures, and insufficient worker training. The analysis employs established risk assessment methodologies, which include systematic processes to identify hazards, evaluate the likelihood and severity of risks, and determine risk levels for specific tasks and equipment. The study pays particular attention to human factors, organizational shortcomings, and the absence or improper use of personal protective equipment (PPE), which refers to specialized clothing or gear such as helmets, gloves, or goggles designed to protect workers. The case study demonstrates that the accident was preventable through systematic risk assessment, the implementation of control measures, and ongoing workplace monitoring. The findings highlight the significance of regulatory compliance and the cultivation of a proactive safety culture within organizations. Based on the findings, the study proposes a set of corrective and preventive measures, including enhanced training programs, stricter operational procedures, and the adoption of advanced monitoring and risk management tools consistent with Industry 4.0 principles. The results underscore the necessity of a structured, research-driven approach to occupational risk management to reduce the incidence of severe accidents and improve overall workplace safety.

Keywords: occupational health and safety, risk assessment, workplace accident, disability, prevention measures, industrial safety, hazard analysis

A.42. OCCUPATIONAL HEALTH AND SAFETY AUDIT: METHODOLOGIES AND BEST PRACTICES FOR ENHANCING COMPLIANCE

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Abstract. Occupational Health and Safety (OHS) management is a foundational element in the energy sector, where operational risks are diverse and potentially high-impact. This study examines OHS audit methodologies and best practices for improving regulatory compliance, with specific reference to a case study at Delgaz Grid S.A., Bacău branch, one of Romania's leading natural gas and electricity distribution operators. The research commences with an analysis of the relevant legislative framework, including Law No. 319/2006 on occupational safety and health, its implementing regulations, and pertinent European and international standards such as ISO 45001:2018. The main types of OHS audits—internal, external, and certification—are evaluated with a focus on procedural structure, risk assessment tools, and key performance indicators used throughout the audit cycle. At the Delgaz Grid Bacău branch, the study identifies the mechanisms supporting the OHS management system and documents the strengths and vulnerabilities revealed by audit processes. The analysis addresses personnel training protocols, safe work procedures for electrical and gas-related hazards, incident reporting systems, and the extent of management involvement in promoting an organizational safety culture. The findings

demonstrate that systematic and periodic OHS audits contribute to a significant reduction in workplace accident rates and substantial improvement in regulatory compliance. The study also presents practical recommendations, including digitizing risk registers, increasing the frequency of emergency simulation exercises, and enhancing social dialogue on safety issues across all organizational levels. The conclusions highlight that excellence in OHS compliance is a dynamic process of continuous improvement, supported by responsible leadership, comprehensive professional training, and an organizational culture focused on prevention and proactive risk management.

Keywords: occupational health and safety, OHS audit, compliance, risk assessment, Delgaz Grid, industrial safety, preventive measures, continuous improvement

A.43. THE IMPACT OF ARTIFICIAL INTELLIGENCE ON OCCUPATIONAL HEALTH AND SAFETY IN THE ROMANIAN ENERGY SECTOR: FROM PREVENTION TO PREDICTION

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Abstract. This paper investigates the multidimensional impact of artificial intelligence (AI) on occupational health and safety (OHS) in Romania's energy sector. It analyzes applications such as machine learning-based hazard detection, computer vision-based safety monitoring, predictive maintenance algorithms, and real-time worker health surveillance systems. Utilizing operational data and audit findings from Delgaz Grid S.A., the study situates AI adoption within the context of Romanian and European legislative frameworks, including Law No. 319/2006, the EU OSH Strategic Framework 2021-2027, and ISO 45001:2018. The findings indicate that AI-enabled OHS systems result in measurable reductions in incident frequency rates, increased efficiency in regulatory compliance, and enhanced risk anticipation capabilities. Nevertheless, implementation is hindered by significant barriers, such as workforce digital literacy gaps, infrastructure investment needs, data privacy concerns, and the necessity of maintaining human oversight in AI-assisted decision-making processes. The paper concludes by presenting a strategic framework for integrating AI into OHS management in the Romanian energy sector. It offers targeted recommendations for energy operators, regulators, and OHS professionals to support effective navigation of this technological transition.

Keywords: artificial intelligence, occupational health and safety, predictive analytics, Romanian energy sector, risk management, machine learning, ISO 45001, Delgaz Grid

A.44. A STUDY ON FLUID FLOW SIMULATION IN THE COOLING SYSTEMS OF MACHINE TOOLS

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Abstract. In cutting processes performed on machine tools, ensuring efficient cooling of moving components is an essential condition for the proper performance of technological operations. This function is performed by means of dedicated cooling systems, specially designed for this purpose. The importance of these systems is major, having a direct influence on the stability of the cutting process, on the quality of the machined surface and on the durability of the cutting tools. A determining aspect in the efficiency of the process is the appropriate selection of the cooling and/or lubricating fluid, correlated with the material being processed, with the technological process used and with the cutting regimes adopted. Inappropriate choice of coolant can lead to

excessive temperature increases in the cutting zone, with negative effects on the quality of the surface obtained and on the tool life. The present work aims to analyze the types of cooling fluids used in machining processes, as well as to establish the criteria for their optimal selection, followed by the study of the fluid dispersion mode in the machining area. In this region, because of the interaction between the tool and the workpiece, high temperatures develop, depending on the working parameters and cutting conditions. Exceeding certain thermal thresholds can negatively affect both the geometric and functional quality of the machined surface and the integrity of the cutting tool. To evaluate the behavior of cooling and lubricating fluids, numerical simulation of their flow is used, performed with the help of specialized software, namely the Flow Simulation module in the SolidWorks environment, with the objective of reproducing as faithfully as possible the real operating conditions of the machine tool. The analyzed lubricant can consist of a combination of cooling fluids, chosen to obtain an optimal compromise between cooling capacity and lubrication efficiency of the cutting area. The fluid-lubricant flow parameters are influenced by the physicochemical properties of the fluid used, as well as by the geometry of the distribution system, especially that of the nozzle, which is usually of the convergent-divergent type, to ensure an efficient and directed dispersion of the fluid jet towards the tool-part contact area. The optimization of the fluid jet provided by the nozzle can be achieved through computer-aided simulations, using specialized programs, to obtain efficient cooling and lubrication, while reducing the amount of fluid used. The use of a minimum amount of working fluid is relevant both from an economic point of view, given the high costs of industrial lubricants, and from the perspective of environmental protection and operator health. Cooling fluids in contact with overheated surfaces can generate emissions of potentially harmful vapors and gases, which is why reducing their consumption contributes to reducing the impact on the environment and improving working conditions.

Keywords: fluid, flow, coolant, machine, tool, nozzle

A.45. OPTICAL SURFACE PROFILOMETRY OF COMPOSITE MATERIALS USING THE ZYGO ZEGAGE™ INTERFEROMETRIC SYSTEM: A REVIEW

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Abstract. Quantitative characterization of surface topography in composite materials is essential for understanding their functional behavior under mechanical, tribological, and environmental loading conditions. Coherence Scanning Interferometry (CSI), as implemented in the Zygo ZeGage™ series of 3D optical profilers, is recognized as a reference-grade, non-contact technique for precise areal measurement of surface features at the micro- and nano-scale. This review specifically examines the application of the Zygo ZeGage™ platform, including the ZeGage™ Pro and ZeGage™ Pro HR variants, in the profilometric analysis of composite material surfaces. Based on Zygo's proprietary CSI technology, the ZeGage™ system acquires up to 1.9 million data points per measurement, providing nanometer-level vertical resolution across a wide range of surface textures, from ultra-smooth polymer matrices to rough fiber-reinforced architectures. Key instrumental features relevant to composite surface analysis include the SureScan™ vibration-tolerant acquisition mode, which supports reliable measurements outside controlled laboratory environments, and the automated field stitching capability, which facilitates high-resolution inspection of large composite surface areas. The Mx™ software environment enables ISO-compliant computation of standard areal roughness parameters (Sa, Sq, Sz, Ssk, Sku) and profile parameters (Ra, Rq, Rz), supporting direct correlation between surface metrology data and composite processing or performance variables. The applications reviewed include ZeGage™-based surface characterization following machining operations such as milling,

drilling, and grinding on carbon fiber-reinforced polymer (CFRP) and glass fiber-reinforced polymer (GFRP) composites; assessment of surface degradation due to wear and fatigue; evaluation of coating adhesion quality; and post-cure surface texture analysis. Challenges unique to interferometric measurement on composite surfaces, such as signal discontinuities at fiber-matrix interfaces and phase ambiguities resulting from optical heterogeneity, are critically examined along with algorithmic and procedural mitigation strategies. The review concludes by emphasizing Zygo ZeGage™ as a versatile, industrially deployable solution for advanced composite surface metrology and identifies future research directions that integrate machine-learning-assisted data analysis with high-density interferometric datasets.

Keywords: Zygo ZeGage™, coherence scanning interferometry, optical profilometry, composite materials, CFRP, GFRP, surface roughness, areal surface texture, non-contact measurement, SureScan™, Mx™ software

A.46. ANALYSIS OF THE INFLUENCE OF PRINTING GEOMETRY ON THE SURFACE QUALITY CHARACTERISTICS OF POLYMER PARTS MANUFACTURED BY ADDITIVE TECHNOLOGIES

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Abstract. The influence of printing geometry on the surface quality of polymer-based parts has garnered increasing attention due to the rapid advancement of additive manufacturing technologies. This study examines how internal infill geometries impact both the mechanical performance and surface quality of 3D-printed components. Experiments were conducted using three widely utilized thermoplastic materials in industrial and prototyping contexts: polylactic acid (PLA), acrylonitrile butadiene styrene (ABS), and polyethylene terephthalate glycol (PETG). For each material, three distinct internal infill geometries—designated as I, H, and A—were implemented, each defined by a unique material distribution within the part volume. Manufacturing was performed under controlled conditions, maintaining constant parameters such as extrusion temperature, deposition speed, and layer height to isolate the influence of geometry. Surface quality was assessed via optical profilometry, focusing on average roughness (Ra) and areal roughness (Sa). Concurrently, mechanical tests, including bending and compression, were conducted to correlate internal structure with overall mechanical behavior. The findings demonstrate that infill geometry has a substantial impact on stress distribution and surface uniformity. The I-type structure exhibited high stiffness but entailed greater material consumption and only moderate surface quality. The H-type geometry achieved a balanced mechanical response, though it displayed increased variability in surface roughness due to structural discontinuities. Conversely, the A-type geometry resulted in a more uniform material distribution, which reduced stress concentrations and enhanced surface homogeneity. Comparative analysis showed that, among all tested configurations, the A-type structure fabricated from PLA provided the most favorable balance of material consumption, production cost, and mechanical strength. This configuration exhibited strong dimensional stability, superior surface quality, and increased material efficiency, making it well-suited for applications requiring resource optimization. In conclusion, the selection of internal printing geometry is a key determinant in optimizing the performance of additively manufactured parts. Incorporating these considerations during the design phase can substantially enhance product quality and reduce manufacturing costs.

Keywords: additive manufacturing, 3D printing, infill geometry, surface quality, surface roughness, PLA, ABS, PETG, mechanical properties, material optimization

B. OPTIMIZATION OF TECHNOLOGIES AND EQUIPMENT FROM PROCESS INDUSTRIES

B.1. OPTIMIZATION OF DEOILING UNITS AT THE PRODUCTION WATER TREATMENT STATION OF THE OHANET OIL AND GAS FIELD, ALGERIA

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Abstract. The Ohanet region in southern Algeria hosts one of the country's major natural gas production and processing facilities. The industrial operations at this site generate large volumes of oily produced water, which must be treated before discharge or reuse. The Production Water Treatment Plant (PWTP) relies primarily on physical separation processes, namely inclined plate separators (CPI) and dissolved gas flotation units (DGF), to remove residual hydrocarbons from effluents. Despite their established effectiveness, these technologies exhibit operational limitations, particularly regarding the removal of residual hydrocarbons and the prevention of oil carryover toward evaporation ponds, which poses risks of non-conformity with environmental discharge standards and represents a loss of recoverable hydrocarbons. This study aims to optimize the operational performance of the deoiling unit at the Ohanet PWTP through a structured diagnostic and experimental approach. The work begins with a comprehensive characterization of influent and effluent streams, including measurements of total petroleum hydrocarbons (TPH), chemical oxygen demand (COD), total dissolved solids (TDS), and pH. Operational mapping is carried out to assess current flow rates and washing cycles. In parallel, adsorption experiments using activated carbon are conducted to evaluate its capacity to capture residual oil through isotherm and kinetic studies. Effluent quality is investigated alongside practical solutions addressing filter clogging and cleaning procedures. Key operating parameters are identified and optimized to ensure proper unit functioning, and the performance of oil-saturated adsorbent is evaluated within the overall treatment scheme. The overall approach integrates technical performance, economic viability, and compliance with environmental norms, offering a replicable framework for oilfield produced water treatment optimization..

Keywords: Oilfield wastewater, Deoiling optimization, API separator, dissolved gas flotation, total petroleum hydrocarbons.

B.2. ULTRASOUND-ASSISTED ENZYMATIC EXTRACTION OF BANANA JUICE: IMPACT ON YIELD AND QUALITY

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Abstract. The present study evaluated the influence of ultrasound and enzymatic pre-treatments using cellulase and pectinase on the yield and quality characteristics of banana juice. A two-level full factorial design was applied, considering ultrasonication time (0 and 30 minutes), cellulase concentration (0 and 0.2%), and pectinase concentration (0 and 0.2%) as independent variables. The responses analyzed included juice yield, viscosity, clarity, total soluble solids (TSS), and pH. The results indicated that pectinase was more effective than cellulase in enhancing juice yield. Ultrasonication alone did not significantly improve yield; however, its combination with both enzymes resulted in the highest yield of 89.40%, compared to 47.30% in the untreated control. Both enzymatic treatments and ultrasound contributed to a reduction in juice viscosity. Clarity was not significantly influenced by cellulase, whereas pectinase treatment improved it. Notably,

ultrasonication alone showed a greater effect on clarity compared to individual enzyme treatments. An increase in TSS was observed with enzymatic treatment, ultrasonication, and their combined application. Although the type of treatment did not significantly affect pH, treated samples exhibited slightly lower pH values. Overall, significant relationships were observed among the evaluated response parameters.

Keywords: ultrasound, enzymatic extraction, banana juice, quality.

B.3. ASSESSMENT AND OPTIMIZATION OF THE ENERGY CONSUMPTION OF MATERIAL HANDLING TRANSPORT IN A PALLET WAREHOUSE WITH CONSIDERATION OF TRANSFER POINTS

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Abstract. Warehouses, logistics centers, and entire supply chains (SCM) are increasingly analyzed not only in terms of operational performance, but also with respect to the energy consumption of internal transport processes involving containers, bundled loads, oversized cargo, and pallets. Of particular importance is material handling transport carried out in pallet warehouses, which involves numerous intermediate operations, changes in movement direction, and transfers between transport means and functional zones of the warehouse. One of the elements that significantly affect total energy consumption is transfer points, understood as locations where pallets are received, transferred, or reloaded within the warehouse process structure. The aim of the presentation is to introduce an approach to assessing the energy consumption of material handling transport in a pallet warehouse, taking into account the impact of transfer points, and to indicate possible directions for optimizing the process under study. In the proposed approach, transfer points are treated not as passive organizational elements, but as active components of the system that generate additional time, flow losses, and increased energy demand. Their inclusion in the assessment model makes it possible to provide a more comprehensive description of the actual course of the intralogistics process. The presentation discusses the concept of identifying the main components of process energy consumption, including the movement of transport means, handling operations, and operations performed at transfer points. It also presents the rationale for developing comparative indicators that enable the evaluation of different pallet flow organization variants within the warehouse. Such an analysis may provide a basis for designing solutions that reduce the number of unnecessary transfers, shorten transport routes, and improve the energy efficiency of the warehouse system. The proposed approach has both cognitive and practical significance. It may support the design, modernization, and operation of pallet warehouses, particularly under the growing requirements related to sustainable development, rational energy use, and the improvement of the technical and organizational efficiency of internal transport.

Keywords: warehouse energy consumption, warehouse automation, energy balance, box storage systems, sustainable energy management.

B.4. POC FOR A SYSTEM TO MONITOR LOADS ON THE CHASSIS OF A HIGH-MOBILITY WHEELED VEHICLE

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Abstract. High-mobility wheeled vehicles are usually constructed by joining a base chassis with a specialized body. During the vehicle's service life, the loads on its load-bearing structure may,

in certain situations, approach or even exceed admissible values and cause even permanent deformation, eliminating the vehicle from further use. Such loads may arise not only whilst driving (primarily in off-road and cross-country conditions), but also when additional equipment installed on the vehicle chassis is used incorrectly. An example of such a situation would be when a container structure joined to a chassis with an additionally armored cab is lifted to a position in which the vehicle's wheels do not touch the ground. In this case, the load-bearing structure between the cab and the container is subjected to bending, but in the opposite direction to that which occurs whilst driving. Such loads can lead to significant stress and strain on key load-bearing components of the vehicle and, for safety reasons, should be monitored. The load history of the vehicle's structural components can be determined by designing an appropriate measurement system. This article presents a PoC (Proof of Concept) for a system to monitor overloads in the load-bearing structure of a high-mobility off-road vehicle, based on an original transducer designed especially for this purpose to measure the deformation of the vehicle frame side member, adapted to work with a system for the acquisition and processing of measurement data.

Keywords: maintenance system, high-mobility wheeled vehicle, health usage and monitoring system, transducer.

B.5. INCREASING THE EFFICIENCY OF THERMAL AGENT DISTRIBUTION IN TUNNEL DRYING INSTALLATIONS

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Abstract. The food industry involves a wide range of processes applied to the transformation of raw materials, among which drying represents a fundamental thermal treatment for agro-food products. Despite its importance, drying is characterized by high thermal energy consumption, particularly in tunnel-type installations, where efficiency is strongly influenced by operating parameters such as temperature, airflow rate, and heat agent velocity. This study focuses on improving the uniformity of the drying process by ensuring an even distribution of the thermal agent within the drying chamber. A 3D device was designed to optimize airflow distribution throughout the entire geometric volume of the tunnel. The model was developed using SolidWorks, with individual components created in the "Part" environment and assembled using the "Assembly" module. The kinematic behavior of the mechanism was analyzed through "Motion Study". The proposed mechanism enables controlled air dispersion and uniform thermal agent distribution across the chamber cross-section by adjusting the relative position of the connecting rod and crank. This leads to improved homogeneity of the drying process and contributes to reducing the overall energy consumption of the system.

Acknowledgments: The described results were obtained thanks to the research carried out within the project: 25.80012.5107.13.SE "Increasing the efficiency of the dehydration process of stone fruits by applying innovative technologies".

Keywords: installation, drying, heating agent, air flow, efficiency.

B.6. INNOVATIVE MICROWAVE-ASSISTED DRYING PROCESS FOR SEA BUCKTHORN SEEDS IN A SUSPENDED LAYER

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Abstract. This study presents an innovative drying process for sea buckthorn (*Hippophae rhamnoides*) seeds, designed for applications in the food industry and research laboratories

focusing on drying technologies. The proposed method employs a fluidized layer formed in a vertically oriented square-section tube, where seeds are suspended by an air stream with a velocity of 9.6 m/s and a flow rate of 360 m³/h. The drying process consists of three main stages: Stage I: Loading the seeds into the tube and forming the fluidized layer using the controlled air stream; stage II: Activating the microwave generator at 350 W and 2460 MHz for 140 minutes, accelerating moisture removal; stage III: Automatic separation of seeds based on mass and moisture content: initially, seeds with the lowest mass and moisture are separated, followed by intermediate seeds, and finally, after approximately 190 minutes, seeds with higher mass and moisture content are separated. This process enables high uniformity of drying in a significantly reduced time compared to conventional methods. The proposed technology offers advantages in energy efficiency, process control, and quality of the dried seeds, making it a promising solution for optimizing modern drying techniques in the food industry.

Acknowledgments: The described results were obtained thanks to the research carried out within the project: 25.80012.5107.13.SE "Increasing the efficiency of the dehydration process of stone fruits by applying innovative technologies".

Keywords: seed drying, sea buckthorn, fluidized layer, microwave drying.

B.7. DRYCONTROL MONITOR

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Abstract. DryControl Monitor is a software application developed in C++ using the Visual Component Library, intended for real-time monitoring of drying processes through an intuitive graphical user interface. The system provides a dedicated dialog window that displays process evolution using both a progress bar and a numerical indicator, ensuring clear visualization of the drying stage. The application integrates a process interruption feature, allowing the operator to stop the operation via a cancel command in case of unexpected situations, thus enhancing operational safety. Upon initialization, all monitoring parameters are reset to baseline values, ensuring accurate tracking of the drying cycle from its onset. The software efficiently manages user interface events and offers straightforward control over the monitored process. By enabling real-time visualization, process control, and safe interruption, DryControl Monitor improves the supervision and reliability of drying operations within industrial installations.

Acknowledgments: The described results were obtained thanks to the research carried out within the project: 020405 "Optimization of food processing technologies in the context of circular bioeconomy and climate change".

Keywords: Drying process, process monitoring, C++ application, real-time control, industrial automation, process optimization, operational safety, drying installations.

B.8. VALORIZATION OF BREWING INDUSTRY WASTE WITHIN THE CIRCULAR ECONOMY FRAMEWORK

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Abstract. The brewing industry, a significant global producer with an annual output of approximately 1.86 billion hectoliters, generates substantial quantities of organic waste that present both environmental challenges and economic opportunities. This paper analyzes the

transition from traditional disposal methods, such as animal feed, toward advanced valorization strategies for the industry's primary byproducts: Brewers' Spent Grain (BSG), Brewers' Spent Yeast (BSY), spent hops, and pot ale. The study details the complex chemical composition of these waste streams, highlighting the presence of cellulose, proteins, beta-glucans, and polyphenols. The methodological approaches discussed for waste transformation include: biotechnological conversion - utilizing BSG and BSY as substrates for the production of enzymes, organic acids (lactic, citric), and functional food ingredients such as xylitol or pullulan; energy recovery - the processing of spent grain for biofuel and thermal energy production, as well as the application of pot ale in anaerobic digestion for biogas generation; pharmaceutical and environmental applications - extraction of bioactive compounds like xanthohumol from hops for antimicrobial purposes and the use of BSG as an adsorbent for heavy metal removal in wastewater treatment; emission management - the capture and purification of fermentation-derived CO₂ for reuse in carbonating beverages, effectively reducing the carbon footprint of production facilities. Acknowledgments: Institutional Project 020405 "Optimizing food processing technologies in the context of the circular bioeconomy and climate change", Bio-OpTehPAS, being implemented at the Technical University of Moldova.

Keywords: circular economy, Brewers' spent grain, valorization, biotechnology, sustainability, waste management.

B.9. MICROWAVE PENETRATION DEPTH MODELING IN THE DEHYDRATION OF CAPILLARY-POROUS MEDIA

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Abstract. Drying is a widely utilized technique for food preservation, typically involving the transfer of thermal energy to the product's surface via convection, conduction, or radiation. Among these methods, microwave drying has emerged as a particularly effective alternative. The physics behind microwave drying is sophisticated, as energy absorption occurs through two primary mechanisms: ionic conductivity and dipole relaxation. For high-moisture substances, dipole relaxation is the dominant process. When a dielectric material is subjected to an electric field, its ions, atoms, and molecules become excited; the resulting motion and subsequent collisions convert kinetic energy into thermal energy. Developing a mathematical model for the microwave heating of capillary-porous bodies allows for new analytical solutions. These solutions make it possible to precisely determine how various parameters—such as electric field strength, processing duration, and wave penetration depth—impact drying intensity. Penetration depth is a decisive factor in ensuring heating uniformity and efficiency. Our modeling and calculations for a product with 40% moisture content situated this parameter between 2 and 6 cm. The numerical solution derived for penetration depth is a critical factor in the dehydration of capillary-porous materials. Furthermore, it provides a necessary benchmark for evaluating the accuracy and reliability of other theoretical models.

Acknowledgments: Institutional Project 020405 "Optimizing food processing technologies in the context of the circular bioeconomy and climate change", Bio-OpTehPAS, being implemented at the Technical University of Moldova.

Keywords: microwave drying, penetration depth, capillary-porous bodies, mathematical modeling, industrial waste circular economy.

B.10. ENHANCING THE EFFICIENCY OF THE DEHYDRATION PROCESS IN SYSTEMS POWERED BY RENEWABLE ENERGY SOURCES

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Abstract. This study addresses the optimization of dehydration processes for fruits and vegetables using installations integrated with renewable energy sources (RES). Given the high energy sensitivity of food preservation, the research aims to minimize thermal losses and maximize the use of solar and biomass energy. To achieve these objectives, a multi-disciplinary modeling approach was adopted. The mechanical components and the airflow dynamics within the drying chamber were designed and visualized using SolidWorks, ensuring an optimal structural configuration for uniform heat distribution. Furthermore, the thermodynamic behavior of the system and the kinetics of water removal were modeled in MATLAB, allowing for the precise determination of drying curves. To validate the experimental results, thermal and fluid-flow simulations were performed in ANSYS, identifying areas of thermal stagnation and optimizing the convective heat transfer coefficient. The results indicate that the integration of these digital twins into the design phase allows for an increase in energy efficiency of approximately 18-22% and a significant reduction in drying time. This integrated approach proves that combining renewable energy with advanced numerical simulation is essential for modern, sustainable, and high-quality food processing.

Acknowledgments: Institutional Project 020405 “Optimizing food processing technologies in the context of the circular bioeconomy and climate change”, Bio-OpTehPAS, being implemented at the Technical University of Moldova.

Keywords: food dehydration, solar drying systems, solidworks design, Matlab modeling, ansys fluid simulation, renewable energy integration, energy efficiency.

B.11. OPTIMIZATION OF PEACH DEHYDRATION THROUGH FORCED CONVECTION METHODS

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Abstract. This paper presents an optimized dehydration process for peaches using forced convection, designed for versatile applications ranging from industrial food processing to laboratory research and domestic use. The study focuses on balancing product quality with energy efficiency by maintaining rigorous control over thermodynamic parameters and raw material preparation. The proposed method follows a structured four-stage protocol. Stage I involves the selection of specific peach cultivars with low stone-to-pulp adherence, characterized by a fruit firmness of 1.0 kgf/cm² and an initial moisture content of approximately 87-90%. The fruit is sliced with high precision into 3-4 mm spherical segments to ensure uniform heat distribution. Stage II details the precise arrangement of slices in a single, non-overlapping layer on perforated supports. Stage III defines the optimal drying environment, utilizing ambient air (20 - 25°C, 60-65% relative humidity) as the thermal agent, with the drying chamber maintained at 50 - 65°C and an airflow velocity of 1,5 – 2,0 m/s. Finally, Stage IV concludes the process within a timeframe of 350-420 minutes, achieving a final moisture content of maximum 20%. The results demonstrate that this method significantly reduces energy consumption to 8 - 10 kWh while preserving the natural color and organoleptic properties of the fruit. Furthermore, the dehydrated peaches exhibit a shelf life of 25 - 30 days without the immediate requirement for vacuum packaging, proving the effectiveness of the method in stabilizing the product for short-to-medium term storage.

Acknowledgments: Institutional Project 020405 “Optimizing food processing technologies in the context of the circular bioeconomy and climate change”, Bio-OpTehPAS, being implemented at the Technical University of Moldova.

Keywords: forced convection, peach dehydration, energy efficiency, food processing, moisture content.

B.12. DETERMINATION OF STRESSES AND STRAINS IN CYLINDRICAL SHELLS SUBJECTED TO INTERNAL PRESSURE

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Abstract. This paper analyses the mechanical behaviour of cylindrical shells used in the process industry, evaluating the stress and strain state of equipment subjected to internal pressure by correlating analytical calculations with the finite element method. It highlights the essential role of stiffening rings and saddle supports in optimizing stress distribution, confirming through numerical simulations the accuracy of classical methods. The results provide technical solutions for increasing structural safety and improving material efficiency, proposing a model of best practices for the computer-aided design of pressure equipment.

Keywords: mechanical stress, cylindrical shells, stiffening rings.

B.13. OPTIMIZATION OF THE STRUCTURAL SOLUTION FOR SUPPORTING A COLUMN-TYPE PRESSURE VESSEL

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Abstract. The paper analyzes the optimization of the structural support solution for a column-type pressure vessel used in the process industry, aiming to increase structural safety and efficiency, by studying three skirt-supported configurations. The geometric and material characteristics of the ethane–ethylene separation column are defined, and the loads due to wind action are evaluated, determining forces, bending moments, and equivalent stresses in the shell-to-skirt junction. The study is complemented by finite element analysis (FEA) under the same support conditions, in order to validate the results and select the optimal structural solution.

Keywords: optimization, stresses, skirt, FEA.

B.14. ON PROMOTING AN ADVANCED TECHNICAL MODEL OF FRONT-FACE MOBILE SEALING

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Abstract. This paper presents one of the advanced technical models of mobile seals that has

produced a major impact and a radical change in the design of traditional stuffing box seals, considered as component subassemblies in the construction of valves and pressure vessels equipped with mixing devices. The proposed sealing model enables the transition to front-face seals with constant pressure applied to the stuffing box, successfully combining the advantages of mechanical face seals with the simplicity and relatively low cost of traditional stuffing box seals. The components that ensure the sealing of the rod or shaft passage through the casing of the pressure vessel introduce additional forces and moments into the operation of the equipment, which must be considered to ensure the correct sizing of the actuation system. Mechanical face seals are characterized by the fact that one of the sealing rings is replaced by a stuffing box, offering significant advantages that considerably extend the applicability of traditional stuffing box seals. During the operation of such a front-face sealing model, the stuffing box is pressed against the metallic contact surface due to the pressure of the working medium. As a result, a confessor space is formed, the length of which is proportional to the ratio between the sealed pressure and the compression pressure applied to the stuffing box. The non-uniformity of the contact pressure along the radial direction, caused by the pressure of the working medium, leads to premature wear of the overloaded areas of the contact surfaces, thereby necessitating the formulation of expressions for estimating frictional power losses in face seals. Literature studies in the field have shown that these losses are significantly lower compared to the power losses occurring in traditional stuffing box seals, and the load factor of the promoted technical model, unlike that of conventional face seals, must tend toward 100%.

Keywords: advanced model, face seal, stuffing box.

B.15. A METHOD FOR APPLYING AN ANALYTICAL CALCULATION APPROACH TO THE APPLIED STUDY OF THERMALLY INSULATED TECHNOLOGICAL PIPES

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Abstract. This scientific paper addresses the application of an analytical calculation method for thermally insulated technological pipelines with a nominal diameter (DN), used in centralized heating systems for thermal energy distribution. For the application of this calculation method, a case study is considered in which the thermal insulation of the pipeline consists of multiple layers of eco-friendly composite materials (clay, cellulose, wood flour, sheep wool). The following parameters are taken into account: the temperature of the heat transfer medium T_i [°C], the ambient temperature T_e [°C], the internal diameter of the pipe d_i , the external diameter of the thermal insulation d_e , the thickness of the thermal insulation layers δ_i , and the thermal conductivity λ_s . The method involves the following steps: (a) calculation of the temperature distribution across the cross-section of the initial pipe and within each insulating layer, using specific calculation relationships for thermal resistances (conductive and convective) of the thermal insulation layers (R_{cj} and R_{sj}), the one-dimensional thermal resistance (R), and the overall heat transfer coefficient (k); (b) recalculation of the temperature distribution across the cross-section of a thermally insulated pipe with larger dimensions than the initial one ($D_i > d_i$ and $D_e > d_e$). In conclusion, a comparative analysis is performed concerning the influence of variations in the thickness of the insulating layers and the temperature of the heat transfer medium inside the pipe on the temperature at the external surface of the insulating layer. The corresponding graphical representations of these variations are provided ($T_e = f(\delta_i)$; $T_e = f(T_i)$).

Keywords: thermal insulation, technological pipeline, analytical calculation, heat transfer.

B.16. EVALUATION OF THE EFFICIENCY OF SEPARATING POLLUTANT PARTICLES AND GASEOUS EMISSIONS GENERATED IN INDUSTRIAL TECHNOLOGICAL PROCESSES USING BAG FILTERS

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Abstract. This paper presents a theoretical study on evaluating the separation efficiency of pollutant particles and gaseous emissions generated in industrial technological processes using bag filters. The literature review showed that the efficiency of dust-removal (dedusting) installations is assessed by the amount of dust/pollutant particles that remains in the gases after they leave the installation and are discharged into the atmosphere. Reducing atmospheric pollution by gases discharged from dust-removal installations is achieved as follows: (a) using filters regenerated by shaking the bags followed by reverse air blow (at the preliminary stage), or bag filters regenerated by air jets (at the final stage); (b) discharging the gases from the dust-removal installation to the atmosphere through sufficiently tall stacks so that the dispersion area is large enough, and the dust concentration in the discharge area remains below the maximum values permitted by environmental protection standards. For the design or selection of bag filters, it is necessary to know the requirements imposed by the dedusting process, such as: dust characteristics (particle size; fire or explosion hazard; electrostatic charge; abrasiveness; tendency to coagulate), characteristics of gaseous emissions (temperature; toxicity; humidity; chemical aggressiveness; fire or explosion hazard; viscosity), as well as their flow rate.

Keywords: separation, bag filters, pollutant particles, gaseous emissions.

B.17. STUDY ON THE DEVELOPMENT OF A MECHANICAL CLAMPING AND BAR FEEDING SYSTEM FOR CONTINUOUS CHROMIUM PLATING PROCESSES

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Abstract. Protective coating technologies play a crucial role in improving the functional performance and durability of components exposed to mechanical, chemical, and environmental stresses. The selection of appropriate coating technology must be closely correlated with the specific requirements of the application, with the primary objective of preventing or delaying material degradation processes. In this context, electroplating technologies have evolved from empirical approaches toward modern chromium plating processes characterized by improved process control, higher efficiency, and increased attention to sustainability. An important step in this evolution is represented by the development of continuous chromium plating lines with multiple cells, designed to overcome the limitations of conventional plating systems. These installations rely on the segmentation of the technological process into a sequence of independent cells, each corresponding to a specific processing stage. Such a modular structure allows improved coating thickness uniformity, precise adjustment of electrochemical parameters along the process line, and optimization of the technological flow through reduced idle times. Consequently, these systems contribute to increased productivity and improved operational safety. The operation of continuous chromium plating lines involves the automatic and uninterrupted horizontal movement of bars from the loading area to the unloading stage. Under these conditions, gripping and feeding mechanisms play a critical role in ensuring process stability. These mechanisms must simultaneously fulfill several functional requirements, including maintaining permanent electrical contact, ensuring efficient current transfer to the cathode, minimizing contact marks on the processed surface, and providing reliable operation in corrosive environments and under repetitive working cycles. The analysis of existing constructive

solutions highlights the need for mechanisms capable of ensuring controlled bar gripping and linear feeding while maintaining the quality of the deposited chromium layer. In this context, the present study proposes a constructive solution for a gripping and feeding mechanism intended for continuous chromium plating lines. The proposed design employs two copper-alloy plates acting as active contact surfaces, providing both electrical current transfer and mechanical stability of the gripping system. The bar is clamped between these plates, which are symmetrically actuated by a lever mechanism. This symmetrical actuation ensures a uniform distribution of the clamping force, contributing to stable electrical contact and reducing undesired effects on the deposited coating layer. At the same time, the proposed configuration prevents unilateral contact, which could otherwise lead to local overheating and localized coating defects.

Keywords: technology, environment, sustainability, optimization.

B.18. STRUCTURAL AND MECHANICAL PROPERTIES OF CARBIDE-REINFORCED CU-FE COMPOSITE COATINGS PRODUCED BY ELECTRIC ARC SPRAYING

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Abstract. This study investigates the microstructural and mechanical properties of Cu-Fe-based composite coatings reinforced with WC and TiC particles and alloyed with Cr, Ni, B and Si, deposited on steel substrates by electric arc spraying. The coatings were characterized using scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDS) to evaluate morphology, phase distribution and elemental composition. SEM observations revealed a typical lamellar structure with partially melted carbide particles uniformly distributed within the metallic matrix. EDS mapping confirmed the presence and distribution of Cu-, Fe-rich phases and carbide reinforcements, along with alloying elements. The microhardness of the coatings ranged between 384 - 862 HV0.1, depending on local composition and carbide concentration. Adhesion strength, assessed by pull-off, showed values of 38±14 MPa, indicating good bonding to the substrate. The porosity level, determined by image analysis, was found to be 8.5-12.2 %, consistent with typical arc-sprayed coatings. The results highlight the influence of carbide reinforcements and multicomponent alloying on the structural integrity and mechanical performance of the coatings. These composite layers show potential for applications requiring enhanced wear resistance and moderate antifriction behavior.

Keywords: arc spraying process, composites, adhesion.

B.19. MAGNETO-INDUCTIVE TESTING OF CABLES IN ROPEWAY INSTALLATIONS

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Abstract. Ropeway installations (chairlifts, drag lifts, gondolas) critically depend on the integrity of metallic wire ropes, which are constantly exposed to mechanical loading and environmental factors. This paper presents the application of the magneto-inductive testing method for non-destructive evaluation of ferromagnetic ropes, focusing on the operational procedure and its usefulness in risk-based maintenance. The method consists of mounting the MH-40/MH-80

measuring head on the rope, calibrating with a standard rod containing artificial defects, scanning along the rope to achieve full magnetisation and continuous data acquisition, followed by signal interpretation using dedicated software. The technique enables detection of internal and external defects (broken wires, corrosion) and estimation of metallic cross-section loss, providing an objective basis for operating decisions, maintenance planning and incident prevention. Demonstration on dedicated equipment and the methodological flow confirm that magneto-inductive testing is a robust, reproducible and safe solution for improving the reliability and service life of ropes in ropeway installations.

Keywords: non-destructive testing, magneto-inductive testing, metallic ropes, ropeway installations.

B.20. LIQUID PENETRANTS — NDT METHOD FOR IDENTIFYING SURFACE DISCONTINUITIES

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Abstract. The liquid penetrant non-destructive testing method is used to detect open-to-surface defects (fine cracks, pores, edge laps) in non-porous, metallic and non-metallic materials. The procedure consists of: (1) thorough cleaning and degreasing, (2) application of coloured/fluorescent penetrant, (3) controlled removal of excess penetrant and (4) application of developer for capillary bleed-out and indication visualisation, followed by (5) visual inspection and decision (accept/rework/reject). The example uses a dedicated set (PFINDER 890 cleaner, PFINDER 860 red penetrant, PFINDER 871 developer), compatible and compliant with reference standards (EN ISO 3452, ASTM E165, ASME Section V, Article 6). Adhering to the steps and using products from the same family ensures high sensitivity, reproducibility and compliance, supporting sound maintenance and quality-control decisions in manufacturing, welded structures, transportation and power industries.

Keywords: non-destructive testing, liquid penetrants, dye penetrant inspection, surface defects, fine cracks, maintenance, quality control.

B.21. GENERALISED KINEMATIC ANALYSIS OF A LEVER PRESS MECHANISM FOR FOOD APPLICATIONS

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Abstract. This study develops a general kinematic model for a lever–connecting-rod press mechanism used to compact curd in cheese production. The analysis focuses on the influence of the geometric parameter l_2 , which defines the position of the intermediate joint B on member AC,

on the mechanism configuration and on the evolution of the active pressing point D. Based on idealised mechanical assumptions—rigid links, frictionless joints and imposed vertical guidance for rod BD—general analytical equations for the position, velocity and acceleration of point D were formulated using the vector kinematic method. The results show that varying l_2 produces significant nonlinear changes in the length of rod BD, in the kinematic angle β and in the vertical displacement of point D. Simulations over a complete kinematic cycle show increased sensitivity in configurations associated with large values of l_2 , yielding greater useful strokes and higher velocities in the final phases of the stroke. At the same time, accelerations remain low throughout the kinematic interval, indicating behaviour favourable to controlled pressure application during compaction. The proposed model provides a robust analytical framework for sizing and optimising simple pressing mechanisms used in the food industry, allowing adjustment of pressure and active displacement by tuning l_2 . The results can serve as a basis for extending the analyses towards dynamics, force optimisation and the development of pressure-control systems in manual or semi-mechanised presses.

Keywords: lever-connecting-rod mechanism, kinematic analysis, geometric parameterisation, mechanical press for cheese, controlled vertical displacement.

B.22. LABORATORY APPLICATIONS FOR STUDYING THE OPERATION OF CENTRIFUGAL PUMPS

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Abstract. This study presents a laboratory-scale investigation on the performance and operational characteristics of a two-stage centrifugal pump system using a dedicated experimental test rig. The experimental setup consisted of two identical centrifugal pumps mounted on a closed-loop hydraulic circuit, allowing operation in single, series, and parallel configurations. The system was equipped with pressure transducers, a Venturi flow meter, torque sensors, and variable-speed motor drives, enabling accurate monitoring of hydraulic and mechanical parameters. Experimental tests were conducted to evaluate pump performance in terms of total head, flow rate, hydraulic power, and efficiency. Flow rate was determined using differential pressure measurements across the Venturi meter, while shaft power was obtained from torque and rotational speed measurements. The influence of operating conditions, such as pump speed and valve adjustments, on system performance was systematically analyzed. Results showed that, in single pump operation, the total head decreased with increasing flow rate, while efficiency exhibited a maximum at intermediate flow conditions. In parallel configuration, the system demonstrated a significant increase in flow rate with relatively constant head, whereas in series operation, the total head increased substantially while maintaining similar flow rates, confirming theoretical expectations for multi-pump systems.

Keywords: centrifugal pumps, flow rate, hydraulic power.

B.23. INTELLIGENT MODELING APPROACHES FOR CHARACTERIZING POLLUTANT TRANSPORT MECHANICS AND SPATIAL DISTRIBUTION IN POROUS AQUIFEROUS MEDIA

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Abstract. This paper investigates the analysis and simulation of pollutant transport and distribution processes in groundwater systems, employing advanced numerical techniques and intelligent modeling approaches to characterize contaminant behavior within aquifers. A central component of the study focuses on surrogate modeling methods, which enable the efficient approximation of complex numerical simulations while significantly reducing computational demands. The research begins with a review of fundamental hydrological principles and groundwater flow dynamics, followed by the application of the Groundwater Modeling System (GMS) and the MODFLOW numerical model to simulate subsurface flow and contaminant dispersion. By integrating modern modeling tools with statistical techniques such as Polynomial Chaos Expansion, the study enhances the identification of pollution sources and provides a structured framework for evaluating uncertainties associated with groundwater modeling.

Keywords: flow dynamics, groundwater modeling system, polynomial chaos expansion.

B.24. TECHNOLOGICAL OPTIMIZATION OF INDUSTRIAL SORTING PROCESSES USING VIBRATING SIEVE

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Abstract. The paper analyzes the optimization of the separation process of solid products with variable particle sizes as an essential technological approach for improving operational efficiency, reducing energy consumption, minimizing operating costs, and enhancing the sustainability of industrial processes. The combination of conventional methods with digital, automated, and adaptive solutions—validated through modelling, simulation, and experimental testing—provides an efficient and flexible framework, adaptable to raw material variability and circular economy requirements. In this context, the performance of the separation process using the MEKA MS vibrating sieve was analyzed, being determined by a series of specific parameters that directly influence sorting efficiency and the quality of the obtained fractions.

Equipping the MEKA MS vibrating sieve with an intelligent drive system controlled through a frequency converter represents a viable and efficient optimization solution that meets the objectives of reducing energy consumption and maintenance requirements.

The modernization of the drive system by integrating a high energy-efficiency motor (IE3/IE4 class) together with a smart frequency converter enabled the real-time adjustment of vibration parameters according to load conditions. The results showed a 25% reduction in energy consumption, a considerable decrease in maintenance requirements, and improved equipment reliability and availability. In addition, operational flexibility was enhanced, allowing adaptation to different material types without performance penalties.

When properly implemented, this technological optimization can transform the MS vibrating sieve into a more economical, intelligent, and robust piece of equipment, aligned with current trends in energy efficiency and industrial automation.

Keywords: smart drive system, particle separation, adaptive vibration control, separation process, technological optimization.

B.25. VALORIZATION OF SIDERITIC TAILINGS IN THE STEEL INDUSTRY WITHIN THE CONTEXT OF CIRCULAR ECONOMY

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Abstract. This paper explores the sustainability of processing tailings and pulverous ferrous waste by converting them into Carbofer-type by-products, utilized as slag foaming agents in Electric Arc Furnaces. The process involves using these materials as mechanical mixtures or through the briquetting/pelletizing of iron-rich waste combined with steelmaking tailings. The valorization into Carbofer represents a viable techno-economic solution that closes the material loop within the steelmaking flow. This approach transforms fine waste into a strategic resource, essential for the transition toward green and competitive metallurgy.

Equipping the MEKA MS vibrating sieve with an intelligent drive system controlled through a frequency converter represents a viable and efficient optimization solution that meets the objectives of reducing energy consumption and maintenance requirements.

Keywords: carbofer by-products, ferrous waste valorization, steelmaking tailings, slag foaming agents, electric arc furnace.

B.26. INTAKE TEMPERATURE IMPACT ON POWER AND EMISSIONS IN DRIFT COMPETITION

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Abstract. This paper presents a comparative analysis of thermal dissipation phenomena within the engine compartment for various vehicle configurations specifically designed for drift competitions. The particularity of this motorsport involves extreme thermal loads combined with an airflow that is often incorrectly oriented relative to the vehicle's longitudinal axis, leading to critical heat accumulation under the hood. The primary objective of this study is to determine the direct influence of intake air temperature on the specific power of internal combustion engines. The research demonstrates that an increase in intake air temperature leads to a reduction in air density, negatively affecting the stoichiometric ratio and, consequently, the engine's thermal efficiency. The methodology involved monitoring thermodynamic parameters across different engine types and chassis, evaluating the correlation between engine bay thermal management and vehicle dynamics. The results highlight a degradation in power performance in the absence of optimized ventilation solutions, with a direct impact on fuel consumption and increased pollutant emissions.

Keywords: thermal dissipation, engine bay heat management, intake air temperature, internal combustion engines, drift vehicles performance.

B.27. OCCUPATIONAL HEALTH AND SAFETY RISK ASSESSMENT IN A LOGGING OPERATION

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Abstract. Occupational health and safety are fundamental to the efficient and sustainable operation of any organization. They protect the most valuable resource—the worker—and contribute to sustainable economic and social development. Occupational health and safety is not just about rules; it is also about fostering an organizational culture based on prevention and accountability: employees become more aware of risks and take an active role in maintaining safety. This paper presents the results of an assessment of the risks of occupational injury and illness resulting from an accident that occurred at a logging site. With regard to the distribution of risk factors by source, the assessment identified the following breakdown: 31% related to the worker, 11% related to the work task, 36% related to the means of production, and 22% related to the work environment. The assessment highlights that 51% of the factors can have irreversible consequences for the worker, namely death or disability (23 risk factors can result in death or disability).

Keywords: Occupational health, safety, risk, environment.

B.28. EVALUATION OF THE TEXTURE OF SOFT PLANT-BASED PRODUCTS USING SENSORY ANALYSIS

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Abstract. Texture analysis is a key factor in assessing the quality of soft-textured plant-based products, as this property determines their acceptability and use by consumers. A product that is too soft or too hard may be rejected by consumers, even if it has good nutritional value. In the food industry as well, texture is an important indicator of the efficiency of manufacturing processes, helping to optimize those processes in order to maintain the desired product properties. The study aims to analyze the texture of soft-textured plant products (fruits and vegetables) by combining puncture measurements with sensory analysis. Research shows that soft products absorb energy, resulting in a faint acoustic signal, while brittle products release energy, resulting in a loud acoustic signal.

Keywords: texture, vegetable, acoustic signal, energy.

B.29. PRODUCT DESIGN AND PROCESS OPTIMIZATION OF A MODULAR ROBOTIC UNIT FOR CONTROLLED MICROGREEN CULTIVATION

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Abstract. A hybrid fabrication approach is used to accelerate the prototyping process and allow future modifications. The enclosure consists of CNC-cut transparent panels, while the mounts,

supports, ducts, connectors, and interfaces are fabricated using 3D-printing technology. Broccoli microgreens were selected as the first test crop due to their fast growth cycle and well-documented bioactive compounds, including glucoraphanin and sulforaphane.

The first optimization stage focuses on essential growth parameters, including lighting, irrigation, air circulation, climate control, resource consumption, canopy uniformity, biomass yield, and harvesting time. The system integrates product design, digital fabrication, automation, environmental sensing, and image-processing capabilities. It also supports future functions such as crop-specific recipes, pre-programmed growth processes, automated operation, and the use of botanical biofilters. The automated device minimizes resource consumption, maintains stable growth conditions, and enables remote monitoring through a mobile application interface.

The benefits of a fully automated system include: resource savings (sensors ensure that water and electricity (for lighting) are used only when absolutely necessary), accelerated growth (IoT technologies can speed up plant growth), and remote monitoring (the condition of the plants can be checked via a mobile phone). Together, these functions can improve yield, quality, repeatability, and traceability by creating a feedback loop between the plants, sensors, and control system, while minimizing the need for manual supervision.

Keywords: microgreens; product design; process optimization; controlled environment agriculture; mechatronics; robotic cultivation; machine vision; digital fabrication; CNC manufacturing;

B.30. STUDY OF THE PROPERTIES OF APS COATINGS DEPOSITED ON AGRICULTURAL PLOUGH COMPONENTS

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Abstract. The present research, conducted in the field of thermal spray coatings, aims to enhance the properties of agricultural plough components subjected to soil tillage operations. Given the particularly demanding operating conditions to which these components are exposed, wear resistance and impact resistance represent the primary performance requirements governing their service life.

Thermal coatings were deposited using the Atmospheric Plasma Spray (APS) technique, employing WC–12%Co-based metallic powders. The microstructural and mechanical characterization of laboratory specimens encompassed micro-scratch testing, and determination of the coefficient of friction under both rotational and translational motion regimes. The results confirm that thermal spraying constitutes an effective methodology for improving the coating morphology and mechanical properties of newly manufactured components, as well as for reconditioning worn parts to restore their requisite functional parameters.

Acknowledgment: This work was supported by a grant from the Ministry of Education and Research, CCCDI–UEFISCDI, project number PN-IV-PCB-RO-MD-2024-0336, within PNCDI IV.

Keywords: Atmospheric Plasma Spray (APS), coatings, wear resistance.

C. OPTIMIZATION IN ENVIRONMENTAL ENGINEERING AND ENVIRONMENTAL PROTECTION

C.1. IMPLEMENTING THE CIRCULAR ECONOMY IN WOOD WASTE MANAGEMENT: A CASE STUDY ON PALLET RECYCLING AND REUSE

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Abstract. The paper presents the analysis of the implementation of the principles of the circular economy in the management of wood waste, having as a case study the activity carried out by S.C. BAMIROM GRUP S.R.L. The research highlights how the technological flow of collection, sorting, reuse and recycling of wooden pallets contributes to the efficient valorization of resources and the reduction of environmental impact. The analyzed operational process includes distinct stages: collection of used pallets from various industrial sources, their sorting according to the degree of damage, disassembly of reusable components and reconditioning of functional pallets. Non-reusable wood material is energetically valorized by transformation into pellets, thus ensuring the full use of the resource. The results highlight a high waste valorization rate of over 90%, demonstrating the efficiency of the implemented circular model. At the same time, a decrease in the quantities collected is observed in the period 2021–2024, correlated with market dynamics and process optimization. The study highlights the benefits of the circular economy, such as reduced consumption of natural resources, reduced waste disposal and reduced CO₂ emissions. It also identifies potential environmental impacts (dust emissions, noise, energy consumption), for which prevention and mitigation measures are proposed.

Keywords: circular economy, wood waste, pallet recycling, sustainability

C.2. THE GENETIC AND BREEDING VALUE OF ROMANIAN TOMATO LINES UNDER THE CONDITIONS OF THE REPUBLIC OF MOLDOVA

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Abstract. One of the main issues in contemporary vegetable growing is the creation of varieties with complex valuable traits, adapted to growing conditions. To demonstrate the variability of traits and to determine the genetic-breeding value of Romanian-origin genotypes, an evaluation of earliness traits, fruit characteristics, productivity, and heat resistance was conducted. The analysis of fruit trait variability was based on fruit weight, fruit length and diameter, pericarp and mesocarp thickness, and the number of locules. Cluster analysis (k-means method) demonstrated that the inter-cluster variance was significantly higher than the intra-cluster variance for traits such as fruit weight, fruit diameter, mesocarp thickness, and the number of locules, which indicates that the genotypes studied exhibited distinct, pronounced differences. For the characters of fruit length and pericarp thickness, the inter-cluster variance was lower than the intra-cluster variance, meaning the differences between genotypes based on these traits were insignificant. The analysis of the resistance trait was performed based on the length of the embryonic radicle, the stem, and the whole seedling. It was found that the reaction of tomato plants (growth of roots, stems, and seedlings) to temperature levels of 25°C and 43°C was different and depended on the genotype, the growing organ, and the temperature level. Line L 168 showed high resistance to 43°C and the highest productivity in the central conditions of the Republic of Moldova and,

therefore, is of interest in breeding work as potential genetic sources for productivity and heat resistance.

Keywords: tomatoes, variability, earliness, temperature, resistance

C.3. BEHAVIORAL ASSESSMENT OF CEFTAZIDIME AND POLYSTYRENE MICROPLASTICS IN ZEBRAFISH USING THE NOVEL TANK TEST

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Abstract. Antibiotics and microplastics are increasingly recognized as emerging pollutants of concern, yet their combined biological effects in aquatic organisms remain insufficiently characterized. This study investigated the behavioral impact of ceftazidime (CAZ 50 µg L⁻¹), polystyrene microplastics (PS MPs 1 mg L⁻¹), and their mixture on adult zebrafish using the Novel Tank Test, a sensitive tool for detecting alterations in anxiety-like behavior, locomotion, and exploratory patterns. Following a 96 hour exposure, behavioral endpoints were quantified from both top and side views, including thigmotaxis, time spent in the upper and bottom side of the tank, mobility states, total distance moved, velocity, and rotational behavior. Exposure to either CAZ or PS MPs independently altered zebrafish behavior, while the mixture induced the most pronounced behavioral disturbances. Both contaminants significantly increased thigmotaxis, a hallmark of elevated anxiety-like responses. Vertical exploration was likewise reduced, with fish from the mixture group showing a marked reduction in time spent in the upper zone of the tank. Additionally, rotational behavior (clockwise and counterclockwise) was elevated in all exposed groups. Overall, the mixture consistently produced additive or potentially synergistic effects across behavioral parameters, compared with individual exposures. These findings highlight the sensitivity of the Novel Tank Test for detecting sublethal behavioral alterations and underscore the relevance of zebrafish as an animal model for environmental contamination. Importantly, this work emphasizes the need for integrated assessment approaches that consider combined pollutant interactions when evaluating ecological risks and designing strategies for environmental protection.

Keywords: ceftazidime, polystyrene microplastics, zebrafish behavior

C.4. PHARMACEUTICAL MIXTURES IN AQUATIC SYSTEMS: DEVELOPMENTAL DISRUPTION BY IBUPROFEN AND VALPROIC ACID IN ZEBRAFISH LARVAE

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Abstract. Pharmaceutical residues are increasingly recognized as emerging contaminants in aquatic ecosystems, where their simultaneous presence may pose risks to early developmental stages of aquatic organisms. Ibuprofen (Ibu) and valproic acid (VPA) are widely used drugs that can reach freshwater environments through wastewater discharge, yet the effects of their combined exposure remain poorly understood. This study evaluated the individual and mixture effects of environmentally relevant concentrations of Ibu (20 µg/L) and VPA (3 µg/L) on the behavior of *Danio rerio* larvae. Newly hatched zebrafish larvae (72 hpf) were exposed for 96 hours, after which behavioral responses were assessed using a light/dark experiment to examine locomotory activity and anxiety related parameters across both photoperiods. The results revealed that both pharmaceuticals altered larval behavior, with significant changes in swimming activity and anxiety indices. While single exposures produced measurable disruptions, the mixture of Ibu and VPA induced more pronounced behavioral impairments, suggesting potential additive or synergistic effects. These findings indicate that the co occurrence of such pharmaceutical pollutants in natural waters may exacerbate neurobehavioral disturbances in early stages of aquatic organisms, potentially compromising their survival, predator avoidance, and overall developmental success.

Keywords: valproic acid, ibuprofen, mixture, zebrafish, pollution

C.5. CHEMICAL PARTITIONING, MOBILITY, BIOAVAILABILITY AND RISK OF TRACE ELEMENTS IN SEDIMENTS FROM A HYDROSYSTEM IN SOUTHERN TOGO

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Abstract. This study aims to assess the environmental risks linked to industrial pollution, based on the bioavailable fractions of trace elements in sediments. For this purpose, sequential extraction was performed and the extracts were analyzed using mass spectrometry (ICP-MS). The majority of trace elements are well represented in the five different geochemical fractions and at the four sites studied. However, these trace elements showed affinities for one or another of the different geochemical fractions. The highest exchangeable fraction value in the sediments is that of lead (Pb) at site L2 (86.58%). The highest proportion of the acid-soluble fraction was recorded for Rb at site L8 (96.26%). Pb presented the highest proportion of reducible fraction at site L11 (75.36%). Ag showed the highest proportion of the oxidizable fraction at site L2 (51.27%). The proportions of the residual fraction reached 84.27% at site L2 for Ti. Fairly significant non-reducible fractions (58.85-99.92%) were recorded for the majority of trace elements at the four sites, indicating their mobility and bioavailability. These were Ga, As, Ti, Pb, Hg, Rb, Se, Cr, Sr, Cs, Zn, Cu, and V at sites L8 and L11, and Cd, U, Ba, Ag, Co, Ni and Li at sites L2 and L7. Ecological and environmental risks have been recorded, with average RACs ranging from 6.55% for Li to 67.31% for U. These risks are low for some trace elements and catastrophic for others, affecting 90% of the trace elements. Therefore, this ecosystem needs particular attention for a sustainable planning of its management.

Keywords: sediments, trace elements, speciation, phosphate, lake togo, aného

C.6. THE INFLUENCE OF ENVIRONMENTAL FACTORS ON AQUACULTURE (ESPECIALLY PONDS) FROM THE PERSPECTIVE OF RISK ASSESSMENT THROUGH THE HACCP SYSTEM

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Abstract. Aquaculture represents the cultivation and controlled growth of aquatic organisms (fish, crustaceans, mollusks, and plants), involving human intervention. Ponds, as seminatural ecosystems, are influenced by microbiological, chemical, and physical factors, elements that directly or indirectly affect the quality of the fish. The present paper highlights the way in which the physicochemical parameters of the water, the feed administered to the fish, the veterinary treatments applied to the fish (antibiotic residues and the waiting time necessary for their elimination), as well as contaminations with nitrites and nitrates originating from agricultural fertilization, represent major risks identified following the performance of the risk analysis and the establishment of Critical Control Points (CCPs) within the Hazard Analysis and Critical Control Points (HACCP) system. Thus, through their correct monitoring, the chemical, physical, and microbiological risks encountered in the aquatic environment are diminished, especially in the case of ponds. The paper analyzes these possible risks from the point of view of the legislative norms in force, both from the point of view of environmental protection, as well as from a sanitary-veterinary perspective and for food safety, in order to establish maximum residue limits and the necessary corrective measures.

Keywords: aquaculture, fish ponds, HACCP system, critical control points, food safety, environmental protection, water quality

C.7. A MULTIDIMENSIONAL ANALYSIS OF FOOD WASTE: SOCIOECONOMIC IMPLICATIONS, AND MITIGATION MECHANISMS

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Abstract. This paper approaches the multidimensional issue of food waste, exploring the intersection between economic inefficiency, environmental degradation, and the ethical imperatives of contemporary society. In a context where the European Union generates approximately 89 million tons of food waste annually, the existence and implementation of a specific regulatory framework is essential; thus, at the European level, Regulation (EU) No. 1169/2011 is in effect, having been transposed into national law by HG. 217/2016, regarding the reduction of food waste, republished in 2024. This paper discusses the hierarchy of waste prevention, emphasizing the priority of donating food surpluses to vulnerable groups over final disposal. It critically analyzes consumers' cognitive barriers, particularly the confusion between the “best before” date and the “use by” date, a factor identified as a major source of waste at the household level. At the same time, the paper highlights the role of new administrative mechanisms, such as the National Platform for the Prevention and Reduction of Food Waste and the Methodological Rules updated by Government Decision No. 955/2024, which impose strict traceability and annual reporting requirements on economic operators. The studies underscore the need for an accelerated transition toward a circular economy model, in which food surpluses cease to be waste and become a social resource managed through digitalization, public education, and corporate responsibility. This systemic approach is essential for achieving sustainable development goals and mitigating the agri-food sector's carbon footprint.

Keywords: food waste, economic efficiency, environmental degradation, food donation, sustainable development, consumer behavior, waste prevention

C.8. FROM BIOMASS TO BIOMEDICAL MATERIALS: PH-CONTROLLED ITACONIC ACID POLYMERIZATION FOR ADVANCED DRUG DELIVERY SYSTEMS

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Abstract. The growing demand for sustainable and bio-based materials has positioned itaconic acid as a highly promising platform monomer due to its renewable origin, dual functionality, and versatility in polymer synthesis. Recognized as one of the top value-added chemicals derived from biomass, itaconic acid offers significant potential for replacing petroleum-based acrylic monomers in biomedical and pharmaceutical applications. In this study, the homopolymerization of itaconic acid was systematically investigated under different pH conditions to obtain polymers with molecular weights exceeding 10 kDa. The effect of pH on polymerization efficiency, chain propagation, and molecular weight distribution was evaluated, emphasizing the critical role of ionization state in governing radical polymerization behavior. Based on these findings, novel copolymeric systems composed of itaconic acid, acrylic acid, and N-vinyl-based monomers were synthesized to develop functional biomaterials with enhanced physicochemical properties. These systems exhibited tunable swelling capacity, improved structural integrity, and increased potential for drug incorporation. The copolymers were further explored as drug delivery matrices for the encapsulation of nistatin, an antifungal agent, and dexamethasone, a nonsteroidal anti-inflammatory drug. Drug loading efficiency and stability were assessed, demonstrating the capability of these materials to serve as multifunctional platforms for combined therapeutic applications. Overall, this work highlights the strategic importance of itaconic acid as a sustainable monomer and provides valuable insights into pH-controlled polymerization and the design of advanced copolymeric systems for biomedical use.

Keywords: itaconic acid, biotechnology, pharmaceuticals, pH responsive

C.9. RESEARCH ON THE INTERACTION OF COMMON WHEAT WITH FUSARIUM LATERITIIUM NEES

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Abstract. The purpose of the research was to establish the peculiarities of interaction of common winter wheat genotypes with one of the causative agents of root rot – *Fusarium lateritium*. Seven wheat genotypes and 3 isolates of *F. lateritium* served as the study material. In the study the following were used: i) culture filtrates (CF) prepared on the basis of Czapek medium; ii) morphometric analysis of 6-day-old plants from grains treated for 18 hours with CF of the fungus was applied; iii) statistical processing of data was performed by applying analysis of variance, factorial analysis (STATISTICS 7). The greatest influence in the source of variation of growth organs was recorded for the isolate factor – 40 ... 62.1%, followed by genotype – 18.6 ... 36.8% and plant x isolate interactions – 11.9 ... 15.6%. Important genetic parameters for plant growth

and development characters were calculated. The heritability coefficient varied within the limits of 0.33 ... 0.56, and genetic progress – 7.26 ... 13.05%. Conclusion: i) the growth of wheat seedlings upon interaction with the fungus *F. lateritium* depends largely on the virulence profile of the fungal isolates, which was reflected in the relatively low capacity for hereditary transmission of characters; ii) the values of the heritability coefficient and genetic progress denote that obtaining resistant wheat genotypes can be achieved through long-term selections from segregating populations.

Keywords: common wheat, isolate, *Fusarium lateritium*, virulence, interaction, growth organ

C.10. OPTIMIZATION OF PACKAGING MANAGEMENT UNDER EUROPEAN CRITICAL RAW MATERIALS POLICIES

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Abstract. This paper analyses packaging management in the context of recent European policies, particularly the critical raw materials act and the packaging and packaging waste regulation, with emphasis on reducing primary raw material dependency and increasing secondary resource utilization. A dual optimization framework is proposed, integrating: external optimization through eco-design of packaging, based on material composition and recyclability, and internal optimization of sorting and recycling processes via advanced environmental engineering solutions. The latter includes sensor-based identification systems, automated sorting technologies, and process digitalization. Results indicate that the combined implementation of eco-design and process-level optimization enhances material recovery rates, improves secondary material quality, and supports the achievement of EU recycling targets. The study also highlights the role of digital traceability and modern infrastructure in enabling efficient circular economy systems.

Keywords: critical raw materials, packaging management, eco-design, recycling technologies, material traceability, circular economy, process optimization, digitalization

C.11. OPTIMIZATION OF FLEXIBLE PLASTIC SORTING PROCESSES WITHIN INDUSTRIAL SYSTEMS

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Abstract. This paper analyses the optimization of industrial processes from an environmental engineering perspective, focusing on advanced technologies and digitalization in flexible plastic sorting. The study highlights the role of automated identification and separation systems based on sensors in improving recycling efficiency and the quality of recovered materials. Solutions for separating waste according to origin and packaging composition are examined, enabling better traceability and higher material recovery rates. The results demonstrate that the integration of digital tools optimizes operational flows and reduces material losses. Furthermore, the contribution of these technologies to the circular economy and environmental impact reduction is emphasized. The paper proposes a best-practice model for implementing smart solutions in sorting facilities. By correlating operational data with industrial processes, a more efficient waste management system is supported. In conclusion, digitalization becomes a key driver in modernizing recycling infrastructure.

Keywords: optimization, environmental engineering, flexible plastics, automated sorting, digitalization

C.12. OPTIMIZATION OF GREEN-SYNTHEZIZED IRON NANOPARTICLES FOR ENHANCED DEFENSIVE ENZYME ACTIVITY AND ANTIBACTERIAL CONTROL OF RALSTONIA SOLANACEARUM IN ENVIRONMENTAL SYSTEMS

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Abstract. The increasing prevalence of plant pathogenic bacteria such as *Ralstonia solanacearum* poses a serious threat to agricultural sustainability and environmental health. Recent advances in nanotechnology, particularly green synthesis approaches, offer eco-friendly alternatives for pathogen control. This study aims to optimize the green fabrication of iron nanoparticles (FeNPs) and evaluate their antibacterial efficacy and their role in inducing defensive enzyme activity under environmentally relevant conditions. Iron nanoparticles were synthesized using a biological (plant-mediated) reduction method, followed by systematic optimization of key synthesis parameters including pH, temperature, precursor concentration, and reaction time to achieve maximum stability and bioactivity. The synthesized nanoparticles were characterized using standard physicochemical techniques to confirm their size, morphology, and surface properties. The antibacterial activity of optimized FeNPs was assessed against *R. solanacearum* using in vitro assays, including inhibition zone measurement and minimum inhibitory concentration (MIC) determination. In addition, the impact of FeNPs on plant defense mechanisms was evaluated by measuring the activity of key defense-related enzymes such as peroxidase (POD), catalase (CAT), and polyphenol oxidase (PPO). The results demonstrated that optimization significantly enhanced nanoparticle efficiency, leading to strong antibacterial activity and substantial inhibition of bacterial growth. Furthermore, treated systems exhibited a marked increase in defensive enzyme activity, indicating induced systemic resistance. These findings highlight the dual role of green-synthesized FeNPs as both antimicrobial agents and plant defense stimulators. In conclusion this study provides an optimized, sustainable, and environmentally compatible strategy for controlling *Ralstonia solanacearum*, with significant implications for environmental engineering and plant protection systems. The integration of nanotechnology and green synthesis represents a promising approach for advancing eco-friendly disease management practices.

Keywords: *Ralstonia solanacearum*, agricultural sustainability

C.13. EVALUATION OF THE EFFICIENCY OF AMMONIUM REMOVAL FROM RURAL WASTEWATER BY CHEMICAL TREATMENTS

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Abstract. Wastewater management in rural areas is a major challenge, driven by the technological, economic and operational constraints specific to small-scale wastewater treatment plants. Ammonium (NH_4^+), a relevant indicator of nitrogen pollution, is frequently found in high concentrations in domestic wastewater, requiring the application of efficient removal methods, especially in situations where advanced biological processes are difficult to implement or maintain stable. In this context, chemical treatments, including the use of coagulants such as ferric chloride (FeCl_3) and polyaluminium chloride (PAC), are viable alternatives, with the ability to reduce ammonium concentrations through adsorption and precipitation mechanisms. The paper presents a study conducted over a year, with the objective of analyzing the variation of the main

wastewater quality indicators, with a focus on ammonium, both at the inlet and outlet of a rural wastewater treatment plant. The analyzed facility serves a local community, and the treated waters are discharged into a nearby watercourse, in accordance with the requirements of the legislation in force. The results obtained allow the evaluation of the efficiency of the treatment processes under real operating conditions and highlight the potential of chemical treatments as complementary or alternative solutions for improving the performance of small-scale treatment systems.

Keywords: wastewater, chemical treatments.

C.14. LOCAL PRODUCERS - TRUE AMBASSADORS OF MOLDOVAN GASTRONOMIC TOURIS

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Abstract. Local producers in the Republic of Moldova play an essential role in the development of gastronomic tourism, becoming true ambassadors of national traditions and culture. Through their authentic products – wines, cheeses, honey, fruits and traditional dishes – they contribute to the creation of a distinct culinary identity, which attracts tourists from the country and abroad. According to this study, in recent years, more and more local Moldovan producers have opened their doors to visitors, offering direct experiences, such as tastings, guided tours and production workshops. These activities allow tourists to discover not only the specific tastes of Moldova, but also the stories behind the products, traditional preparation methods and the close connection between people and the land. Rural guesthouses and gastronomic festivals also play an important role, where producers promote their products and interact directly with visitors. Thus, an authentic relationship is created between the tourist and the local community, which contributes to a memorable experience and to promoting the image of the country. Also, collaborations between producers, tourism agencies and authorities support the development of gastronomic and wine routes, which highlight the regions and their specificities. These initiatives not only stimulate the local economy, but also encourage the preservation of traditions and sustainable development. According to the conclusion of this study, local producers in the Republic of Moldova become ambassadors of gastronomic tourism through authenticity, hospitality and active involvement in promoting culinary culture. Through their efforts, they contribute to creating an attractive image of the country and transforming gastronomy into an important reason to visit.

Keywords: gastronomic tourism, traditional preparation methods

C.15. STUDY ON THE IMPACT OF AIR QUALITY IN THE CITY OF BACĂU IN TERMS OF PM2.5 AND PM10 EMISSIONS

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Abstract. Air pollution is one of the most pressing global environmental issues, affecting public health, ecosystems, and the climate balance. Combating this phenomenon requires the implementation of integrated strategies and effective policies designed to reduce pollutant

emissions and promote sustainable solutions. The city of Bacău, like other cities in Romania, faces significant challenges in managing air quality, which is why it is essential to adopt concrete measures based on successful international models. Among the main shortcomings are inadequate infrastructure for sustainable public transportation, the lack of an efficient waste management system, and a shortage of urban green spaces. These problems are exacerbated by a low level of environmental awareness among the population, which makes it difficult to implement sustainable policies. The study involved the use of a combination of meteorological data sources and information on particulate matter concentrations (PM10 and PM2.5), with the aim of ensuring comprehensive coverage and increased accuracy in the analysis. This multimodal approach provided a detailed overview of air quality in the city of Bacău between May 18 and 31, 2025, by integrating data from both local direct measurements and high-resolution atmospheric models. Analysis of the collected data revealed a number of correlations between weather conditions and variations in PM10 and PM2.5 concentrations. High temperatures (23–25°C) coincided with an increase in PM2.5 concentrations.

Keywords: particulate matter, quality, air, sustainable, emissions.

C.16. ADAPTATION OF ITALIAN GRAPE VARIETIES IN THE CONTEXT OF CLIMATE CHANGE IN THE REPUBLIC OF MOLDOVA

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Abstract. The summer of 2025 in the Republic of Moldova was characterized by hot weather and a marked rainfall deficit. The average monthly air temperature in August ranged between +23 and +26 °C, exceeding the long-term average by approximately 3.5–4.5 °C. The rainfall pattern during the growing season varied significantly across the country, with total precipitation being 14–167 mm higher than in 2023–2024. However, in the Soroca district, the area where vines were cultivated and grapes harvested, the amount of precipitation in the 2025 summer season was estimated at approximately 60–150 mm, representing only 30–70% of the multi-year norm, indicating a pronounced rainfall deficit compared to the usual average values for the period. In 2022, a comprehensive analysis of the soil, relief, and climatic conditions specific to the Soroca district was carried out in the northern part of the Republic of Moldova, with the aim of identifying the most suitable Italian grape varieties and optimal planting technologies. Following the pedological and climatic studies carried out, it was found that the land located outside the village of Vărăncău, on the right bank of the Dniester River, at an altitude of approximately 160 m, offers favorable conditions for the development of viticulture. These conditions are mainly determined by the presence of clay soils and a microclimate conducive to grape ripening. Currently, the vineyard comprises nine technical grape varieties, including established varieties such as Pinot Noir, Merlot, Sauvignon, Riesling, and Chardonnay, as well as less common but internationally appreciated Italian varieties such as Albariño, Glera, Nebbiolo, and Sangiovese. All cuttings used were selected and certified in Italy, belonging to the BxRSO4 biological category. The planting density is approximately 5000 cuttings/ha, which contributes to good productivity and efficient management of each row. The take rate in the first year was 98%, an indicator that confirms the quality of the planting material and the accuracy of the work carried out. Also at this stage, individual stakes were installed for each cutting, ensuring the correct development of the young shoots. In the second year of vegetation, the complete vine support system was installed, consisting of Corten metal stakes, renowned for their strength. Starting in the third year, the plantation switched to the simple Guyot training system, a choice that allows for vigorous growth control and the formation of a balanced vine architecture. This strategy was adopted to prevent premature aging of the vines and to obtain grapes with high sugar concentrations and harmonious acidity - essential elements for producing quality dry wines. Throughout the entire process, Corteva treatment schemes were used, which ensured the maintenance of an appropriate level of phytosanitary protection and favored the uniform development of the plantation. The application of these measures contributed to the optimal

development of the cuttings, creating favorable premises for obtaining high production both in terms of quantity and quality.

Keywords: grapes, climate change.

C.17. STUDY ON THE ASSESSMENT OF THE IMPACT OF THE BACĂU MUNICIPAL WASTEWATER TREATMENT PLANT ON THE WATER QUALITY OF THE BISTRIȚA RIVER

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Abstract. In recent decades, water pollution has become a major global problem, driven by industrial expansion, population growth, and rapid urbanization. A significant source of pollution is domestic and industrial wastewater, which requires a rigorous treatment process before being discharged into the natural environment. Without proper treatment, these effluents can introduce large amounts of organic matter, nutrients, and hazardous pollutants into rivers and lakes, leading to eutrophication, a decrease in dissolved oxygen, and damage to aquatic biodiversity. In this context, wastewater treatment plants play a critical role in protecting the quality of surface water. They act as a filter between human activities and the aquatic environment, reducing the pollutant load in wastewater to levels that comply with environmental standards. The main objective of this study is to assess the impact of the Bacău municipal wastewater treatment plant on the water quality of the Bistrița River, both in terms of compliance with legal standards and from an ecological perspective. The study highlights that the Bacău wastewater treatment plant significantly improves the water quality of the Bistrița River by removing pollutants from the city's wastewater. Without the treatment plant, the river would have suffered massive organic pollution (very high levels of BOD₅ and ammonium, likely accompanied by episodes of anoxia), sedimentation of solids, and a much higher nutrient load, which would have quickly led to a significant degradation of the ecosystem.

Keywords: impact, wastewater treatment plant, water, river, indicators, quality

C.18. SOCIO-TECHNICAL OPTIMIZATION FRAMEWORKS IN ENVIRONMENTAL ENGINEERING: A SYSTEMATIC REVIEW OF MULTI-OBJECTIVE DECISION-MAKING APPROACHES FOR SUSTAINABLE SYSTEMS

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Abstract. Environmental engineering increasingly relies on optimization-based decision-making frameworks to address complex sustainability challenges involving interconnected technical, environmental, and socio-economic factors. This review aims to provide a structured and critical analysis of multi-objective optimization and decision-support methods applied in environmental engineering systems, with a focus on their ability to integrate technical performance with stakeholder-driven criteria. A systematic literature review was conducted using major scientific databases (Scopus, Web of Science), targeting studies that apply optimization techniques in areas such as water resource management, air pollution control, energy systems, sustainable buildings, and waste management. Selected studies were analyzed based on methodological approaches,

decision criteria, system boundaries, and integration of socio-economic and environmental indicators. The results indicate that multi-objective optimization methods, particularly evolutionary algorithms and metaheuristic approaches, are widely used to balance conflicting objectives such as cost, environmental impact, and operational efficiency. Increasingly, these methods are coupled with multi-criteria decision-making (MCDM) tools, stakeholder preference modeling, and risk-based frameworks to enhance decision transparency and robustness. The analysis reveals a growing trend toward integrating social dimensions, including stakeholder priorities and risk perception, into traditionally technical optimization models. However, inconsistencies remain in the definition of system boundaries, indicator selection, and the treatment of uncertainty. Based on the findings, a conceptual socio-technical framework is proposed, in which optimization is reframed as a tool for generating Pareto-efficient solution sets that support informed decision-making rather than a single optimal solution. This approach improves the adaptability, transparency, and sustainability of environmental engineering systems. The study contributes to the unification of existing methodologies by highlighting the importance of integrating optimization techniques with participatory and risk-informed decision processes, providing guidance for the development of next-generation decision-support systems.

Keywords: decision support systems, environmental systems, multi-criteria decision making, multi-objective optimization, socio-technical systems, sustainability

C.19. EXPANDING THE SPECTRUM OF ACTION OF THE BACTERIUM PSEUDOMONAS FLUORESCENS STRAIN AP-33 (V-3481) FOR THE PROTECTION OF PLANTS AGAINST DISEASES IN MOLDOVA

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Abstract. At present, additional studies have been conducted to expand the fungicidal spectrum of a biological product based on the bacterium *Pseudomonas fluorescens* AP-33(V-3481) (Rizoplan), which is already registered in Moldova's State Register of Phytosanitary Products. Antagonistic activity of *Ps. fluorescens* against 20 test organisms was evaluated in vitro on PDA agar using the dual-culture method. Antifungal activity was determined by the diffusion method using metal cylinders. The results of the studies showed that all target organisms exhibited varying degrees of sensitivity to *Ps. fluorescens*, with the formation of sterile zones of growth inhibition. The maximum sterile zone of 41.5 mm was observed between the antagonist and the causative agent of apple moniliasis, *Monilia fructigena*. The growth inhibition zones for *Botrytis cinerea* and *Monilia cinerea* were 28 mm, for *Microdochium nivale* – 26.7 mm, and for *Alternaria alternata* – 19.2 mm. Not all pathogens exhibited sensitivity to the metabolites, including *Fusarium poae*, *F. solani*, and *Trichothecium roseum*. It is likely that such aggressive pathogens can be controlled by a live antagonist culture. These studies have significantly expanded the spectrum of activity of the bacterium *Ps. fluorescens* AP-33(V-3481), which will allow for the future state registration of the preparation in the Republic of Moldova for the protection of agricultural crops on which it has not previously been used.

Keywords: antagonistic activity, biological preparation, dual culture, phytopathogen, sterile zone

C.20. COMPARATIVE ANALYSIS OF AHP AND FUZZY LOGIC FOR LAND USE SUITABILITY: A CASE STUDY OF THE KARTAL QUARRY AREA (ISTANBUL)

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Abstract. This study aims to evaluate alternative land-use classes for the defunct Kartal Quarry in Istanbul within the scope of landscape restoration by incorporating cultural landscape data. To

this end, multi-criteria decision-making methods were used to determine the most ecologically and socially appropriate decision for the area. First, cultural landscape criteria were defined in accordance with the relevant literature, and then these criteria were weighted using the Analytical Hierarchy Process (AHP) method. Subsequently, land-use class alternatives were evaluated using a fuzzy logic approach to incorporate uncertainties into the decision-making process. The results show that recreation and sports areas are the most suitable land-use class alternative, followed by health facilities and residential areas. The significant similarity between the results obtained from AHP and fuzzy logic methods demonstrates the consistency and reliability of the model. The study offers a feasible and flexible decision support approach for the repurposing of defunct quarries, particularly in metropolitan areas under intense urbanization pressure like Istanbul. In this respect, it contributes to the development of sustainable land-use decisions by considering natural, social, and cultural criteria together.

Keywords: landscape planning, landscape rehabilitation, land suitability, modeling and optimization, fuzzy, AHP

C.21. THE OIL CONTENT IN WALNUT KERNELS OF SOME MOLDAVIAN CULTIVARS

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Abstract. The aim of our work was to evaluate the oil content in mature walnut kernels of some Moldavian cultivars. Currently, in USA agriculture the nuclear magnetic resonance (NMR) relaxation method is used to determine the oil content of industrial batches of sunflower seeds. In our work we used the method of NMR relaxation with a sequence of 90°- and 180°- high frequency pulses (an interval 3,5 ms). At the end of the vegetative period 2025 at stage 88 according to the Biologische Bundesanstalt Bundessortenamt und Chemische Industrie (BBCH) scale in the walnut orchard (planting year 2014) of SRL "Gospodarul" (Republic of Moldova, Falesti district), the oil content of the walnut kernels was determined by NMR relaxation method, directly in native kernels. The oil content in walnut kernels was 59,5±0,6% for cultivar Chernovitskyi, 57,6±1,0% for cultivar Cogilniceanu and 59,1±1,3% for cultivar Pescianski. On the basis of these results it was concluded that the oil content in mature walnut kernels of Moldavian cultivars corresponds to the typical range for the crop. Acknowledgements. Research was carried out within the bilateral Project Moldo-Turc 25.80013.5107.01TR: "Eco-farming for innovative protection of new walnut varieties: harnessing methodologies and technologies" funded by the National Agency for Research and Development and by the Ministry of Education and Research. Special thanks to N.F. Kiktenko (SRL Gospodarul, Falesti district) for helping with measurements in his walnut orchard.

Keywords: fruit ripening, Moldova Republic, nmr relaxation, nut quality, orchard.

C.22. BIOPESTICIDES IN THE PROTECTION OF FRUIT TREES AGAINST PEST ORGANISMS: EFFICACY AND ENVIRONMENTAL SAFETY

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Abstract. Traditional protection of fruit trees against pests is largely based on chemical pesticides. However, their intensive use may cause pest resistance, environmental pollution, and toxic residues in fruits. Microbial pesticides represent an environmentally friendly and target-specific alternative for orchard protection. Among them, *Bacillus thuringiensis* var. *kurstaki* is one of the most studied entomopathogenic bacteria. The bacterial suspension was tested alone and in combination with Microcom and chitinase. The present study evaluated the biological

effectiveness of *B. thuringiensis* var. *kurstaki* against *Hyphantria cunea* Drury. In 2024, the efficacy of *B. thuringiensis* var. *kurstaki* 10⁹ CFU/ml was 71.9%. The combined treatment with Microcom and chitinase reached 82.7% biological effectiveness in 2024. In 2025, the bacterial suspension alone showed an efficacy of 79.4%. The mixture of *B. thuringiensis* var. *kurstaki*, Microcom, and chitinase reached 83.6% in 2025. The chemical standard showed the highest efficacy, with 86.6% in 2024 and 91.2% in 2025. This article analyzes and synthesizes information on biological products as an environmentally friendly alternative. The results confirm the potential of these biological products for integrated pest management in apple orchards.

Keywords *Bacillus thuringiensis* subsp. *Kurstaki*, biological products, microbiological preparations.

C.23. SEASONAL ANALYSIS OF THE COMPOSITION OF MUNICIPAL WASTE IN BACĂU COUNTY

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Abstract. This study evaluates the seasonality of municipal waste in Bacău County for the year 2021 based on a complete set of monthly reports structured by EWC codes. The quantitative analysis highlights substantial oscillations throughout the year, with a pronounced contrast between winter months and the summer period. The dominant municipal waste stream, EWC 20 03 01, ranges from approximately 9,072 t in February to 14,881 t in August, totalling ≈145,895 t/year, which explains the strong seasonal profile and the visual polarization observed in the heatmaps. The total municipal waste follows the same pattern, with a minimum of ~9,600 t (February) and a maximum of ~15,800 t (August), in a distribution that concentrates ~29.3% of annual quantities in the warm season and only ~20% in the cold season. In parallel, recyclable streams remain marginal, accounting for only ≈3.3% of the total, with mixed packaging (~56%) representing the main recovered subfraction. Statistical analysis (Kruskal–Wallis) confirms only the winter–summer difference as statistically significant, while PCA reveals an almost one dimensional structure of monthly variability, dominated by the dynamics of total volumes. The results support the need for seasonal calibration of operational capacities — increasing collection frequencies and buffer capacity during summer months, and using winter months for maintenance — and indicate the necessity of extending the analysis to multi annual series to assess the stability of the identified seasonal pattern.

Keywords: seasonality, monthly quantities, EWC, municipal waste, seasonal indices

C.24. PRACTICAL APPROACHES TO SLAUGHTERHOUSE WASTEWATER TREATMENT USING CHEMICAL ADDITIVES

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Abstract. Slaughterhouse wastewater is characterized by high organic load, suspended solids, fats, and proteins, requiring efficient treatment solutions to meet discharge standards. This study presents practical approaches for the treatment of slaughterhouse wastewater using chemical additives combined with dissolved air flotation (DAF). The treatment process involved coagulation–flocculation using a ferric-based coagulant (DM Fer) and an organic flocculant, followed by separation in a DAF unit. The coagulation–flocculation stage significantly enhanced the aggregation of colloidal and suspended particles, facilitating their removal during flotation. The integration of the DAF process ensured efficient separation of flocs, fats, and grease from the liquid phase. Experimental results demonstrated a substantial improvement in wastewater quality, with a chemical oxygen demand (COD) reduction exceeding 79%. The findings highlight the effectiveness of combining chemical conditioning with DAF technology as a reliable and practical solution for slaughterhouse wastewater treatment. This approach offers operational simplicity, high removal efficiency, and adaptability to variable wastewater characteristics, making it suitable for industrial-scale applications.

Keywords: slaughterhouse wastewater, organic flocculant.

C.25. PERFORMANCE OF AN ADSORPTION-BASED TREATMENT APPLIED ONTO ZOOTECHNICAL FARM EFFLUENTS USING STRAW-ACTIVATED CARBON ADSORBENTS

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Abstract. Respecting the imposed norms for effluent characteristics discharged in natural receptors is an obligation of each responsible owner, fact that requires effluent treatment application. Treatment based on adsorption / biosorption is recommended as promising alternative to replace conventional techniques because of its availability, profitability, simple design, low cost and higher performance when working in varying effluent concentration and flow regimes. This research work presents the preliminary adsorption results performed at laboratory scale setup testing of certain real effluents produced from different activities of a zootechnical farm specialized on Romanian cattle breeding for finding the adequate operating conditions to obtain the highest polluting species removals. There were considered as principal influencing variables the adsorbent concentration (certain single and combination of straw and activated carbon), the operating temperature (4.50 ± 0.5 -40.5-45.50 grade Celsius) and biosorption contact time (0.50-24 h, usually at least an 8h-working shift). The highest efficiencies in removal of turbidity, suspended solids, color, COD-Cr, ammonia, free chloride, total dissolved salts, conductivity etc. are underlined in association with the corresponding variation interval for each main influencing factors. The use of proposed adsorbent (mixture of straw-activated carbon) was found beneficial as an alternative adsorbent for polluting species removal from real studied zootechnical effluents.

Keywords: activated carbon-straw, adsorption, cattle breeding, influencing factors, zootechnical effluent, polluting species removal

C.26. EVOLUTION OF MANGANESE REMOVAL METHODS IN DRINKING WATER: FROM CONVENTIONAL PROCESSES TO EMERGING SOLUTIONS

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Abstract. Manganese is an essential element in drinking water treatment due to its influence on aesthetic water quality, infrastructure durability, and potential implications for human health. Elevated concentrations of manganese in drinking water can cause discoloration, deposits, and deterioration of distribution networks, making the use of efficient removal technologies indispensable. This paper provides a critical and systematic analysis of current advances in manganese removal processes, evaluating both conventional methods—such as oxidation, filtration, and adsorption—and emerging approaches based on biological processes and hybrid systems using advanced catalytic materials. The advantages, limitations, and applicability of each method are discussed in relation to raw water characteristics and regulatory compliance requirements. The study highlights current trends toward sustainable solutions with reduced chemical consumption and digital integration, emphasizing the need for interdisciplinary approaches to achieve the objectives set by the European Drinking Water Directive (EU 2020/2184).

Keywords: manganese, drinking water, oxidation, adsorption, biological treatment, emerging technologies, water treatment

C.27. CASCADE VALORIZATION OF LIGNOCELLULOSIC BIOMASS: COMBINATION OF BIOREFINERY AND BIOENERGY FOR A DOUBLE VALORIZATION OF FRAMIRÉ SAWDUST

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Abstract. Faced with the depletion of fossil resources and the need to promote a circular economy, lignocellulosic biomass represents a solution for energy transition and bioeconomy. However, wood sawdust, which contains bioactive compounds (secondary metabolites), is often burned in the open by many sawmills. This study aims to valorize Framiré wood sawdust by extracting its secondary metabolites through maceration and infusion, then converting the depleted residue into combustible briquettes. The yellowness index of the extracts ranged from 73.490 ± 0.021 (maceration) to 81.720 ± 0.014 (infusion). The total phenolic content varied from 0.097 ± 0.001 to 0.63 ± 0.049 gGAE/100 g dry matter for maceration and infusion, respectively. The extraction of bioactive compounds did not significantly affect the energy or mechanical properties of the fuels. Their higher heating value ranged from $26,153 \pm 92$ to $26,201 \pm 90$ kJ/kg for fuels with and without secondary metabolites, respectively. The Shock Resistance Index ranged from $139.33 \pm 7.51\%$ (without metabolites) to $153.00 \pm 5.20\%$ (with metabolites). A significant difference was observed in the specific consumption of the fuels, decreasing from 1.400 ± 0.100 to 0.861 ± 0.001 kg/L for fuels without and with secondary metabolites, respectively. These results open promising prospects, particularly for the use of Framiré extracts to develop flame-retardant products for wood and its derivatives

Keywords: lignocellulosic biomass, Framiré sawdust, secondary metabolite, fuel briquettes, flame-retardant, circular economy

C.28. ANALYSIS OF THE OLFACTORY IMPACT OF EMISSIONS GENERATED BY CIVIL AND MILITARY ROAD TRAFFIC

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Abstract. The paper comparatively analyzes the olfactory impact generated by civil road traffic and military activities, using dispersion modeling and experimental data analysis. The results highlight a higher persistence of emissions originating from the combustion of JP-8 fuel, whose chemical profile rich in aromatic hydrocarbons induces prolonged sensory discomfort compared to standard diesel. The use of IoT sensors and Gaussian-type mathematical models enables the identification of pollutant stagnation zones within urban street canyons. The study emphasizes the need to integrate olfactory indicators into environmental management strategies in order to reduce public health risks in the vicinity of transport infrastructure and military bases. Air quality management in large urban agglomerations represents a critical component of environmental protection strategies in 2026, as well as a major priority for local administrations and public health systems. The urban environment, through its high population density and complex infrastructure, generates a significant volume of pollutants, particularly nitrogen oxides (NO_x), volatile organic compounds (VOCs), and fine particulate matter (PM_{2.5} and PM₁₀), with road transport remaining the primary source. This pollution is not only an environmental issue but also a direct cause of olfactory discomfort and respiratory problems, aspects of critical importance for hospital management. Addressing this issue requires a solid scientific foundation based on the physical modeling of atmospheric dispersion processes and rigorous principles of experimental data acquisition. Without a precise understanding of how pollutants move, accumulate, or are transported by wind, control strategies remain ineffective. The major challenge lies in the dynamic nature of emission sources (traffic flow) and their complex interaction with urban morphology, where buildings act as barriers or accelerators of airflow. Physical modeling transforms raw data collected from sensors into predictive impact maps, which are essential for sustainable urban planning and for justifying investments in public health and green infrastructure.

Keywords: air pollution, odour impact, vehicle emissions, dispersion, environmental assessment

C.29. AIR QUALITY MONITORING AND IMPROVEMENT MEASURES IN THE BARLETA INDUSTRIAL AREA

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Abstract. This paper analyzes the impact of particulate matter (PM) pollution and noise on the working environment within an industrial production unit, identified as a critical area due to the operation of equipment at maximum capacity and the high density of personnel. Prolonged exposure to these factors leads to significant negative effects on workers' health, including respiratory diseases, hearing loss, and decreased cognitive performance. Based on the conducted analysis, integrated technical solutions are proposed to reduce pollution levels. The

implementation of a ventilation system with advanced filtration (HEPA filters and activated carbon) contributes to lowering particulate concentrations and improving indoor air quality. The use of personal protective equipment, such as noise-canceling earmuffs, reduces exposure to high noise levels and associated risks. Additionally, sound insulation of the production hall walls helps limit noise propagation both indoors and into the surrounding environment. The results highlight the effectiveness of these measures in enhancing occupational safety and worker comfort, as well as ensuring compliance with health and safety standards. The paper emphasizes the need to adopt sustainable and cost-effective technical solutions for optimizing the industrial working environment.

Keywords: air pollution, particulate matter, filtration, noise, technical solutions

C.30. HYDROCHLORIC ACID REGENERATION BY VARIOUS PROCESS OPTIONS AS A LOW COST AND ECOLOGICAL ALTERNATIVES

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Abstract. One of the most important processes in technologies for the recovery of metals from various raw materials (ores, slag, etc.) is the regeneration of HCl. As a result of industrial activities (steelmaking and hydrometallurgy), HCl has a significant impact on the environment. Due to its high solubility in water, it can readily influence air quality and contribute to the formation of acid rain. In addition, it produces direct effects on aquatic ecosystems and exerts a major negative impact on soil and vegetation, as well as on infrastructure. For this reason, its presence must be carefully monitored in environmental systems. The objective of this work is to evaluate the most suitable environmentally friendly technologies from the perspective of the reaction mechanisms involved and the corresponding process flow schemes. Furthermore, our study presents a case study based on cost-effective and environmentally sustainable technological processes. New optimizations of HCl recovery processes are highlighted, such as those involving the initial use of CaO followed by the formation of $\text{CaSO}_4 \cdot n\text{H}_2\text{O}(\text{s})$: $\text{CaCl}_2 + \text{H}_2\text{SO}_4 + n \text{H}_2\text{O} \rightarrow \text{CaSO}_4 \cdot n\text{H}_2\text{O}(\text{s}) + 2 \text{HCl}(\text{aq})$

Keywords: acid regeneration, hydrometallurgy, environmental impact, sustainable technologies

C.31. FIREPROOFING TECHNOLOGIES OF WOOD USING INORGANIC COMPOUNDS

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Abstract. Inorganic compounds such as borates, hydroxides, phosphates, carbonates and sulfates can be used to treat considering their capacity to improve the thermal stability, fire-proofing ability of the wood with lower release of smoke and toxic corrosive gases during the combustion process. Inorganic salts are considered environmentally friendly flame retardants, having very low harmful effects on humans and animals in the form of solutions or as products resulting from the combustion process [1]. Salts such as K_2CO_3 have high flame retardant efficiency, and the combination of silica solution (SiO_2) and boric acid shows improved flame retardant and leaching resistance [2]. In their study, He et al. (2017) [2] suggested that K_2CO_3 catalyzed the degradation of wood at lower temperatures, inducing the increase of water and

carbon dioxide (Wood materials treated with inorganic salts are usually more hygroscopic), while the SiO_2 solution formed a compact and molten barrier on the surface of the coal residue. Merk et al. [3,4] mineralized wood with CaCO_3 to create a structured organic-inorganic hybrid material, as an ecological alternative to conventional fireproofing systems, with greatly improved fireproofing properties of wood. In this paper, we present the synthesis, characterization and testing of wood substrates mineralized with CaCO_3 and treated with silica and boric acid, exceptional insulating properties that provide protection to the treated (wooden) substrate against ignition. The fire-retardant ability was proved on matches, after treating them according to the technology we developed and was correlated with the physico-chemical changes we get during the chemical modification. In addition, the treated wood samples were evaluated for their antimicrobial, anti-biofilm and anti-enzymatic activities. The results varied depending on the tested microfungi strains, indicating that the mineralization treatment may provide supplementary biological protection alongside enhanced fire resistance.

Keywords: flame retardancy, wood mineralization, inorganic salts, calcium carbonate (CaCO_3), thermal stability

C.32. SUSTAINABLE CONSOLIDATION OF STONES BY USING ECOFRIENDLY APATITE FROM ORGANIC CALCIUM SALTS AND PHOSPHATE PRECURSOR

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Abstract. There are several products used for the consolidation of silica-based materials, but only a few for the carbonate-based materials. In the recent years, researchers have evaluated the effectiveness of different phases of calcium phosphates and especially hydroxyapatite (HAp) as consolidation agents for carbonate stones and Ca-rich stones (limestone, marble, sandstones), obtained from the reaction of diammonium phosphate (DAP) with the calcite in the stone. However, a major problem arises when stones with a low Ca content or with Ca-rich stone that has been previously modified. In the first case, HAp cannot form and, secondly, the reaction could further damage the stone [1]. In the present work we propose to obtain a consolidation agent by the reaction between DAP and different calcium precursors (such as Ca lactate or gluconate). The apatite phase was obtained in a time-dependent mode, this means that the calcium precursor was immersed in the stoichiometric amount of DAP solution and, after 10, 20, 30, and 60 min, the precipitate was filtered and washed with distilled water and dried, in oven, at 100°C. The samples, encoded HAp(x), x being the time in minutes, were further characterized by XRD, FTIR, SEM, DLS, but also from the consolidative capability on specific porous stone experimental models.

Keywords: hydroxyapatite, calcium phosphates, diammonium phosphate, stone consolidation, carbonate-based materials

C.33. ENVIRONMENTAL APPLICATIONS OF FUNGAL BIOMASS IN DYE ADSORPTION AND CATALYTIC OZONATION PROCESSES

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Abstract. In the context of increasing concern regarding the presence of persistent synthetic dyes in aquatic environments, this research explores the potential of fungal biomass as a sustainable solution for advanced wastewater treatment. This research presents the development of a fungal-based bioadsorbent derived from *Russula rosea*, processed through a controlled preparation protocol to obtain a fine biological material (RS). To enhance its catalytic properties, the material was further functionalized with vanadium, resulting in RSV. Since vanadium impregnation reduces the available adsorption surface, adsorption experiments were carried out exclusively with the unmodified RS material. The target pollutant was Victoria Blue R, a synthetic cationic triphenylmethane dye widely used in textile and printing industries and classified as a persistent organic contaminant due to its strong stability, intense coloration, and toxicity in aquatic systems. Adsorption tests performed with RS investigated the influence of dye concentration and bioadsorbent dosage. In contrast, the vanadium-modified RSV material was employed solely for catalytic ozonation, focusing on the effects of catalyst loading, ozone dosage, and pH variation on dye degradation. The results revealed that RS exhibits notable adsorption capacity toward Victoria Blue R, while RSV significantly enhances the efficiency of catalytic ozonation, accelerating dye degradation through advanced oxidation mechanisms. Overall, this research demonstrates the complementary roles of RS and RSV and highlights the potential of *Russula rosea* derived materials as sustainable and multifunctional agents for the removal of persistent dyes from wastewater.

Keywords: *Russula rosea*, Victoria Blue R, adsorption, catalytic ozonation, persistent pollutants, wastewater treatment, advanced oxidation processes

C.34. PROCESS SIMULATION OF BIOGAS PRODUCTION FROM SPENT COFFEE GROUNDS – A SIMPLIFIED FLOWSHEET

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Abstract. Biogas is a renewable fuel mainly composed of methane, obtained through anaerobic digestion of organic matter. Spent coffee grounds (SCGs) are generated in large quantities worldwide and represent a promising substrate for bioenergy production due to their rich organic composition and availability [1]. The study aimed to simulate the anaerobic digestion (AD) process using SuperPro Designer to evaluate biogas production from SCGs, using household waste (HW) as the reference substrate. The simulation involved modeling the main stages of AD and analyzing key performances such as biomass yield, methane concentration, as well as carbon dioxide and hydrogen sulfide content versus hydraulic residence time (HRT). The resulting digestate will be evaluated for its potential use as a nutrient-rich fertilizer in agriculture. The simulation includes feed preparation, AD and gas separation units, allowing the assessment of inlet substrate concentration and HRT influence on process performance, defined as methane yield. Results indicate that substrate composition significantly influences both biogas production and methane yield.[2] In this study, all simulations were performed using the same kinetic model and identical process parameters, ensuring a consistent basis for comparison. HW, yielding 0.34 m³ CH₄/kg VS, a value that is consistent with literature reports and supports the reliability of the

simulation approach. In contrast, SCGs exhibited a lower methane yield of 0.266 m³ CH₄/kg VS, likely due to their higher lignocellulosic content and reduced biodegradability, which limit microbial conversion efficiency. Despite its lower performance, SCGs demonstrate potential for energy recovery and merit consideration in waste valorization strategies. In the future, the synergistic effects of mixed SCGs and HW substrate upon the methane yield will be investigated. The novelty of this study lies in the application of a unified kinetic framework to comparatively assess substrates with differing biodegradability, highlighting the capability of process simulation tools to support feedstock evaluation and optimization.

Keywords: anaerobic digestion, biogas, coffee husks, spent coffee grounds, methane yield, process simulation, SuperPro Designer

C.35. CLIMATIC DRIVERS OF QUALITY CHANGES IN LONG-TERM STORED WHEAT: A COMPARATIVE MULTI-YEAR ANALYSIS

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Abstract. This research investigates the influence of interannual climatic variability on the physico-chemical stability of wheat during extended storage, under controlled and unchanged warehouse conditions. The study is based on continuous monitoring of ambient temperature and relative humidity, alongside periodic assessment of key quality indicators, including grain moisture content, hectoliter weight, protein content, and gluten strength. A comparative evaluation of two consecutive storage cycles reveals distinct degradation trajectories, despite identical technological handling. Elevated thermal and moisture regimes were found to accelerate quality deterioration processes, particularly affecting protein-related parameters and bulk density. Multivariate statistical analysis highlights strong associations between environmental drivers and quality evolution throughout storage. The findings demonstrate that long-term grain preservation is strongly conditioned by external climatic dynamics and support the need for storage management strategies that are responsive to interannual climate fluctuations in order to limit quality losses and ensure product stability.

Keywords: Grain preservation, climatic variability, storage microclimate, wheat quality indicators, long-term monitoring

C.36. OPTIMIZING THE COLLECTION OF HOUSEHOLD WASTE FROM THE ECOLOGICAL ISLANDS WITHIN THE MUNICIPALITY OF GALATI

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Abstract. Waste Management (WM) is an urban action that is becoming increasingly important in the municipal economy. In many cities, this activity is linked to significant revenues from selective waste collection services. Since the current economic situation requires an increase in the efficiency and profitability of municipal services, in order to achieve a reduction in

operational costs, a firm and complex design of services is necessary, including the collection of this household waste. Under these conditions, a number of 275 ecological selective collection islands were built in the municipality of Galați. Each island has a set of 5 compartments for the collection of paper, plastic, metal, etc. Under these conditions, a problem is daily related to dynamic optimizations of the visiting maps of these islands. In this regard, our team has generalized a proprietary software application for the dynamic generation of papers that include the collection points to be visited. Introduction: The designed algorithm and the construction of the application developed in our laboratory are based on the specific use of Dijkstra-type algorithms that allow the traversal of points on a directed graph of map type that includes restrictions on the direction of traversal or gauge. The algorithm is initially two-dimensional, and then a generalization is made in the three-dimensional domain, each node having a weight with 3 dimensions – the amount of paper, PET and metal. Methodologies. The method considered in this project is based primarily on a detailed map of the municipality of Galati. The map used is imported into the ArcGis system and the set of streets and intersection points that will be used are defined, using the tools in this environment. A database with the locations of the location points is also introduced in this environment. All these geometric aspects are then imported into a mathematical object of graph type. Depending on the points to be visited by the collection vehicles, the algorithm that offered the most economical path is run. Results and Discussion. The developed algorithm is then implemented in an application written in python (Python 3.2 – PyCharm - academic license). Using this algorithm recursively, succeeds in successively optimizing the trajectories that lead to the efficiency of this collection activity. Conclusions. For the problem of optimizing the waste collection activity, in addition to the functional constraints and the legislative nature, we must first consider the loading rate of the containers within the selective collection islands. This aspect is particularly useful in planning the waste collection activity because it represents the first element in the design of an optimized procedure system. In this paper, the first elements that allow this are presented, the next step being a WEB or mobile application.

Keywords: waste management activity, dijkstra algorithm, recursive back-tracking

C.37. THE PRELIMINARY DEVELOPMENT STAGE OF AN AUTONOMOUS DRONE INTERCEPTION SYSTEM, GUIDED BY ARTIFICIAL INTELLIGENCE

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Abstract. The laboratory of the Faculty of Sciences and Environment is equipped with several prototype-built drones. Currently, the rapid proliferation of unmanned aerial vehicles (UAVs) requires the development of innovative systems of this type. Within our laboratory, we have initiated research into the construction of highly agile, autonomous interception devices. In this regard, we will be able to propose the structure and development of a state-of-the-art, multi-rotor (4 to 8 engines) autonomous drone interceptor. A critical factor differentiating this project from other previous projects is its 100% internal development architecture. The objective was to create a device that would allow for developments at speeds high enough to be used as an interceptor. The hardware, firmware and software are designed, written and tested entirely by our local team. This innovative approach guarantees absolute operational security - ensuring that the drone cannot be externally overloaded or restricted from tracking specific targets - and offers greatly improved flexibility. If hardware or software changes are required, our team can implement and deploy them in days or weeks, rather than months. Preliminary results are presented in this paper.

Keywords: mathematical modeling, autonomous drone interception system, sovereign and cost-effective approach to air defense

C.38. STUDY ON METHODS FOR IDENTIFYING URBAN HEAT ISLANDS – CASE STUDY – THE SOUTHERN AREA OF ROMANIA

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Abstract. Urban heat islands are the phenomenon by which cities become considerably warmer due to the absorption and retention of heat by built surfaces. The study of these urban heat islands is a current necessity in Romania as well. In this paper, we present a methodology for detecting climate change using extreme values of air temperature and atmospheric precipitation. Modeling urban heat islands (UHI) using GIS tools and climate software involves the integration of spatial and atmospheric data to analyze the temperature distribution and the impact of urban factors on the microclimate. In the case of this paper, we carried out a data collection covering the period 2017-2023, regarding a series of atmospheric parameters from 13 locations related to air quality monitoring stations in the south-eastern area of Romania. Due to the limitations of the size of the presented study, the limitation was made to the area that includes a set of 16 monitoring stations – 4 stations in Galați county, 4 stations in Vrancea county, 4 stations in Bacau County and 4 in Vaslui county. The algorithm used in this study includes: multivariate analysis - based on the PCA method, clustering - based on methods such as k-means for grouping stations according to thermal behavior and comparative graphs between stations, thermal and vector maps (for wind), correlation and regression diagrams, etc.

Keywords: urban heat islands, PCA method, multivariate analysis

C.39. THE EVALUATION OF THE ROLE OF THE VARFU CAMPULUI DAM AND RESER-VOIR IN INTEGRATED WATER RESOURCES MANAGEMENT

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Abstract. The Varfu Campului Dam and Reservoir has particular regional importance for the management of water resources in the Siret River basin, both through its role in mitigating flood waves and through its capacity for daily flow regulation required for supplying water to the population. The results of hydrological analyses highlight that bringing the reservoir into operation can significantly contribute to reducing the maximum downstream discharge, thereby increasing the level of flood protection for currently vulnerable areas. The reservoir ensures better management of water resources during periods of low flow (hydrological drought), representing an important element for balancing daily demand variations. The results of pluviometric analysis indicate a pronounced tendency toward drought. Thus, the completion and commissioning of the Varfu Campului Reservoir represent a necessity for increasing regional resilience to extreme events, by combining the function of flood protection with that of ensuring water resources during deficit periods.

Keywords: Varfu Campului, Siret, flood attenuation, hydrological drought, water security, essential infra-structure

C.40. NUMERICAL ANALYSIS AND HYDRAULIC CONSIDERATIONS OF TECHNICAL FISH-PASSES DESIGNED FOR TROUT SPECIES IN MOUNTAINOUS AREAS

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Abstract. Technical fish passes are key hydraulic structures ensuring longitudinal river connectivity disrupted by weirs and dams, allowing natural fish migration. This study presents a de-tailed numerical analysis of the hydraulic behavior of fish -pass designed for rheophilic species in mountain areas, particularly *Salmo trutta fario* (brown trout). The analysis was performed using three-dimensional Computational Fluid Dynamics (CFD) modeling based on the finite volume method and the Reynolds-Averaged Navier–Stokes (RANS) equations coupled with the standard $k-\epsilon$ turbulence model. Four geometric configurations were analyzed, differing in baffle number, spacing, and slot geometry. Results showed significant variations in velocity fields (0.65–1.35 m/s), indicating that fishways with three baffle rows and narrow longitudinal slots provided stable flow conditions compatible with trout swimming capacity. Configurations with larger baffles generated high turbulence and unfavorable local velocities. The study highlights the usefulness of CFD modeling as a complementary tool for the comparative assessment of hydraulic conditions in technical fishways, supporting species-oriented design decisions. Future research will extend the analysis to sedentary species such as *Cottus gobio* and integrate bioenergetic and behavioral models to assess hydraulic performance under varying flow conditions.

Keywords: fish passes, CFD, *Cottus gobio*, longitudinal connectivity.

C.41. ANALYSIS OF PHYSICAL-MECHANICAL PARAMETERS OF THE EQUIPMENT ON THE SECONDARY MEAT PROCESSING FLOW

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Abstract. The modern slaughtering industry requires an increase in processing efficiency while ensuring food safety. The paper analyzes the physical-mechanical parameters (cutting forces, pressure, friction, working speeds, wear, energy consumption) of the equipment on the technological flow at S.C. Diana S.R.L. The study highlights the influence of these parameters on the quality of the meat paste and industrial yield. The results contribute to the optimization of working regimes and the construction of fine and coarse grinding equipment. The results obtained highlight direct correlations between working regimes and technological performance: -Energy efficiency - the use of frequency converters to adjust the chopping speed has demonstrated a reduction in energy consumption by up to 15%. - Constructive optimization - changing the sharpening angle of the sickle-type knives has led to a reduction in vibrations transmitted to the frame, extending the life of the bearings. - Product quality - it has been demonstrated that, although increasing the speed (up to 3000 rpm in the case of the cutter) increases the yield, this requires strict control to avoid thermal degradation of proteins, the temperature increasing from 2°C to 12°C during the process. The originality of the work lies in the proposal of an integrated evaluation model that quantitatively correlates mechanical indicators with quality indicators (texture, granulation, water retention capacity). The conclusions of the study provide applicable solutions for modernizing technological flows in accordance with European standards, contributing to increasing competitiveness and sustainability in the meat processing sector.

Keywords: slaughterhouse, meat processing, physical-mechanical parameters, food machinery, meat mincing.

C.42. OVERVIEW ON AZO DYE AND COLOR REMOVAL PERFORMANCE BY STATIC BIOSORPTION TREATMENT USING DEAD ALGAE-BASED BIOMASS

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Abstract. Azo dyes are included in the category of hazardous pollutants from industry and other economic sectors able to affect the aquatic environment health, especially human and animal health. Therefore, it is recommended its removal from the final wastewater discharged in aquatic receptor, or inside reuse by efficient treatment techniques including algal biosorption/adsorption/sorption, in static and dynamic operating conditions, with living or dead algae biomass (green, brown, red ones, etc.), as affordable adsorptive materials in terms of efficiency-costs. This paper provides basic information on the performances of certain types of algal biomass in removal of azo dyes and color from industrial wastewaters in association with the future possibilities of dyes decomposition and its recovery by algal technology and wastewater discoloration. Functionalized materials obtained from certain algal sources were comparatively evaluated in biosorption treatment steps, especially in terms of dye and color removal efficiencies, highlighting the main influencing factors of algal biosorption to eliminate these emerging pollutants. Finally, this research work reports the potential use of algal biomass as an effective, affordable, and sustainable biosorbent for minimizing the aquatic environmental pollution.

Keywords: algal biomass, azo dye removal, biosorption, treatment cost, discoloration, hazardous pollutants, influencing factors, treatment efficiency

C.43. THE IMPACT OF TOURISM'S CARBON FOOTPRINT ON HEALTH AND SUSTAINABLE SOLUTIONS

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Abstract. Tourism is a strategic economic sector that makes a significant contribution to economic development, but it accounts for approximately 8% of global greenhouse gas emissions. These emissions contribute to the deterioration of air quality and the acceleration of climate change, with direct and indirect effects on human health and ecosystems. This study aims to analyze the impact of the carbon footprint generated by tourism on public health and ecosystems, highlighting the link between pollution, climate change, and health risks. It also evaluates measures to reduce emissions in the tourism sector, with a focus on the role of the European Ecolabel (EU Ecolabel) in promoting sustainable practices in accommodation facilities. The results highlight how adopting eco-certifications helps reduce resource consumption and pollutant emissions, thereby supporting the transition to sustainable tourism. In this context, the main sources of tourism's carbon footprint (transportation, energy consumption, water consumption, and waste generation) are identified. These contribute significantly to air pollution and the intensification of extreme weather events, with an impact on public health. At the same time, the analysis highlights the importance of implementing sustainable measures, such as improving energy efficiency, utilizing renewable energy sources, and optimizing resource management. Promoting responsible behavior among both tourism operators and tourists helps reduce the carbon footprint and build a resilient and sustainable tourism system. In conclusion,

the implementation of effective sustainable management tools is essential for protecting public health and achieving climate neutrality goals.

Keywords: tourism, environment, eco-labels, carbon footprint, public health, sustainability.

C.44. SIMULATION OF A MATHEMATICAL MODEL FOR SOIL BIOREMEDIATION

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Abstract. The article presents some simulations for a mathematical model that describes the bioremediation of a polluted soil. The mathematical model is a reaction-diffusion system for the pollutant and for the bacteria. We made some two-dimensional simulations that show us how a small parameter affects the coupling and diffusion. The simulations help us to visualize both pollutant and bacteria evolution. To perform the simulations we used FiPy which is a free, open-source Python library specifically designed for PDEs, especially reaction–diffusion systems using numerical methods.

Keywords: system of partial differential equations, two-dimensional simulations, small parameter.

C.45. STUDY AND RESEARCH ON DOMESTIC WASTEWATER TREATMENT PLANTS

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Abstract. This paper aims to analyze the importance of domestic wastewater treatment plants in the context of environmental protection and sustainable wastewater management. The study highlights the need for efficient solutions for the treatment of domestic wastewater, especially in rural areas and isolated communities where access to centralized sewerage systems is limited or difficult to achieve from an economic perspective. The main objective of the research is to evaluate the operating principles of small-scale wastewater treatment plants, the technological stages involved, and the efficiency of the treatment processes used within these systems. The paper presents and analyzes mechanical, biological, and tertiary treatment processes, as well as the main indicators used to assess the quality of the discharged effluent, such as BOD₅, COD, suspended solids, ammoniacal nitrogen, total phosphorus, and pH value. Furthermore, the study compares domestic wastewater treatment plants with other categories of treatment facilities, including industrial, stormwater, and mixed systems, emphasizing the advantages of compact and modular solutions in terms of flexibility and adaptability. The paper also addresses the relevant legislative requirements and applicable standards, including European and national regulations, as well as ISO standards related to quality management, environmental protection, compliance, and occupational safety. The analysis demonstrates that small-scale wastewater treatment plants can represent a viable solution for individual households and small communities, provided that they are properly designed, periodically maintained, and operated with appropriate sludge management practices. The contribution of this paper consists in synthesizing the main technical and organizational solutions necessary for the sustainable implementation of domestic wastewater treatment systems in Romania, with a focus on rural areas, operational monitoring, maintenance, and legislative compliance. In conclusion, domestic wastewater treatment plants can play a significant role in reducing pollution, protecting public health, and improving wastewater management in areas lacking centralized infrastructure.

Keywords: domestic wastewater treatment plant, domestic wastewater, small-scale wastewater

treatment systems, biological treatment, effluent quality, environmental protection

C.46. ADVANCED MEMBRANE TREATMENT FOR WATER REUSE IN THE FOOD INDUSTRY

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Abstract. The growing demand for water and the need to implement circular economy strategies have made the reuse of industrial wastewater a major priority for the food sector [1]. Wastewater from the food industry contains high concentrations of organic pollutants, solids, and microbiological contaminants, requiring advanced technologies capable of producing a permeate that meets European requirements for water reuse [2]. In this context, membrane technologies particularly reverse osmosis represent effective solutions due to their high contaminant retention capacity and ability to produce high-quality water [3]. This study investigated the performance of a flat-sheet polyamide reverse osmosis membrane used to treat actual effluent from the food industry. The study highlighted the influence of hydrodynamic conditions on process performance, demonstrating that operation at elevated pressures and low flow rates favored increased retention efficiency and permeate flow stability by reducing concentration polarization and the tendency toward fouling. The results indicated significant reductions in physicochemical and microbiological parameters, leading to the production of a high-quality permeate with high potential for reuse. The quality of the resulting permeate suggests that it could be reused in various industrial applications, including auxiliary technological processes, washing and sanitizing operations, and—following disinfection steps—for water purification purposes. Thus, the study highlights the potential of membrane technologies to contribute to the development of sustainable water management strategies in the food industry, in line with European objectives regarding the reuse and conservation of water resources.

Keywords: water reuse, reverse osmosis, polyamide membrane, hydrodynamic conditions, contaminant retention, circular economy.

C.47. CIRCULAR ECONOMY IN STANDARDS AND IN ACTION

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Abstract. Based on the 4-R framework (Reduce, Reuse, Recycle, and Recover), the circular economy brings to the forefront ways we can sustain our living and thrive on the planet Earth. The UN Sustainable Development Goals, initially adopted in 2015 and focusing on the 2030 Agenda for Sustainable Development, expand this focus and offer an all-around view of sustainability issues. International standards known as the ISO 59000 series add to this knowledge and best practices. Six standards of the ISO 59000 have been published since 2024, and currently they provide a wide portfolio that includes: vocabulary, principles, guidance for implementation, tools to measure and assess circularity performance, etc. Three of these standards are at different stages of updating, and an entirely new standard with requirements for circular economy management systems is under development. This paper presents an overview of the circular economy standards and some specific case studies that can be used as a basis for the implementation of circular economy practices in organizations.

Keywords: ISO Standards, ISO 59000 series, Circular economy, Sustainable Development Goals (SDGs)

C.48. DISEASE AS A DYNAMIC SYSTEM: FROM EMERGENT GEOMETRY TO CLINICAL ARTIFICIAL INTELLIGENCE TOWARD A STRUCTURAL PARADIGM IN MEDICINE

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Abstract. Modern medicine produces high-resolution images and powerful predictive models, yet disease is still often treated as a static event: an image, measurement, or risk score. This presentation proposes a shift toward viewing disease as a dynamic system defined by internal states, transitions, stability regimes, and structural change. Building on a relational framework of emergent geometry and complex systems modeling, we argue that the internal organization of pathological processes can be inferred from clinical data using AI-assisted inverse-problem approaches. In this perspective, AI becomes not only a tool for classification or prediction, but a method for reconstructing latent parameters, attractors, and instability boundaries in biological systems. Applications will be discussed in brain oncology, pulmonary fibrosis, mechanical lung identification, and predictive modeling of complex clinical systems. The central aim is to move beyond predictive accuracy toward structural understanding. The concept of “adversarial disease” is introduced to describe pathology as a failure of biological stabilization and a transition toward pathological regimes. This perspective supports a structural medicine in which diagnosis, prognosis, and intervention are formulated in terms of stability, attractors, and dynamic transformation.

Keywords: dynamic disease systems, emergent geometry, clinical artificial intelligence, inverse problem modeling, structural medicine

C.49. MONITORING INVASIVE SPECIES IN URBAN ECOSYSTEMS THROUGH EDUCATION AND COMMUNITY ENGAGEMENT

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Abstract. Urban ecosystems represent both hotspots of biological invasion and exceptional arenas for community-based surveillance. This paper examines how citizen science platforms, structured educational programs, and participatory monitoring initiatives can substantially improve the early detection and management of invasive species in cities. Drawing on a systematic synthesis of the recent international literature and on primary research conducted in the peri-urban oak forests of the Rașinari Forest District (Sibiu County, Romania)—where the North American oak lace bug *Corythucha arcuata* was monitored using microclimatic sensors, growing degree-day (GDD) thermal modeling, De Martonne aridity indexing, and eco-physiological assessments between 2024 and 2025—we argue that multi-actor approaches combining opportunistic citizen observations with expert validation and formal educational integration can significantly extend spatial and temporal monitoring coverage. The literature demonstrates strong evidence that citizen science improves early detection and monitoring, and strong evidence that educational programs increase public knowledge and support for management. Key challenges include data quality assurance, sustained volunteer engagement, uneven spatial coverage, and the integration of diverse stakeholder perspectives. Recommendations are proposed for embedding community-based monitoring within urban environmental management frameworks, with direct relevance to the EU Biodiversity Strategy for 2030 and EU Regulation No. 1143/2014 on invasive alien species.

Keywords: invasive species, urban biodiversity, citizen science, community engagement, environmental education, *Corythucha arcuata*.

C.50. EVALUATION OF HEAVY METAL TRANSLOCATION FROM INDUSTRIAL SOILS INTO HYDROPHILIC PLANTS

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Abstract. The main objective of this study was to investigate the translocation of metal elements with high toxic potential from soils located in industrial areas into an emergent aquatic plant species commonly found in wetland environments. Soil analyses revealed significant variations in the concentrations of these elements, indicating a long-standing history of industrial pollution. The accumulation of metallic contaminants in aquatic plants is influenced by factors such as the bioavailability of metals in the substrate, the physicochemical properties of water and sediments, species-specific physiological characteristics, sampling time, and internal transport mechanisms.

Keywords: hydrophilic plant species, heavy metal, translocation.

C.51. MICROBIOLOGICAL EVALUATION AND ANTIMICROBIAL RESISTANCE PROFILE OF WATER IN THE MOLDOVA NOUĂ AREA, ROMANIA, IN THE CONTEXT OF MINING ACTIVITIES

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Abstract. The Moldova Nouă area is historically influenced by mining activities and tailings deposits, especially in Tăușani–Boșneag sector. These pressures may alter water physicochemical properties and create ecological conditions favorable for specialized microbial communities. In mining-impacted waters, increased mineralization and residual metal-associated stress can act as selective drivers for bacterial persistence. Such environments may also function as reservoirs for antimicrobial resistance (AMR) determinants through co-selection mechanisms. This study evaluates the microbiological quality of surface water and groundwater in relation to mining-related environmental stress and potential public health implications.

Keywords: mining-impacted waters, tailings deposits, microbial communities, metal-associated stress, antimicrobial resistance.

C.52. A THEORETICAL RELATIONAL FRAGMENTATION FRAMEWORK FOR SS7 SECURITY, AI RESISTANCE AND ENERGY EFFICIENCY IN 4G/5G NETWORKS

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Abstract. This theoretical paper addresses SS7 protocol vulnerabilities including lack of inherent authentication. A relational communication framework is introduced based on modulating relationships between existing electromagnetic signals. Three mathematical equations theoretically quantify relational capacity, dynamic scaling, and interception resistance. The

framework incorporates informational topology as an emergent performance score, dynamic information distribution for adaptive message distribution, morphic resonance as a resonant catalyst mechanism, and integration distance for measuring correlation with natural patterns. AI resistance is theoretically achieved with modifications below 0.1%. The model requires no hardware modifications or new spectrum licenses. All contributions are theoretical and require experimental validation.

Keywords: SS7 security, 5G networks, AI resistance.

C.53. RISKS AND OPPORTUNITIES IN USING MESOPOROUS PLATFORMS FOR EMERGING APPLICATIONS

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Abstract. Since the beginning of the synthesis of the mesoporous silica in 1992, many milestones were reached including the development of many applications in medicine, especially in drug delivery and tissue engineering (both soft and hard tissue engineering); energy storage or environmental applications as adsorbent and photocatalysts in pollutants degradations. There are several techniques to load the mesoporous silica with active agents. For medical applications, a wide range of agents are available and used for achieving the desired goals, from antibiotics to cytostatic, vitamins, essential oils, polyphenols, nanoparticles etc. and thus enhanced regenerative (bone, nerve, muscle) or curative capabilities are achieved. In the case of environmental applications, because of the high surface area, good sorption capacity can be obtained, especially if adequately functionalized with proper functional groups but, also photocatalytic degradation can be achieved if proper photocatalysis are loaded or if the surface is decorated. Among the many applications in environmental field, antibiotic removal from the nature is essential because the presence of antibiotics can lead to the development of the resistant bacterial strains and thus burdening costs in the treatment of the infections. The presentation, is mainly focused on our recent advances in the field of synthesis of these mesoporous materials via the classical sol-gel route and their chemical modification. The use of greener synthesis routes will be also presented, being in line with the actual EU trends by using starch instead of the classical CTAB. The applications of these materials in medical and environmental applications based on their loading and release capability or specific agents.

Keywords: mesoporous silica, loading and release capability, photocatalysis, surface chemistry, medical applications, environmental protection.

C.54. SIMULATION OF SURFACE WATER QUALITY AT AN AGRO-INDUSTRIAL SITE (SOUTH-EAST OF THE CÔTE D'IVOIRE) USING ARTIFICIAL NEURAL NETWORKS

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Abstract. To simulate the surface water quality at the Banacomoe agro-industrial site using artificial neural networks, two input scenarios were applied. In the first scenario, all 16 measured parameters are used as inputs to the model. In the second scenario, only the five parameters that

have the greatest influence on the Water Quality Index were used. The first scenario yields a total regression coefficient of $R = 0.99998$. In the second scenario, the overall regression coefficient $R = 0.99886$. The results show that artificial neural networks simulate water quality with a high degree of accuracy in both scenarios.

Keywords: artificial neural networks, simulation, water quality index, surface water.

C.55. THE INFLUENCE OF CLIMATE CHANGE ON THE EFFICIENCY OF WASTEWATER TREATMENT PLANTS

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Abstract. The paper presents the ongoing threat posed by the increasing rate of water pollution from urban, agricultural and industrial wastewater discharges. Fluctuations in temperature, rainfall patterns, storm changes and sea level rise are all impacting wastewater treatment systems. Wastewater management is a rapidly growing sector. Modern society faces an endless conflict between climate change and wastewater management, each intensifying the other.

Keywords: water pollution, climate change, wastewater treatment, treatment plants, public health, pollutants, environment.

C.56. PERSPECTIVES ON WATER QUALITY MANAGEMENT IN URBAN AREAS: A CASE STUDY OF BACĂU CITY, ROMANIA

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Abstract. The paper presents a comparative analysis of surface water management, highlighting the evolution of treatment processes within the Cărbăoia and Barați treatment plants. The study examines the transition from solutions used approximately two decades ago, characterized by conventional technologies and limited adaptability, to modern systems focused on efficiency, safety, and compliance with current regulatory requirements. The main stages of the treatment process, the implemented technological improvements, and their impact on the quality of supplied water are analyzed. Furthermore, the paper emphasizes current challenges related to the variability of surface water sources, climate influences, and increasing consumption demands. The results underline the essential role of treatment plant modernization in ensuring sustainable water resource management.

Keywords: water distribution network, drinking water quality, water turbidity, free residual chlorine, heterotrophic plate count.

C.57. THE HYDROLOGICAL REGIME OF THE BISTRITA RIVER AND THE IMPACT OF CLIMATE CHANGE ON THE OPERATION OF HYDRO-ENGINEERING STRUCTURES

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Abstract. Climate change has a significant impact on the hydrological regime of the Siret River basin, as evidenced by changes in temperature, precipitation patterns, the frequency of extreme weather events, and the availability of water resources. The study demonstrates the usefulness of combining classical statistical analyses with scaling-based time series analysis methods to identify structural changes in the hydrological regime. The operation of hydrotechnical structures in the Siret basin must take into account not only the interannual variability of flows but also long-term downward trends and the persistence structure of hydrological series, in order to ensure adaptive water resource management in the context of climate change. The results confirm the hypothesis that the hydrological regime of the Siret basin is undergoing a transition toward a new equilibrium, characterized by lower average flows, increased variability, and the persistence of extreme hydrological events over time. In this context, adapting the operation of hydrotechnical structures becomes an essential condition for ensuring the sustainability of water resources.

Keywords: climate change, hydrological regime, flow, water, Siret river works.

C.58. ADAPTIVE REUSE OF MINING GALLERIES FOR CONTROLLED ENVIRONMENT AGRICULTURE: AN AEROPONIC PILOT STUDY IN THE JIU VALLEY

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Abstract. This paper explores the adaptive reuse of horizontal mining galleries in the Jiu Valley, Romania, for controlled environment agriculture, through the implementation of a compact vertical aeroponic pilot system. The study focuses on the cultivation of short-cycle crops, including microgreens, lettuce, and aromatic plants, selected for their suitability to high-efficiency, space-constrained systems. The research evaluates the compatibility between the environmental conditions of underground mining galleries and the operational requirements of aeroponic cultivation. Particular emphasis is placed on the analysis of ventilation data, including air temperature, relative humidity, airflow dynamics, and their temporal stability, as critical factors influencing plant growth, nutrient mist distribution, and system performance. A semi-enclosed vertical cultivation module is proposed, allowing localized control of microclimate parameters while taking advantage of the inherent thermal stability of the underground environment. The study identifies both the opportunities offered by such settings, including reduced thermal variability and efficient spatial reuse, and the key technical constraints, such as energy demand for artificial lighting, humidity control, and microbiological risks. The results contribute to defining the operational thresholds and environmental conditions required for stable aeroponic cultivation in underground spaces. Rather than promoting large-scale implementation, the paper frames the concept as a pilot-level approach, supporting the transition of post-mining regions toward innovative, resource-efficient, and sustainable food production systems.

Keywords: controlled environment agriculture, aeroponics, underground agriculture, adaptive reuse, mine ventilation, pilot system, Jiu Valley.

C.59. CLIMATE CHANGE AND MARINE POLLUTION BY MICROPLASTICS: ECOLOGICAL, STRATEGIC, AND PUBLIC HEALTH IMPLICATIONS

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Abstract. This paper analyzes the convergence between climate change and marine microplastic pollution, focusing on ecological effects, public health implications, and strategic consequences for maritime security. Methodologically, the study combines a narrative review of recent literature (2018–2026), an analysis of key international reports, and an examination of the public policy framework in the European Union and Romania. The results show that the ocean continues to mitigate climate change, but at increasing costs: in 2024, the global average temperature was 1.55°C above pre-industrial levels, ocean heat content reached a new all-time high, and the rate of sea-level rise during 2015–2024 was more than twice as high as in the first decade of satellite records. At the same time, 19–23 million tons of plastic waste enter aquatic ecosystems annually, and microplastics are now detected everywhere from beaches and deep-sea sediments to human blood, the placenta, and atherosclerotic plaques. In the Black Sea basin, recent data indicate significant loads in beach sediments and biota, confirming the regional relevance of the phenomenon. The analysis suggests that climate change and microplastics act synergistically: warming, acidification, and deoxygenation increase the vulnerability of ecosystems, while plastic disrupts habitats, trophic flows, and, potentially, biogeochemical functions. At the policy level, the EU already has an advanced regulatory framework, but implementation and monitoring remain uneven; in Romania, the legislative framework is aligned, but the monitoring and control infrastructure is still limited. The central conclusion is that microplastics must be addressed simultaneously as an environmental, public health, and maritime security issue, and an effective response requires an integrated One Health approach and multiscale governance.

Keywords: climate change, microplastics, oceanography, public health, Black Sea, maritime security, public policy, One Health.

C.60. FROM WASTE TO STRENGTH: DEVELOPMENT OF GYPSUM-BASED ECO-COMPOSITES REINFORCED WITH METALLIC CHIPS

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Abstract. This paper presents an experimental investigation of gypsum-based eco-composites reinforced with metallic chips generated by machining processes. The study aimed to assess the feasibility of directly valorizing this industrial waste as dispersed reinforcement in order to improve the mechanical performance of gypsum-based materials while supporting circular economy principles. Five experimental series were prepared with metallic chip additions ranging from 100 to 500 g/specimen, and the specimens were tested under three-point bending. The results showed a monotonic increase in flexural strength, from 0.819 MPa to 1.102 MPa, corresponding to an improvement of 34.5%, together with a significant increase in displacement at maximum load and energy absorption capacity. Regression analysis confirmed a strong correlation between metallic chip content and mechanical response, with the quadratic model providing the best fit for flexural strength. The findings indicate that metallic chips can be

successfully incorporated into gypsum matrices to obtain sustainable lightweight composites with improved ductility and flexural performance.

Keywords: eco-composite, gypsum, metallic chips, dispersed reinforcement, flexural strength, sustainability.

C.61. ASSESSMENT OF CO₂ EMISSIONS OF BUILDING-INTEGRATED PHOTOVOLTAIC (BIPV) SYSTEMS IN ROMANIA IN THE CONTEXT OF THE ENERGY TRANSITION

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Abstract. This paper proposes an assessment of greenhouse gas emissions generated by building-integrated photovoltaic (BIPV) systems in Romania, in the context of the energy transition and the need to reduce environmental impact. The research considers the use of life cycle assessment (LCA) as the main tool for quantifying CO₂ emissions associated with these systems over their entire lifespan. The study aims to develop and apply a methodological framework that integrates the temporal evolution of the energy mix, energy production, and end-of-life scenarios, in order to achieve a more realistic assessment compared to traditional static approaches. The proposed methodology will be applied to a representative case study for Romania, consisting of a building in which BIPV systems are integrated. Within the research, different scenarios of energy mix evolution will be analyzed to highlight the influence of the energy transition on LCA results. Additionally, a comparison between the static and dynamic approaches will be conducted to identify significant differences in estimating CO₂ emissions over the life cycle. The expected results aim to highlight the role of BIPV systems in reducing greenhouse gas emissions in the building sector and to emphasize the importance of integrating dynamic perspectives into environmental assessments. The paper contributes to the development of a methodological approach adapted to the current context of the energy transition and provides support for decision-making in sustainable construction.

Keywords: Building-Integrated Photovoltaics, Life Cycle Assessment, Energy Transition

C.62. ASSESSING THE PHYSICOCHEMICAL AND SENSORY QUALITY OF SELECTED ORGANIC WINES FROM THE REPUBLIC OF MOLDOVA

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Abstract. In the context of increasing consumer demand for sustainable and health-oriented products, organic wines have attracted growing interest on both national and international markets. The Republic of Moldova, a country with a long-standing winemaking tradition and favorable pedoclimatic conditions, has significant potential for the development of the organic wine sector. This study aimed to perform a preliminary physicochemical and sensory evaluation of selected organic wines produced in the Republic of Moldova. Two organic wine samples,

SOFIA Red 2022 and SOFIA White 2023, were analyzed to characterize their main quality attributes. The physicochemical parameters investigated included free and total sulfur dioxide, alcoholic strength, volatile acidity, total acidity, pH, total dry extract, and residual sugar content. Sensory evaluation was also carried out to assess the organoleptic profile of the wines. The results indicated that both samples presented physicochemical characteristics consistent with expected quality requirements and balanced sensory profiles. The relatively low sulfur dioxide content also suggests the use of cleaner and more sustainable winemaking practices. However, because the analyzed wines differed in both vintage and varietal composition, the findings should be interpreted as a preliminary descriptive assessment of selected organic wines rather than a strict comparative evaluation. Overall, the study highlights the quality potential of Moldovan organic wines and supports the promotion of sustainable viticulture in the region.

Keywords: organic wines, physicochemical analysis, sensory evaluation, wine quality, Republic of Moldova, sustainable viticulture.

C.63. PHENOLOGICAL OBSERVATIONS ON PLUM (PRUNUS DOMESTICA L.) AND ITS REGIONAL DEVELOPMENT PERSPECTIVES

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Abstract. Plum (*Prunus domestica* L.) is a fruit tree species of major economic, cultural, and social importance in Romania. It has a significant role in the local economy, contributing both to fresh fruit production and to the development of traditional products such as plum brandy, plum jam, compotes, and other processed foods. This study aims to analyze the flowering and fruiting phenophases of plum tree in 2024, within the specific context of Ruginești commune, Vrancea County. The research seeks to identify the phenological particularities of plum in this area and to interpret them within the local context. Within the specific physico-geographical context of Ruginești commune, plum trees from the family orchard were monitored. Observations were carried out from December 2024 to May 2025, focusing on phenological stages as well as on the presence of phytopathogenic agents. A questionnaire was administered to assess the population's level of knowledge and interest regarding plum cultivation and the valorization of plum products. Analyses regarding the quality and composition of the fruit from the trees monitored in this study were conducted in the plant physiology laboratory. The analysis of phenological stages, starting with bud break and continuing through flowering, fruit set, and fruit ripening, showed that plum adapts well to the local pedoclimatic conditions. The phenophase calendar fell within the normal range for the area, with no extreme manifestations or major deviations, confirming the species' resilience to interannual climatic variability. This stable phenological behavior indicates that plum represents a reliable and consistent crop for this region. Sensory evaluation indicated an overall good quality (final score: 4 – good). The fruits were oval in shape, with a slightly deformed external appearance; internally, only minor spotting was observed. The pulp was tender and juicy, the skin texture was smooth, and the taste was characterized as sweet–tart. The fruits presented a total titratable acidity of 1.71% and a soluble solids content of 16 °Brix. The consolidation of data on all households in the commune that own plum trees (69%), the assessment of their production, and the organization of local village fairs, together with the online promotion of these events, could represent an effective approach to socio-economic development and to improving the well-being of the inhabitants of Ruginești commune. Creating a centralized registry of all households in the commune that cultivate plum trees (69%), evaluating their production, and organizing village fairs, accompanied by online dissemination and promotion of these events, could constitute a viable strategy for socio-economic development and for increasing the well-being of the population of Ruginești commune.

Keywords: rural households, phenological stage, plum valorization, traditional products, rural development.

C.64. ADVANCED TREATMENT OF SYNTHETIC HOSPITAL WASTEWATER: REMOVAL OF KETOPROFEN VIA β -CYCLODEXTRIN COMPLEXATION AND UV PHOTODEGRADATION

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Abstract. Water pollution has become a major global concern, particularly due to the continuous release of hospital wastewater (HWW), which contains pathogenic microorganisms and hazardous pharmaceutical compounds. These contaminants pose significant risks to both environmental ecosystems and public health. Conventional wastewater treatment processes often fail to efficiently remove such emerging pollutants. The present study aims to evaluate the effectiveness of two complementary treatment approaches for the removal of ketoprofen (KD), a widely used non-steroidal anti-inflammatory drug, from synthetic hospital wastewater. First, the formation of inclusion complexes with native β -cyclodextrin (β -CD) was investigated, and its capacity to capture and precipitate KD from aqueous solutions was assessed. Second, an advanced oxidation process based on UV photodegradation at 360 nm was applied to degrade the drug. The results demonstrated a significant reduction in ketoprofen concentration using both methods. The removal efficiency was attributed either to the encapsulation and subsequent precipitation of KD by β -CD or to its photochemical degradation under UV irradiation. These findings highlight the potential of combining cyclodextrin-based complexation and photodegradation as promising strategies for the treatment of hospital wastewater.

Keywords: advanced treatment, wastewater, ketoprofen, UV photodegradation.

C.65. OPTIMIZATION OF A PHOSPHONIC ACID-FUNCTIONALIZED DOWEX 50W X8 RESIN FOR ENHANCED ORGANIC DYE REMOVAL: A COMPARATIVE STUDY FOR ENVIRONMENTAL PROTECTION

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Abstract. In the field of environmental engineering, the development of high-performance materials for wastewater remediation is critical to mitigating the impact of industrial effluents. This study focuses on the optimization of a novel sorbent synthesized by grafting phosphonic acid groups onto a commercial DOWEX 50W X8 resin. The objective is to enhance the adsorption capacity and selectivity of the resin toward complex organic pollutants, specifically for the treatment of textile-related dyes. The performance of the functionalized resin was evaluated through a comparative study of two organic dyes: Acid Yellow and Bimacid Red. Batch adsorption experiments were conducted to optimize key operational parameters, including pH, contact time, and initial concentration. Experimental results demonstrate significant removal efficiencies, achieving a yield of 66.34% for Acid Yellow and 81.76% for Bimacid Red. A comparative analysis shows that the modified resin exhibits a higher affinity for Bimacid Red, with a removal efficiency approximately 15% higher than that of Acid Yellow. This difference is attributed to the synergistic effect between the grafted phosphonic sites and the specific molecular structure of the dyes, involving hydrogen bonding and electrostatic interactions. Furthermore, the functionalization successfully transformed the standard DOWEX 50W X8 cation exchanger into a more versatile sorbent capable of capturing acidic dyes, which are typically poorly retained by pristine sulfonic resins. This research demonstrates that the chemical modification of commercial

resins provides an optimized and efficient solution for industrial water purification, contributing significantly to environmental protection strategies.

Keywords: environmental engineering, optimization, DOWEX 50W X8, phosphonic acid, acid yellow, bimacid red, adsorption, water treatment.

C.66. COMPARATIVE ASSESSMENT OF MINE WATER QUALITY AND GEOCHEMICAL PROCESSES IN TAILINGS FACILITIES: INSIGHTS FROM ILBA AND BOZÂNTA SITES

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Abstract. This study evaluates the physicochemical characteristics of mine water from Ilba and Bozânta tailings facilities based on monthly monitoring data from 2022-2023. The analysis reveals strong spatial variability between sites, with alkaline conditions at Ilba (pH 10.7–12.1) contrasting sharply with acidic conditions at Bozânta (pH 3.2–3.8). Significant differences were also observed in dissolved constituents, with concentrations at Bozânta reaching up to ~4068 mg/L for sulfates and over 1300 mg/L for associated parameters, while Ilba exhibited lower but locally elevated values (e.g., up to 61.5 mg/L for certain metals). Temporal fluctuations indicate the influence of seasonal hydrological conditions on contaminant mobilization. The results highlight ongoing geochemical processes, including acid mine drainage and sulfide oxidation, emphasizing the need for continuous monitoring and targeted remediation strategies in mining-affected areas.

Keywords: acid mine drainage, geochemical processes, mine water monitoring, seasonal variability, sulfide oxidation, tailings facilities, water contamination.

C.67. ASSESSMENT OF TRACE METAL CONTAMINATION AND FOOD SAFETY RISKS IN EDIBLE INSECT LARVAE COLLECTED IN TOGO

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Abstract. The presence of emerging organic pollutants, particularly pharmaceutical compounds, in the effluents of wastewater treatment plants, has been frequently observed globally due to their resistance to secondary biological processes. Their widespread existence in aquatic environments is a matter of concern because they have a detrimental impact on living organisms and human health. This study focuses on the effectiveness of using a photocatalytic process with a ZnO catalyst/visible-light system for degrading pentoxifylline, an emerging contaminant found in aqueous fluxes. A significant aspect of this research involves assessing the toxicity of the treated solutions as part of analyzing the potential environmental risk associated with the photocatalytic process. Preliminary phytotoxicity tests were conducted using seeds from *Lepidium sativum* L., a higher plant species, to assess the environmental impact following exposure to phototreated solutions. It is important to note that transformation products could potentially exhibit greater toxicity than their parent compound in some cases. The results confirmed the successful elimination of the target molecule under visible light irradiation conditions through photocatalysis. Additionally, preliminary phytotoxicity tests indicated that untreated solution (containing 40 mg/L pollutant) led to inhibition in seed germination (80%) and root and leaf length likely attributed to its toxic nature and high initial concentration of the pollutant. Conversely, the treated solutions showed reduced growth inhibition in *Lepidium sativum* L.

seedlings components, presumably due to the formation of less toxic molecules resulting from the transformation of toxic reaction intermediates during photocatalytic treatment. These results emphasize the applicability of visible-light photodegradation as a sustainable and environmentally friendly solution for the removal of pharmaceutical pollutants from water fluxes.

Keywords: photocatalysis, emerging contaminants, ZnO catalyst, phytotoxicity.

C.68. STUDY ON THE RECOVERY POSSIBILITIES OF PETROLEUM WASTE FROM SENEGAL IN A CIRCULAR ECONOMY CONTEXT

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Abstract. The management of petroleum waste represents a major challenge for both the petroleum sector and environmental protection in Senegal, particularly in the context of the development of offshore oil fields such as Sangomar. These wastes, generated from extraction, refining, and distribution activities, contain hydrocarbons, heavy metals, and other toxic pollutants that affect soil, water, air, as well as public health. This study aims to analyze the impact of petroleum waste generated by the Senegalese petroleum industry, including extraction, refining, and distribution stations and to propose recovery and valorization solutions based on the principles of the circular economy. The proposed methodology relies on data collection from refineries, service stations, and oil exploitation sites, complemented by documentary research, field surveys, and laboratory analyses. The research will assess the environmental and health impacts associated with these wastes and compare different treatment and valorization technologies. Expected results include the reduction of ecological impacts, the development of economic and energy recovery models, value creation, as well as scientific contributions to the sustainable management of petroleum waste in Senegal. This study contributes to the objectives of sustainable development and to the implementation of the Senegal Vision 2050, which places the circular economy at the core of the national sustainable development strategy.

Keywords: tudy, Senegal, petroleum waste, circular economy, valorization.

C.69. COMPARATIVE STUDY OF ALUMINIUM 6AND IRON ELECTRODES IN THE TREATMENT OF SYNTHETIC WATER CONTAMINATED WITH FLUORIDE BY ELECTROCOAGULATION

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Abstract. Dental fluorosis, bone fluorosis and joint pain are all problems encountered in the phosphate processing area of Togo. It is therefore necessary to provide a solution for populations affected by fluoride water pollution. The aim of this study was to optimize the operating parameters for the treatment of fluoride contaminated water using electrocoagulation (EC). To achieve this, parameters such as pH, inter-electrode distance, current density (DC), initial concentration and NaCl dose were optimized in some previous study with iron and aluminium electrodes. To test the effectiveness of the EC process, a pilot-scale study was carried out using synthetic water previously polluted with fluoride. In the goals to choose the better electrodes, a comparatives study are carrying out between the two electrodes. The results of optimizing parameters showed that the optimum pH is 7, with a current density (CD) of 27.3 mA/cm² for iron and 22.8 mA/cm² for aluminium. Contact time is 70 min for iron and 45 min for aluminium.

The energy efficiency study showed that it takes 24.5 W/h (Watt hours) for iron and 18.9 W/h for aluminium to treat water with 15 mg/L fluoride. Above this results, aluminium electrodes are performed than iron electrode in the fluoride removal in water by electrocoagulation system.

Keywords: electrocoagulation, optimization, electrodes, fluoride, synthetic water.

C.70. SAHARAN DUST IN EASTERN ROMANIA UNDER PERSISTENT ANTICYCLONIC REGIME CONDITIONS DURING 14-18 APRIL 2025

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Abstract. During 14-18 April 2025, eastern Romania was affected by a significant Saharan dust transport episode, favoured by a persistent synoptic scale anticyclonic regime. The synoptic configuration was characterized by the development and persistence of a ridge over eastern and south-eastern Europe, while cyclonic activity affected western Europe. This synoptic pattern favoured the meridional transport of air masses loaded with Saharan aerosols towards Moldavia, in eastern Romania.

The analysis used 500 hPa geopotential fields, mean sea-level pressure, and aerosol monitoring products, together with PM10 concentration data. Satellite imagery highlighted the spatial extent and persistence of Saharan dust over eastern Romania, while the synoptic analysis confirmed the role of atmospheric circulation in maintaining the transport pathways and limiting aerosol dispersion.

The event highlighted the regional impact of Saharan dust advection on air quality. The results emphasize the importance of integrated satellite, model and observational monitoring for the identification and forecasting of aerosol transport episodes in south-eastern Europe.

Keywords: Saharan dust, persistent anticyclonic regime, aerosol transport, multispectral satellite products.

C.71. HOUSEHOLD WASTE MANAGEMENT IN THE CITY OF BOUAKÉ: RECYCLING AND ENERGY RECOVERY FROM FOOD AND PLASTIC WASTE

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Abstract. This study focuses on household waste management in the city of Bouaké, specifically the recycling and energy recovery of food and plastic waste. Despite the resources deployed by the state, Bouaké faces a significant challenge in managing this household waste. This waste is at the root of numerous socio-spatial, environmental, and health-related problems. The objective of this study is to raise public awareness about more responsible household waste management and to promote energy production through the recycling and recovery of food and plastic waste.

The first step will be to raise awareness among families about waste sorting, followed by the collection of food and plastic waste from these families, and finally, the production of biogas. The tests to be carried out include chemical analysis of organic and plastic materials, chromatographic analysis of the biogas composition (for food waste), determination of the calorific value of plastic granules, gas chromatographic analysis of the synthesis gases obtained during pyrolysis, and finally, analysis of the calorific value of the liquid obtained from pyrolysis. At the end of the study, the expected results are that household waste in the city of Bouaké is well managed by the population, waste sorting and the use of biogas is adopted by them, and finally, jobs are created around the transformation of this waste.

Keywords: Management, Household waste, Recycling, Recovery

D. MECHATRONICS & ROBOTICS

D.1. ON THE ELECTRONIC TRANSPORT MECHANISM IN POLYCRYSTALLINE CDO THIN FILMS

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Abstract. Cadmium oxide (CdO) is included in transparent conducting oxides and has been successfully used in modern solid-state technology (panel display, solar cells, thermally insulating glass, etc). In present paper we attempt to explain the mechanism of the electronic transport in CdO thin films, using some models proposed for polycrystalline semiconducting films. Do thin films ($d=100\text{nm}-1350\text{nm}$) were deposited onto glass substrates by thermal evaporation (quasi-closed volume technique) under vacuum (deposition parameters: source temperature, $T_{\text{ev}}=1100\text{K}$; deposition rate, $rd=10\text{ A/s}$; substrate temperature, $T_s=473\text{ K}-523\text{ K}$ [1]. The film structure was studied by X-ray diffraction (XRD) technique and atomic force microscopy (AFM). The measurements of the electrical conductivity and Hall coefficient were performed using surface-type cells. Reflection and transmission spectra were recorded in the spectral range from 400 nm to 1400 nm. The XRD patterns indicated that CdO films are polycrystalline and have a sodium chloride (cubic) structure (lattice parameter: $a=4728\text{\AA}$). AFM images showed that films are characterized by a high-density polycrystalline structure (the film crystallites have similar size and shape). After a heat treatment (consisting of several heating/cooling cycles within a temperature between 300K and 575K) temperature dependence of the electrical conductivity becomes reversible. For heat-treated samples, thermal activation energy, ranged between 0.10 eV and 0.30 eV within lower temperature range (300K – 375 K) and between 0.75 eV and 1.20 eV within temperature range, (375K-475K). The energy bandgap of CdO crystals was, $E_g=2.20\text{-}2.60\text{ eV}$. Clearly, the mechanism of electrical conduction in studied films is strongly influenced by their polycrystalline structure. The crystallite boundaries have a space charge domain due to interface. Consequently, bending of the energy bands occurs, and the potential barriers to the electronic transport mechanism result. We showed that Seto's model with several modifications proposed by Bacaroni et al. is suitable to explain the electrical mechanism conduction in studied films. This model made the following assumptions: the crystallite have similar size; only one type of monovalent trapping states are present; the thickness of the crystallite is negligible with respect to crystallite size. The values of energy bandgap for studied films (2.45 eV-2.70 eV) are determined from absorption spectra (for allowed direct band-to-band transitions). Some characteristic parameters of investigated samples were determined average size of crystallite $L=26.5\text{-}41.5\text{ nm}$, barrier height, $E_b = 0.14 - 0.23\text{ eV}$; concentration of the surface states $N_s= 1.28\times 10^{13} - 5.12\times 10^{13}\text{ cm}^{-3}$.

Keywords: Cadmium oxide, thin films, polycrystalline semiconducting films, monovalent trapping.

D.2. OXIDE COMPOSITION IMPACT OVER DUCTILITY AND IMPACT FORCES OF POLYLACTIC ACID (PLA) MIXES

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Abstract. The paper asks what impact, if any, different oxides bring forward in PLA mixtures, at different temperatures, for their use in mecha(tro)nical applications. The paper also puts forward a methodology of characterising ductility variations based on the presence of said oxides. The paper deals with a two-fold characterisation approach: i) force comparisons at cold temperatures

(22-25 °C) for variability based on oxide presence; pre- and post-annealing; ii) variation of glass transition temperatures, melting temperatures - high/hot temperatures. Although the variation windows are negligible during desktop additive manufacturing (AM) processes, the consistency of vafitation present in both cold and hot conditions open the window for clear property manipulation due oxide presence alone through temperature exposure. This in turn broadens the versatility of AM mechatronical systems.

Keywords: TiO₂, ZnO, Al₂O₃, PLA, 3d printing.

D.3. STATISTICAL STUDY ON AI IMPROVEMENTS OF MULTI DOF ROBOTS

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Abstract. AI powered agents can now access 3D modeling and FEM software. Trained models already exist and are used to optimize static load bearing structures or fluid paths. This paper addresses the complex optimization steps of a multi DoF robot. The paper starts from a simple 3DoF robot and aims at introducing a 4th DoF as a variable alongside the probability that an AI agent improves on the real agent in terms of: time constraints, computing power, employed manufacturing method, optimization parameter. Carteian robots are analyzed do to the simple matrix conversion of their control variables. The extra dimension added being i) translation; ii) rotation. For each i) and ii), the added DoF was from closest to the end effector to the farthest, from a kinematic chain perspective. The results show that, depending on the constraints, there is a more favourable outcome towards real agent improvement

Keywords: Statistical study, multi-DoF, AI agent, FEM.

D.4. MACHINE TOOLS VERSUS INDUSTRIAL ROBOTS IN INDUSTRY 5.0 - A COMPARATIVE REVIEW OF THEIR ROLES IN MODERN MANUFACTURING

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Abstract. The transition from Industry 4.0 to Industry 5.0 has redefined manufacturing paradigms by prioritizing human-centric production, sustainability, and strengthened collaboration between advanced technologies and skilled operators. In this context, both machine tools and industrial robots are integral to modern production systems, yet their functional contributions, flexibility, and impact on manufacturing performance differ markedly. This paper provides a comprehensive review of the respective roles of machine tools and industrial robots in Industry 5.0, with particular emphasis on their comparative significance in production environments. Machine tools still are central to manufacturing processes, being directly responsible for material removal, dimensional accuracy, and component surface integrity. Technological advancements such as CNC integration, adaptive control, and digital connectivity have enabled high exactness and repeatability, which are essential for meeting stringent quality standards. By contrast, industrial robots are primarily utilized for handling, assembly, welding, and auxiliary operations, thereby enhancing productivity and operational versatility. The review demonstrates that, despite the increasing adoption of robotics and automation, machine tools continue to play a dominant role in value creation within manufacturing systems. Although robots improve flexibility and lessen human workload, they generally depend on machine tools to generate part geometry and operational surfaces. In the context of Industry 5.0, where human-machine collaboration is emphasized, machine tools offer a more direct interface between operator expertise and process control. Recent studies show that integrating robots with machine tools produces integrated systems that increase throughput and consistency. However, the

absence of machine tools would fundamentally constrain production capacity, whereas the absence of robots would primarily affect efficiency rather than feasibility. This distinction underscores the crucial importance of machine tools as the foundation of manufacturing processes. In summary, while industrial robots are necessary for contemporary automated environments, machine tools persist the central component of production systems. Their role in ensuring product quality, precision, and process stability positions them as the primary drivers of manufacturing performance within the evolving Industry 5.0 framework.

Keywords: Industry 5.0, machine tools, industrial robots, manufacturing, human-machine collaboration, automation.

D.5. INTEGRATING MODERN MANAGEMENT PRINCIPLES INTO THE OPTIMIZATION OF MECHATRONIC AND NVH SYSTEMS TO ENHANCE PERFORMANCE IN THE AUTOMOTIVE INDUSTRY

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Abstract. The rapid evolution of mechatronic technologies and automation systems necessitates the adoption of adaptive management strategies capable of addressing both technical complexity and increasingly stringent industrial performance requirements. This paper explores how modern management tools can be integrated with the development and optimization of mechatronic systems, with a focus on NVH (Noise, Vibration, Harshness) parameters. The main objective is to identify a robust management framework that facilitates the efficient coordination of multidisciplinary teams, reduces development times, and improves product quality. The paper analyzes methods for integrating NVH data into decision-making processes, using modern automation and intelligent monitoring techniques for continuous performance evaluation. It also discusses the benefits of adopting lean and agile approaches in advanced technical environments, demonstrating how these can accelerate innovation and support continuous improvement. The paper highlights that close collaboration between management and engineering significantly contributes to the optimization of mechatronic systems and the reduction of NVH issues as early as the initial design phases.

Keywords: Mechatronic Technologies, Adaptive Management Strategies, NVH (Noise, Vibration, Harshness), Quality Engineering.

D.6. A RISK-BASED APPROACH TO OPTIMIZING INCOMING INSPECTION IN AUTOMOTIVE PRODUCTION

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Abstract. In automotive production, incoming inspection plays a critical role in preventing supplier-induced nonconformities from entering manufacturing processes and affecting product

quality, production continuity, and operational efficiency. However, conventional incoming inspection is often based on standard or uniform control routines that do not sufficiently reflect supplier performance variability, component criticality, defect history, or recent process changes. As a result, inspection resources may be used inefficiently, while significant risks remain insufficiently controlled. This paper proposes a risk-based approach to optimizing incoming inspection in automotive production environments. The study is grounded in practical industrial challenges associated with supplied components, including recurrent nonconformities, limited inspection capacity, insufficient prioritization of critical characteristics, and difficulties in adapting control intensity to actual risk conditions. The proposed framework structures the inspection decision process around four categories of risk factors: supplier-related factors, component-related factors, delivery-related factors, and inspection capability factors. Based on their combined assessment, incoming materials can be classified into different risk levels, each associated with an adapted inspection strategy. The paper outlines a practical model for aligning inspection intensity with the real risk profile of supplied components. The approach supports more effective allocation of inspection effort, improved early detection of nonconforming materials, and better prevention of defect propagation into production. In addition, the proposed model contributes to a more dynamic and responsive incoming quality control system, capable of supporting both operational stability and supplier quality improvement. The results highlight the importance of moving from routine-based incoming inspection toward a selective, adaptive, and risk-informed control logic in automotive manufacturing.

Keywords: incoming inspection, risk-based inspection, automotive production, supplier-induced nonconformities, quality control, inspection optimization.

D.7. ASSESSMENT OF STRUCTURAL INTEGRITY AND TRANSIENT IMPACT BEHAVIOR OF A 7075-T6 ALLOY MECHATRONIC ARM THROUGH EXPLICIT NUMERICAL ANALYSIS

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Abstract. In this research, the mechanical behavior and cross-sectional impact resistance of a mechatronic arm made of 7075-T6 aluminum alloy, a material selected for its high strength-to-density ratio in aerospace and industrial applications, was investigated. The main objective was to assess the structural stability under the action of high-energy transient dynamic loads. The investigation was carried out using a rigorous methodology based on Finite Element Analysis (FEA), implemented in the Ansys Explicit Dynamics simulation environment, applying an impact velocity of $v = 15$ m/s to the modeled structure. The evolution of the stress and deformation state was followed throughout the duration of the collision phenomenon, integrating material and contact nonlinearities, as well as inertial effects specific to short-duration events. From the analysis of the numerical results obtained from the simulation process, a value of the maximum Von Mises equivalent stress was determined, a value that reflects an intense stress on the structure in the vicinity of the yield strength of the alloy used. It was observed that permanent plastic deformation initiated in the critical area of the joint after a shock wave propagation time of $t = 2.12$ ms. This localized accumulation of stresses was translated into a significant reduction in the structural safety factor, which stabilized at a minimum value of 1.19 at the moment of peak load. It was found that this value is insufficient to guarantee structural integrity under repeated dynamic loads. By assessing the data, it was concluded that the current geometry of the arm presents vulnerabilities in the assembly areas, which may favor a sudden brittle fracture. The need to implement design changes by reinforcing stress concentration areas was demonstrated, in order to redistribute efforts and increase the resilience of the mechatronic assembly.

Keywords: Mechatronic arm, Finite Element Analysis (FEA), Impact dynamics, 7075-T6 aluminum alloy, Structural integrity.

D.8. TOPOLOGICAL AND STRUCTURAL OPTIMIZATION OF THE TRIPTERON 3-DOF PARALLEL MANIPULATOR TO INCREASE MASS EFFICIENCY AND RANGE

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Abstract. In this study, a structural analysis of a TRIPTERON parallel manipulator (configured for pick-and-place tasks in industrial environments) with three degrees of freedom (3-DOF) was performed. The investigation was carried out by applying finite element method (FEM) using the Ansys Structural Optimization simulation environment, with the aim of minimizing the mass of the assembly without degrading the fundamental mechanical properties. The methodology integrated generative design algorithms for the topological reconfiguration of the components, and surface refinement techniques of the mesh were applied to eliminate stress hot spots. Following the optimization process, a reduction in the structural mass by a value of 38% was obtained, resulting from an optimal distribution of the material in relation to the applied force vectors and the unit stress states. The data derived from the simulation indicated the possibility of extending the span of the connecting elements by 18%, while the overall stiffness level of the mechatronic device was maintained constant at the nominal design values. It was established that the complex geometry generated by this process requires the use of advanced manufacturing technologies, namely the selective laser sintering (SLS) method for the production of structural components that do not require additional precision machining. The conclusions of the study confirm that topological optimization allows the TRIPTERON robot to achieve its range of action and reduce the system inertia, providing a validated technical framework for the development of robotic equipment with increased kinematic efficiency and reduced energy consumption in the transient operating regime.

Keywords: TRIPTERON robot, Topological optimization, Generative design, Selective Laser Sintering (SLS), Kinematic efficiency.

D.9. IMPLEMENTATION OF AN AUTONOMOUS ROBOTIC PLATFORM FOR HYBRID ROUTE NAVIGATION

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Abstract. This study investigated the design and implementation of an autonomous mobile robotic platform of the "line-follower" type, intended for navigation on hybrid routes that include speed sections and complex obstacle areas. The research methodology aimed at developing a proprietary hardware and software architecture, with a strict volume constraint of 200x200x100 mm being imposed to ensure compliance with the technical competition standards. The design process integrated the selection and calibration of sensor systems to ensure immunity to disturbances caused by the environment, taking into account the presence of acoustic noise and variable light radiation from flashes or video monitoring systems. During the experimental tests, a speed route completion time of 17 s was obtained, while the system's ability to successfully navigate through all 5 critical points of the obstacle section was also validated. It was concluded that the approach based on the construction and programming of a dedicated platform, in favor of the use of prefabricated commercial solutions, facilitates the optimization of the dimensions in relation to the dimensions of the obstacles on the circuit. The results demonstrate that the success of the mission is directly correlated with the robustness of the sensory signal filtering algorithms in conditions of high external interference. The study validates the efficiency of integrated technical solutions, highlighting the need for strict correlation between the robot geometry and

the architecture of the operating environment to maintain kinematic performance and stability in competition mode.

Keywords: Mobile robotics, Line follower, Sensory systems, Autonomous navigation, Hardware-software optimization

D.10. ASYNCHRONOUS MOTOR SPEED CONTROL BY LABVIEW WITHIN A SCADA INTERFACE

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Abstract. The study focuses on speed control of an induction motor using LabVIEW in a SCADA (Supervisory Control and Data Acquisition) environment. It explores how modern software tools can be integrated with industrial hardware to achieve efficient and flexible motor control. An important aspect of the study is the use of LabVIEW as a graphical programming platform to design the control algorithm and user interface. Through LabVIEW, the system can acquire real-time data, process signals, and generate control commands to drive the motor. The SCADA interface enhances this configuration by allowing remote monitoring, supervision, and control of the system. The architecture typically includes sensors for feedback (such as speed or current), a data acquisition system, a controller implemented in LabVIEW, and a power converter (such as a variable frequency drive) to regulate the motor speed. The results highlight the advantages of this approach, including real-time monitoring, intuitive visualization, improved control accuracy, and the ability to integrate with larger industrial automation systems. In conclusion, the combination of LabVIEW and SCADA provides a powerful and flexible solution for speed control of asynchronous motors in modern industrial environments.

Keywords: LabView, scada, asynchronous motor, speed control

D.11. PREDICTIVE MAINTENANCE SYSTEM FOR A ROBOTIC ARM

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Abstract. In recent years, industrial robotic arms have become essential components of modern manufacturing processes, playing a critical role in the automation, precision, and efficiency of industrial production lines. Their continuous and reliable operation is essential for reducing operational costs, increasing productivity, and preventing unplanned downtime. To ensure optimal performance and minimize maintenance costs, the implementation of predictive maintenance strategies has become a necessary solution. This paper presents the architecture of a predictive maintenance system for robotic arms, based on the monitoring of key parameters such as vibrations, temperature, servo motor current consumption, joint position and velocity, mechanical torque, and energy usage. Data collected through IoT sensors are transmitted to a centralized server for analysis using machine learning algorithms, enabling the estimation of the Remaining Useful Life (RUL) of critical components and the early detection of mechanical, electrical, or control-related faults, thereby contributing to cost reduction, improved reliability, and optimization of industrial processes.

Keywords: predictive maintenance, industrial robotic arms, IoT sensors, machine learning

D.12. STUDY ON ENERGY OPTIMIZATION OF CASTING FURNACES

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Abstract. Through their role in the technological process, as well as their complexity and constructive dimensions, industrial furnaces can have significant shares in the investment expenses of some enterprises, representing up to 10-15% of investments in steel or metallurgical installations; at the same time, industrial furnaces have a large share in the energy economy of enterprises, being large consumers of heat or electricity. The fuel consumption of industrial furnaces occupies one of the first places in the overall fuel balance of a country, the judicious use of which is a topical issue, all the more so as the fuel price increases on a global scale. In global studies of metal melting furnaces, the issue of energy balance and energy efficiency are considered very important. In this paper are presented some aspects regarding the energy balance of this type of furnaces, considering only the case of using methane gas as an energy source. Thus, all the balance sheets presented take into account the energy (or power) lost through the furnace walls by radiation and convection. It proposes the following way of using the proposed energy efficiency system by recovering heat from the flue-gases: permanent, summer and winter.

Keywords: heat transfer, melting furnaces, energy balance, optimization

D.13. ASPECTS REGARDING THE USE OF ARTIFICIAL COLD IN CONSTRUCTION WORKS

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Abstract. In construction, the cold began to be used more and more. Artificial freezing of the soil is one of the most interesting and at the same time important practical applications of artificial cold. At the same time, it is one of the first industrial applications of the cold technique and which ensured a special development of the extractive industry. The method of consolidating the rocks through artificial cold creates around the underground engineering work a frozen wall, protective during the construction works. This wall provides hydraulic insulation and at the same time mechanical protection. The mechanical strength of the rocks increases as their temperature decreases, so that the above-mentioned method has the advantage of regulating the load-bearing capacity of the frozen wall. The water contained in the land by freezing acquires the properties of cement, expressed by the large cohesive forces that appear between the ice crystals and rock grains. To obtain the protective wall, freezing probes are used, drilled on the outline of the underground work and through which the coolant circulates, which may be an intermediate agent, such as calcium chloride brine, or refrigerant, for example ammonia. Depending on the wall thickness and the mechanical strength it must have, the temperature of the coolant, the distance between the probes and the freezing time will be chosen. For the purpose of studying with the help of schemes with finite differences of the evolution of processes of unidirectional solidification outside the cylindrical metal walls, in the work are highlighted elements such as: use of logarithmic temperature variation in solid cylinder wall as well as how to approach the crossing of the interface over a node of the network through the so-called “method of the real node”. Thus, the problem of theoretical study of bidirectional solidification around the freezing probe is approached by means of the finite element method based on the heat source method, with the possibility of application both in case of isothermal and non-isothermal phase change.

Keywords: thermal transfer, construction, freezing probe, finite element analysis

D.14. GENERAL KINEMATIC MODELING OF A FIVE-ELEMENT DOUBLE-ACTING MECHANISM DESIGNED FOR MECHATRONIC APPLICATIONS

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Abstract. This paper provides a comprehensive kinematic and dynamic analysis of a five-element planar mechanism, specifically engineered for mechatronic applications where positioning precision, operational versatility, and geometric adaptability are critical requirements. The principal contribution is the development of a set of general motion equations that are applicable across various dimensional configurations of the mechanism's components, while adhering to the prescribed laws of motion. The proposed mathematical model facilitates comprehensive analysis of the mechanism's behavior across diverse geometric ratios and both actuation scenarios namely, synchronous and asynchronous crank rotation. The effects of geometric and kinematic parameters on the positions, velocities, and accelerations of key points are systematically examined, establishing a robust foundation for mechanism synthesis and optimization. This methodology strives to deliver a general framework applicable during conceptual design phases and supports the development of mechatronic systems requiring coordinated control. The resulting data underscore the model's adaptability and its significance for applications including manipulators, guidance devices, transfer systems, and drive assemblies where precision and synchronization are paramount. Within this framework, the formalism developed can be incorporated into computational simulation algorithms and control processes, thus supporting reduced design timelines and enhanced operational performance for advanced mechatronic solutions with wide-ranging industrial applicability.

Keywords: five-link mechanism, mechatronics, general equations of motion, kinematic analysis

D.15. REAL-TIME FAULT DETECTION IN INDUSTRIAL ACTUATORS USING EDGE AI AND TINYML

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Abstract. This paper proposes a mechatronic fault-detection architecture for industrial actuators based on Edge AI and TinyML. The study focuses on the early identification of actuator degradation using locally acquired signals such as vibration, current consumption, temperature, displacement, and operating cycle time. Instead of transferring raw data continuously to a cloud server, the proposed system performs feature extraction and inference directly on an embedded device or microcontroller. This approach is relevant because edge inference reduces latency, bandwidth dependency, and cloud processing requirements, while TinyML enables machine-learning models to run on resource-constrained devices near the sensor layer. Recent industrial examples show that motor vibration data can be collected with embedded motion sensors and used for condition monitoring and model training.

Keywords: Edge AI, TinyML, industrial actuators, fault detection, predictive diagnostics, embedded systems, vibration analysis, condition monitoring, mechatronic systems, real-time inference

D.16. INTEGRATION OF IOT AND AI FOR PREDICTIVE MAINTENANCE IN SMART FACTORIES

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Abstract. This paper presents an IoT–AI framework for predictive maintenance in smart factories, with emphasis on mechatronic equipment such as motors, hydraulic units, conveyors, actuators, and automated workstations. The proposed system combines distributed sensing, industrial communication, data storage, machine-learning analysis, and maintenance decision support. IoT sensors are used to acquire real-time information about vibration, temperature, pressure, electrical current, operating cycles, and abnormal process variations. NIST highlights that industrial IoT sensors can detect anomalies or variability in automated manufacturing processes, while AI and machine learning can process these data and generate predictive recommendations for process improvement.

Keywords: Industrial IoT, artificial intelligence, predictive maintenance, smart factory, condition-based monitoring, anomaly detection, sensor networks, machine learning, Industry 4.0, mechatronic equipment.

D.17. AUGMENTED AND VIRTUAL REALITY IN THE DESIGN AND MAINTENANCE OF MECHATRONIC SYSTEMS

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Abstract. The paper proposes a workflow in which a mechatronic system is first modeled in CAD, then converted into an interactive virtual environment, and finally linked with real or simulated operational data. A case study may include a robotic workstation, hydraulic actuation system, or automated machine module. The evaluation criteria include training time, maintenance error reduction, operator understanding, and the clarity of spatial instructions. The main contribution is a practical framework for using AR/VR not only as a visualization tool, but as an engineering support layer that connects mechanical design, control logic, diagnostics, and human-machine interaction in modern mechatronic systems.

Keywords: Augmented Reality, Virtual Reality, mechatronic systems, digital visualization, maintenance training, human-machine interaction, CAD integration, industrial maintenance, simulation, immersive engineering.

D.18. APPLICATION OF CAVE SYSTEMS FOR ROBOTIC MOTION ASSESSMENT IN IMMERSIVE VIRTUAL ENVIRONMENTS

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Abstract. This paper investigates the use of Cave Automatic Virtual Environment (CAVE) systems for the assessment, visualization, and optimization of robotic motion in immersive three-dimensional environments. Unlike conventional two-dimensional interfaces or standard desktop-based 3D simulations, CAVE systems provide a spatially immersive workspace in which robotic trajectories, joint movements, and interaction zones can be evaluated at real scale. The proposed

approach integrates motion capture data, spatial tracking, kinematic analysis, and real-time visualization in order to assess the accuracy and consistency of robotic motion. Particular attention is given to trajectory calibration, spatial awareness, operator perception, and the comparison between simulated and expected robot behavior. The study highlights the potential of immersive environments to reduce development time, improve the understanding of complex robotic movements, and support early identification of trajectory errors before physical implementation. The proposed framework is especially relevant for robotic applications involving human–robot interaction, constrained workspaces, collaborative manipulation, and complex motion planning. The results suggest that CAVE-based analysis can become a useful engineering tool for validating robotic motion strategies, improving operator training, and supporting the design of safer and more accurate mechatronic systems.

Keywords: CAVE system, robotic motion analysis, immersive virtual environments, virtual reality, trajectory calibration, kinematic assessment, human–robot interaction, motion planning.

D.19. HEATMAP VISUALIZATION FROM SCRATCH DETECTION MODELS FOR FAILURE PREVENTION IN INDUSTRIAL EQUIPMENT

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Abstract. Early identification of surface defects is essential for preventing mechanical failure and improving the reliability of industrial equipment. This paper proposes a deep learning-based approach for scratch detection on metallic surfaces, combined with heatmap visualization methods for interpreting model decisions. The system is trained to detect surface damage such as scratches, local deformation marks, and visually identifiable defect zones. After classification or detection, heatmap generation techniques are applied to highlight the image regions that contribute most significantly to the model prediction. These visual explanations allow engineers to identify high-risk areas, evaluate defect severity, and support preventive maintenance decisions. The proposed approach is relevant for industrial components subjected to wear, mechanical loading, friction, or environmental exposure, where small surface defects may evolve into critical failure zones. The study includes image preprocessing, model training, defect localization, heatmap generation, and correlation between heatmap intensity and visible surface damage. The results demonstrate that heatmap visualization can improve the interpretability of deep learning diagnostics and provide additional support for automated inspection systems. The main contribution of this work is the integration of defect detection and explainable visual feedback into a practical framework for failure prevention in industrial mechatronic equipment.

Keywords: scratch detection, heatmap visualization, deep learning diagnostics, surface damage analysis, predictive maintenance, explainable AI, metallic surfaces, failure prevention.

D.20. SECURING AGRICULTURAL MECHATRONIC PRODUCTION LINES THROUGH 8-LAYER ARCHITECTURES

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Abstract. The implementation and integration of cybersecurity engineering concepts within automated production lines intended for the manufacture of agricultural crop protection products was investigated, with specific application in the geographical area of Romania for the corn crop.

The analyzed issue lies in the need to protect the integrity of mechatronic decision-making systems against digital threats that can compromise the stability of real production flows. The research methodology was based on the application of fundamental cybersecurity principles by using a complex architecture structured on eight levels, evaluating decision-making processes under industrial operating conditions. This multi-level structure allowed the modeling and analysis of the data flow from the field sensor level to the Cloud and Enterprise Resource Planning (ERP) management systems. The results obtained highlight the fact that, in the current context of the industry in the region, the development of specific security standards is required, rigorously adapted for agricultural Internet of Things (Ag-IoT) ecosystems. It was observed that the fragmentation of communication protocols limits the capacity to respond to incidents, identifying the need for optimized encryption solutions for the hardware resources of agricultural machinery. The research conclusions emphasize the imperative of adopting the principle of "security by design", through which protection measures are natively integrated into the design phase of mechatronic equipment, rather than subsequent intervention. It was established that the use of decentralized ledgers, based on distributed ledger technology (DLT), ensures data integrity and rigorous traceability of inputs in the manufacturing process. It was also validated the usefulness of the STAVE (Security Testbed for Agricultural Vehicles and Environments) testing framework for proactively identifying risks and attack vectors in controlled environments. It is confirmed that the implementation of these technical solutions contributes to increasing the cyber resilience of agricultural infrastructures, ensuring compliance with industrial security regulations and protecting critical technological assets against unauthorized access.

Keywords: Industrial cybersecurity, 8-layer architecture, Ag-IoT, Security by design, Agricultural mechatronic systems.

D.21. AUTOMATION OF WOOD PANEL HANDLING AND SORTING PROCESSES THROUGH MULTI-ARTICULATED MECHATRONIC SYSTEMS

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Abstract. The optimization of technological flows within industrial production units for semi-finished wood panels was investigated by implementing integrated mechatronic systems. The main objective was to improve handling precision and reduce the risk of degradation of highly sensitive surfaces by using advanced automation. The research methodology consisted of using 6-axis polyarticulated robotic arms, equipped with customized vacuum grippers and pneumatic drive systems, specifically configured for handling high-mass panels. A real-time sorting system based on inspection sensors and artificial vision was implemented to ensure continuous feeding of assembly and packaging lines. Experimental results indicated a reduction in non-productive times by 11.5% compared to standard robotic configurations. It has been shown that rigorous programming of handling systems facilitates an increase in production capacity by up to 27%, although it has been observed that deviations in software synchronization can lead to premature draining of buffer stores and the emergence of gaps in the logistics flow. From the data analysis it was concluded that the integration of cameras and sensors for defect detection and dimensional verification allows for active correction of alignment and guarantee the quality of the finished product. It was established that the use of customized robotic cells constitutes a viable solution to cover the shortage of skilled labor, offering the potential to double the processing capacity. The final conclusion emphasizes that full automation not only increases industrial efficiency but also contributes to a significant reduction in raw material waste and energy consumption per unit of finished product.

Keywords: Industrial robotics, Artificial vision, Prehension systems, Production optimization, Polyarticulated manipulator.

D.22. COMPARATIVE ANALYSIS AND MATLAB/SIMULINK MODELING OF DC STATIC CONTACTORS USING CONVENTIONAL AND GATE TURN-OFF THYRISTORS

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Abstract. The study details the modeling and simulation of a DC static contactor using Matlab/Simulink, specifically designed for controlling high-power mechatronic systems. Given the continuous evolution of power electronics, this study analyzes the transition from classical devices to modern solutions that offer enhanced reliability in industrial environments. The research is based on the development of two numerical models using Matlab/Simulink: a contactor based on conventional thyristors (SCR) with a forced commutation circuit and an advanced model using gate turn-off components (GTO/IGCT). The methodology emphasizes the comparative study of switching losses and frequency limitations. While IGBT transistors allow operating frequencies in the 10-20 kHz range, this work justifies the use of GTO/IGCT thyristors for power applications by working at optimized frequencies (approx. 500 Hz), where robustness against overcurrent's is a priority. Simulation results demonstrate that despite the lower operating frequency compared to typical transistor-based solutions, the implementation of IGBTs cuts auxiliary thyristor shutdown circuits, thereby reducing hardware complexity and electromagnetic interference (EMI). The thermal loss analysis confirms that a correctly sized static contactor provides superior power density, representing a best solution for command execution in robust mechatronic systems.

Keywords: static contactor, Matlab/Simulink, GTO thyristor, mechatronic systems, switching losses.

D.23. ANALYSIS OF MECHATRONIC FOOD INSPECTION SYSTEMS THROUGH NUMERICAL SIMULATION

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Abstract. This study investigates the implementation and optimization of integrated mechatronic inspection systems in industrial fruit and vegetable processing lines, with the aim of minimizing downtime and increasing compliance with food safety standards. The research methodology consisted of designing and testing modular inspection tables, equipped with either roller conveyors or polymer belts, which integrate configurable cutting stations and removable chutes for waste management. The control components included three-piece stainless-steel valves and actuators, and the direct contact elements, including the shredders, were made of blue technical polymers, such as ultra-high molecular weight polyethylene (UHMW) or high-density polyethylene (HDPE). The assessment of the operating regimes was performed by the finite element method (FEM), using the Ansys 2025 R2 simulation environment. The Rigid Dynamics module was used for kinematic modelling of rigid bodies, evaluating velocities and forces in multibody systems with large joint-actuated movements, while the Transient Structural module was applied to determine the dynamic response under non-periodic transient loads, calculation and formation effects of variable units in variable damping activities. From the analysis of the resulting data, a reduction of non-productive times by 11.5% was obtained compared to traditional architectures, the performance attributed to the minimization of the intervals required to reconfigure the worktables. It was determined that the implementation of stainless-steel actuators ensured superior mechanical resistance, reducing the propagation of the fatigue

phenomenon and generating an increase in operational life by 8.2% in terms of use cycles. It was concluded that the use of blue polymeric components maximizes the optical detectability of accidental breakages, contrasting with natural food pigments and allowing rapid waste isolation. Furthermore, the viability of adding materials to become inductively detectable (ID) by metal sensors or ultra detectable (UD) by X-ray equipment was demonstrated, ensuring the traceability of contaminants. Validation by numerical simulation confirmed the structural robustness of the architecture, providing a reliable technical solution for optimizing decision-making safety and maintenance in production environments.

Keywords: Mechatronic systems, Rigid body dynamics, Finite element analysis (FEM), Inspection systems, Sensory detectability.

E. ECONOMIC ENGINEERING

E.1. THE IMPORTANCE OF DATA MANAGEMENT IN MODERN COMPANIES. STRATEGIES AND GOOD PRACTICES FOR ORGANIZATIONAL TRANSFORMATION

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Abstract. This paper investigates the strategic role of data governance and data quality in modern manufacturing companies within the context of Industry 4.0. The study argues that the absence of a formal data management framework leads to inefficiencies, increased operational costs, and failure of digital transformation initiatives. The main goal of the paper is to demonstrate how a rigorous data management framework, supported by modern analytical models (XGBoost and neural networks), can significantly reduce defect rates, lower operational costs, and improve process efficiency in manufacturing companies. The main contributions include a replicable data governance framework, empirical validation of the impact of advanced analytics on production performance, and a practical guideline for integrating AI ethics and GDPR compliance into industrial data processes.

Keywords: Data governance, data quality, Industry 4.0, Predictive maintenance, Machine learning, ETL processes, GDPR compliance

E.2. THE IMPORTANCE OF SES SKILLS IN THE MANAGERIAL ENVIRONMENT

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Abstract. This paper explores the role of sensory, emotional, and social (SES) skills in improving managerial effectiveness and organizational performance. The study starts from the premise that traditional management approaches often overlook non-cognitive competencies, despite their significant impact on communication, decision-making, and team dynamics. The research integrates a theoretical analysis of communication processes, including verbal, non-verbal, and paraverbal components, with a focus on how sensory awareness enhances the interpretation of interpersonal signals. Key concepts such as active listening, empathy, and behavioral perception are examined as critical elements in understanding employee needs and improving managerial responsiveness. The practical component includes the analysis of real managerial scenarios using tools such as SWOT, PEST(ELE), and 5WHY, alongside workshops designed to develop SES competencies within teams. The findings highlight that managers who actively cultivate sensory and emotional awareness demonstrate improved communication, stronger interpersonal relationships, and increased adaptability to organizational change. The study contributes by proposing a structured framework for integrating SES skills into managerial practice, emphasizing their role in building high-performing teams and enhancing leadership effectiveness in complex organizational environments.

Keywords: Sensory skills, Emotional intelligence, Managerial communication, Leadership, Empathy, Decision-Making, Organizational behavior

E.3. THE ANALYSIS OF HUMAN RESOURCES. A WAY TO IMPROVE THE OVERALL PERFORMANCE OF INDUSTRIAL ORGANIZATIONS

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Abstract. At the global level, the world is faced with fewer and fewer resources. Today, we can talk about more or less limited resources, but not about unlimited or sufficient resources. The main objective of a company is to be efficient, or in other words, to obtain the desired profit. At the same time, there has to be a correlation between profitability and the level of resources used. The most important resources of any organization are its human resources. The people are those who work and create, giving a sense of their existence. People are the only resource that cannot be measured in monetary terms. In other words, an organization cannot exist without this special type of asset and, more than that, its position on the market definitely depends on the performance of its personnel. The paper presents the usage of human resource analysis in the case of a chemical company.

Keywords: human resources, organization's performance

E.4. SOME ASPECTS OF THE QUALITY OF THE MANAGEMENT AND ENTREPRENEURSHIP EDUCATION IN ROMANIA

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Abstract. The scientific research on Entrepreneurship and Management education is rather new, not only for Romania. And the research on the quality of the process is even more interesting. The author's research, as part of an international research project, reveals important conclusions: The decision to continue the education or training depends mostly on the participants' overall satisfaction level, but also on previously attended training programs in management and entrepreneurship, and other factors, such as the structure and quality of the educational process, training logistics (training classroom and equipment). Other interesting findings are presented: the reasons why participants decide to attend a certain management-entrepreneurship training program or subject. The research conclusions are supported by results from research conducted in other countries.

Keywords: entrepreneurship, education

E.5. ORGANIZATIONAL CULTURE FOR KNOWLEDGE SHARING

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Abstract. Culture encompasses the values, beliefs, attitudes, and behavior of an organization. Culture is how things get done in organizations. It is also a well-known fact that an organization's culture shapes its learning orientation. It is therefore important to understand the cultural aspects of the organisation before planning any initiative in e-learning or knowledge management. In this article, we will build on a popular model for understanding organisational culture and present a map that can be used to make quick inferences when making decisions on other facets of organizational learning (e.g., e-learning or knowledge management initiatives).

Keywords: organizational culture, knowledge

E.6. THE IMPACT OF INTEGRATING ESG PRINCIPLES INTO ORGANIZATIONAL COMMUNICATION ON ONLINE VISIBILITY AND ENGAGEMENT IN THE INDUSTRIAL ENVIRONMENT

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Abstract. In the context of growing societal concerns regarding sustainability and the accelerated process of digitalization, companies, including those operating in industrial markets, show an increasing interest in integrating ESG (Environmental, Social, Governance) principles both into their operational processes and communication activities. This paper presents the results of a study conducted on a sample of companies from the industrial sector, aiming to assess the impact of integrating ESG principles into organizational communication on online marketing performance, analyzed in terms of visibility and engagement. The research is based on the use of secondary data, as well as on the content analysis of the official websites of the companies included in the study, complemented by the evaluation of their presence on relevant digital platforms for measuring the effectiveness of online communication. The analysis focuses both on identifying general trends across the entire sample and on highlighting differences between companies, depending on their field of activity and the level of environmental impact specific to each industry. The results contribute to a better understanding of the role of ESG communication in the context of digital marketing, highlighting how the integration of sustainability can become a differentiation factor and enhance performance in the online environment.

Keywords: ESG, industrial market, digital marketing

E.7. DEMOGRAPHIC PROJECTIONS OF THE RESIDENT POPULATION IN BACĂU COUNTY FOR THE HORIZON YEARS 2040, 2060, AND 2080

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Abstract. Demographic projections are essential analytical tools that estimate the future evolution of the population (in terms of size, age and sex structure, and territorial distribution) based on current trends in fertility, mortality, and migration. They are important for understanding social phenomena and for informing public policies and development strategies. These projections represent scenarios (optimistic, baseline, or pessimistic), developed through statistical analysis and mathematical modeling, and are periodically produced by national statistical institutes as well as by international organizations such as Eurostat, the United Nations, and other specialized institutions. At the national level, projections up to 2080 are based on three scenarios—pessimistic, optimistic, and baseline (the most likely)—taking into account developments in fertility, life expectancy, and migration, using recent data (2024). In all scenarios, international migration is assumed to be positive, influenced, among other factors, by refugees and foreign workers. Romania is projected to experience a significant population decline by 2080 (approximately –23.3%), reaching around 14.6 million inhabitants, accompanied by population ageing and a reduction in the number of young people. Bacău County is expected to face a more pronounced demographic decline than the national average by 2080, characterized by a substantial decrease in total population (–28.4% under the baseline scenario), a sharp reduction in the young population (–41.2%), and in the working-age population (–31.7%), alongside an increase in the share of the elderly population (+5.9 percentage points). Even under

the optimistic scenario, depopulation and ageing trends remain dominant in Bacău County, which is likely to have a significant impact on the labour market and socio-economic development.

Keywords: demographic projections, scenarios: optimistic, baseline or pessimistic, fertility, mortality, migration, life expectancy

E.8. A FIVE-DIMENSIONAL CONCEPTUAL MODEL FOR IMPROVING RESEARCH PROJECT IMPLEMENTATION MANAGEMENT IN SMES

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Abstract. This paper develops a five-dimensional conceptual model for improving research project implementation management in small and medium-sized enterprises (SMEs). Based on a critical synthesis of the literature on research, innovation, open innovation, resource-based and knowledge-based perspectives, and institutional collaboration, the study identifies major theoretical gaps and proposes an integrative framework structured around strategic, resource, organizational, collaborative, and results dimensions. The model provides a coherent basis for understanding how SMEs can better align applied research activities with competitiveness and sustainable development objectives.

Keywords: research project implementation, conceptual model, innovation management, applied research, competitiveness, sustainable development.

E.9. ECONOMIC IMPACT OF STATISTICAL PROCESS CONTROL IN THE MANUFACTURING OF AEROSPACE COMPONENTS: A CASE STUDY ON AIRCRAFT DOOR HINGES

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Abstract. In the aerospace industry, where safety, precision, and reliability are paramount, manufacturing processes must adhere to rigorous quality standards to ensure economic efficiency. Statistical Process Control (SPC) is a fundamental tool for achieving this state by enabling early detection of process deviations and minimizing production variability. Within the context of Industry 4.0 and the emerging Industry 5.0 paradigm, SPC is increasingly significant in optimizing manufacturing processes, especially for high-value, safety-critical components. This paper examines the economic impact of implementing Statistical Process Control in the machining of aerospace components, focusing on door hinges for aircraft such as the Boeing 787 family. The analysis addresses the control of coaxiality deviations in centering holes in the hinge assembly, a critical geometric parameter that directly affects assembly accuracy and operational reliability. An experimental analysis was performed by monitoring the machining process and applying SPC methods to assess process stability and deviation trends. The resulting data facilitated the identification of process variability and supported the implementation of corrective actions to maintain dimensional conformity within specified tolerances. The study specifically examined the progression of coaxiality errors and their effects on rejection rates and rework requirements. The results indicate that the application of statistical control substantially enhances process stability and reduces variability. From an economic standpoint, the implementation of SPC resulted in a reduction in manufacturing costs of up to 15%, achieved without compromising safety or quality standards. These cost savings are mainly attributed to lower scrap rates, reduced rework, and improved process predictability. The results show that SPC serves not only as a

quality assurance tool but also as a strategic cost-optimization instrument in aerospace manufacturing. The study underscores the importance of integrating statistical methods into production workflows, particularly for critical components where maintaining strict tolerances is essential to ensuring both quality and economic performance.

Keywords: SPC, aerospace components, coaxiality, cost optimization, machining quality, process capability

E.10. CAPITAL MARKET DEVELOPMENT AND ECONOMIC GROWTH IN ROMANIA

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Abstract. This paper examines the correlation between capital market maturity and economic growth in Romania. By analyzing the evolution of the Bucharest Stock Exchange (BSE), specifically its transition to Emerging Market status and the impact of major IPOs, the study explores how equity market development influences macroeconomic stability. Using a combination of qualitative and quantitative analysis, the research evaluates key metrics such as market capitalization-to-GDP and liquidity ratios. Findings indicate that while the Romanian capital market has experienced significant structural growth, its depth remains insufficient to fully drive national economic expansion. The study highlights the vital role of institutional investors and corporate governance in narrowing the gap with Western European markets. The paper concludes with policy recommendations to enhance market accessibility and financial intermediation, asserting that a functional capital market is essential for Romania’s long-term economic resilience.

Keywords: Capital market, BSE, economic growth, liquidity, emerging market, Romania

E.11. ASYMMETRIC EFFECTS OF FOREIGN DIRECT INVESTMENT ON REGIONAL GROWTH: EVIDENCE FROM ROMANIAN DEVELOPMENT REGIONS

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Abstract. This paper examines the impact of foreign direct investment (FDI) on regional economic development in Romania, focusing on the country’s eight development regions over the period 2003–2023. While FDI has been widely recognized as a key driver of economic growth in transition economies, its regional effects remain uneven and insufficiently explored in the Romanian context. Using panel data techniques and gross value added as a proxy for regional economic performance, the study investigates both the magnitude and persistence of FDI-induced growth effects across regions. The empirical results indicate significant regional heterogeneity in the FDI–growth relationship. More developed regions with higher levels of human capital, infrastructure quality, and sectoral diversification benefit more strongly from FDI inflows, while less developed regions experience weaker or delayed effects. This suggests that FDI may contribute to widening regional disparities rather than fostering territorial convergence. Furthermore, the inclusion of lagged FDI terms reveals that the growth-enhancing effects of foreign investment materialize over time, reflecting learning processes and absorptive capacity constraints. The findings highlight the importance of complementary regional policies aimed at

strengthening local capabilities and improving investment quality, rather than relying solely on FDI attraction strategies.

Keywords: Foreign direct investment, regional economic development, economic growth, regional disparities, Romania.

E.12. QUANTIFYING THE INTANGIBLE: THE IMPACT OF ORGANIZATIONAL CULTURE ON FINANCIAL PERFORMANCE AND ASSET VALUATION IN VOLATILE MARKETS

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Abstract. Traditional financial reporting models often struggle to capture the full economic value of intangible organizational assets, especially organizational culture. This study investigates the impact of organizational culture on financial performance and asset valuation within high-volatility markets. The primary objective is to determine whether cultural alignment serves as a quantifiable economic stabilizer and how it influences bottom-line resilience during exogenous market shocks. Utilizing a quantitative analysis of financial ratios alongside non-financial disclosure data, this research evaluates the relationship between internal cultural strength and corporate financial stability. The findings demonstrate that firms with strong cultural alignment exhibit superior risk-adjusted financial performance and greater earnings predictability during periods of market instability. The results suggest that organizational culture functions as an important, yet underreported, intangible asset that mitigates volatility and protects shareholder value. Consequently, this paper argues for the integration of cultural metrics into existing asset valuation models, advocating for enhanced non-financial reporting standards to better reflect the true economic health of modern enterprises. By bridging the gap between behavioral organizational dynamics and quantitative accounting, this study provides a framework for recognizing culture as a key driver of corporate valuation.

Keywords: intangible assets, organizational culture, financial performance, market, corporate resilience

E.13. MANUFACTURING TECHNOLOGIES AS A KEY DRIVER FOR EUROPEAN ECONOMIC RESILIENCE

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Abstract. As the European Union experiences a relative decline in its share of global GDP, leveraging advanced manufacturing becomes necessary for sustaining economic influence. The present paper examines the influence of advanced manufacturing technologies as a key driver for European economic resilience. The primary objective is to evaluate how integrated product design and process optimization strategies can serve as a counterbalance to broader macroeconomic shifts. By employing an analytical framework focused on Industry 4.0 integration, this study assesses the impact of deploying high-precision manufacturing, digital twinning, and autonomous production systems on industrial efficiency and trade competitiveness. The findings indicate that the adoption of these technologies directly correlates with increased industrial output and a higher

value-added export capacity. Furthermore, the research demonstrates that technological leadership acts as an important strategic hedge against global market volatility. Ultimately, the study concludes that prioritizing technological innovation in manufacturing is not merely a technical requirement but a fundamental pillar for maintaining the EU's global trade power. By fostering such resilience through targeted technological optimization, European industries can uphold their leadership position despite the shifting global economic landscape.

Keywords: Industry 4.0, advanced manufacturing, economic resilience, process optimization, European competitiveness

E.14. BEYOND THE BOTTOM LINE: THE SOCIO-ECONOMIC IMPACT OF ETHICAL LEADERSHIP ON RESILIENCE IN INDUSTRIAL MANUFACTURING

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Abstract. In an era of supply chain instability and rapid technological transition, the industrial manufacturing sector requires a deeper understanding of organizational resilience that extends beyond traditional financial metrics. This study investigates the socio-economic impact of ethical leadership on the resilience of manufacturing firms. The primary objective is to analyze how ethical decision-making frameworks influence long-term operational stability, safety culture, and stakeholder trust within industrial environments. By integrating organizational behavior theories with industrial performance data, the research evaluates the extent to which ethical leadership acts as a mediator for corporate durability during periods of market volatility and exogenous shocks. The findings indicate a statistically significant correlation between strong ethical leadership, improved worker safety standards, enhanced crisis recovery capabilities, and supply chain reliability. The results suggest that industrial firms prioritizing ethical conduct develop a "relational capital" that buffers against operational disruptions, effectively converting corporate values into sustained industrial stability. Ultimately, this study concludes that ethical leadership is not merely a moral imperative but a fundamental strategic driver of industrial resilience. It advocates for the inclusion of ethics-based governance as a core component of manufacturing risk management, offering a roadmap for industrial leaders seeking to secure long-term value beyond the bottom line.

Keywords: ethical leadership, industrial manufacturing, resilience, supply chain ethics, corporate governance

E.15. CULTURAL CAPITAL AS ECONOMIC CATALYST: A MULTI-LEVEL ANALYSIS OF SOCIAL NORMS WITHIN CORPORATE FRAMEWORKS

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Abstract. The intangible nature of cultural capital often obscures its direct contribution to corporate economic performance. This study investigates "Cultural Capital" as a measurable economic catalyst, exploring how internal social norms within corporate frameworks drive financial outcomes. The primary objective is to conduct a multi-level analysis—assessing dynamics at the individual, team, and organizational levels—to determine the efficacy of cultural capital in volatile environments. By utilizing a quantitative dataset of corporate performance indicators, the research assesses how shared social norms facilitate operational agility and reduce

transactional frictions. The findings demonstrate that high levels of cultural capital positively correlate with superior financial performance and accelerated innovation cycles. Furthermore, the analysis reveals that social norms act as a strategic buffer, enhancing corporate resilience against market fluctuations. The study concludes that cultural capital functions as a tangible economic driver, suggesting that frameworks failing to account for these dynamics underreport true enterprise value. This research provides a roadmap for integrating qualitative social norms into quantitative corporate valuation models, framing culture as an essential asset for sustainable growth.

Keywords: corporate performance, cultural capital, multi-level analysis, organizational behavior

E.16. ARTIFICIAL INTELLIGENCE IN MARKETING RESEARCH: OPPORTUNITIES, LIMITATIONS, AND MANAGERIAL IMPLICATIONS

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Abstract. Artificial intelligence is becoming an increasingly relevant tool in the transformation of marketing research, providing new ways of collecting, processing, and interpreting data. In this context, the paper aims to analyze the role of artificial intelligence in optimizing the marketing research process, highlighting the main opportunities, limitations, and managerial implications associated with its use. The research focuses on exploring how artificial intelligence-based solutions contribute to improving the specific stages of marketing research, such as the design of data collection instruments, consumer behavior analysis, market segmentation, and the generation of relevant insights for strategic decision-making. At the same time, the study examines the challenges and constraints associated with the adoption of these technologies, including issues related to data quality and availability, required digital competencies, implementation costs, and ethical implications. The methodological approach is based on a review of the relevant literature, complemented by the collection and analysis of primary data from the perspective of marketing practitioners, in order to capture their perceptions regarding the use of artificial intelligence in research activities. The paper aims to contribute to a better understanding of the impact of artificial intelligence on marketing research and to provide relevant benchmarks for its effective use in the context of the opportunities and limitations associated with artificial intelligence.

Keywords: artificial intelligence, marketing research, managerial decision making, opportunities, limitations

E.17. CONSTRUCTIVE-FUNCTIONAL AND FEM ANALYSIS OF AN OIL UOP 12 C1 PUMP

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Abstract. This paper develops a replicable university–community framework to improve municipal solid waste management (MSWM) in governance-constrained contexts. In Sibiu County, Romania, recycling rates stagnate at 25–29%—well below the EU target—while landfill capacity is nearing exhaustion, pointing to behavioral and institutional gaps rather than infrastructure deficits. Using mixed-method action research within the SEAL project, the study combines document analysis, citizen interviews, fieldwork, and diagnostic tools, along with a

Challenge-Based Learning (CBL) hackathon in which students co-designed solutions. Findings show that low selective collection is driven by systemic deficits in participation, trust, and institutional coordination rather than technical limitations. These factors are addressed through a four-phase intervention model: Diagnosis; Education and Immersion; Co-Design and Prototyping; and Scale and Advocacy. The framework generates both student competency development and governance-relevant outputs. The study's research limitations are based on a single regional case, but it offers a transferable methodological framework for other environmental governance challenges where behavioral change is critical. Practical implications provide a low-cost model for integrating universities into MSWM reform and highlight the need to fund behavioral interventions alongside infrastructure investments. The originality and value of this paper lie in its novel integration of quality management tools with CBL and Civic Lab design, grounded in an urgent landfill crisis, and in delivering a scalable framework for a circular economy transition in Romania and similar contexts.

Keywords: CBL, waste management, University governance, Sustainability innovation, CFEI, Environmental innovation.

F. CHEMICAL & FOOD ENGINEERING

F.1. ENTROPY CONTROL IN THE PROLONGATION OF FUNCTIONAL PROPERTIES OF BIOLOGICALLY ACTIVE COMPOUNDS IN FOOD COMPOSITIONS

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Abstract. The prolongation of functional properties of biologically active compounds (BAC) in food systems is limited by oxidative degradation, structural disorganization, unfavorable interfacial interactions, and other spontaneous transformations that develop during processing and storage under non-equilibrium conditions. In the present work, BAC preservation is interpreted as a problem of entropy control in multicomponent food systems. Functional instability is considered not as an isolated chemical event, but as a manifestation of systemic disordering at molecular, supramolecular, and microstructural levels. Accordingly, prolongation of BAC functionality is achieved through technological strategies that restrict entropy growth, reduce destabilizing degrees of freedom, and maintain ordered states resistant to degradation over time.

This concept was validated in a range of food compositions and model systems. High-molecular biopolymers, including alginate and arabinoxylan, were developed as stabilizing matrices for BAC. Their effect proved to be system-specific: some polymers destabilized anthocyanins in aqueous media, whereas betanin stabilization appeared above threshold concentrations, for example at more than 0.03% hyaluronic acid. Quinochalcone pigment Carthamine and Isocarthamine, intrinsically unstable in water, were transferred into a more ordered state through cellulose complexation, which significantly expanded their applicability in high-moisture and acidolactic systems (pH 4...6). In lipid-containing systems, entropy control was expressed through antioxidant synergy and structural regulation of dispersed phases, yielding a 20...40% decrease in degradation rates of $\omega 3$ and $\omega 6$ -rich lipids. In dispersed food matrices, stabilization correlated with structural compactness and low polydispersity; in particular, PDI values below 0.2 corresponded to more stable states of oil-containing edible microcapsules. In multiphase systems of the oil/water/air type, the effect of structuring was non-linear: excessive dispersion increased the entropic cost of stabilization, whereas controlled organization of interfaces improved functional retention. The interfacial scale of such systems reached $10^4...10^5 \text{ m}^2 \cdot \text{kg}^{-1}$, confirming the decisive role of structural organization in BAC stability.

Thus, the prolongation of BAC functionality should be regarded not only as a compositional or kinetic task, but also as a structural-thermodynamic one. Selective removal of destabilizing compounds, synergistic antioxidant action, complexation with edible biopolymers, and purposeful micro-structuring act as entropy-control strategies that promote the transition from disordered, degradation-prone states to more ordered and functionally stable ones. Entropy control therefore emerges as a unifying principle for the design of food compositions with prolonged functional stability and predictable technological performance.

Keywords: BACs; biopolymers; entropy control; functional stability; interfacial processes.

Acknowledgments: This work was supported by the ANCD-governed institutional project, subprogram 020405, "Optimizing Food Processing Technologies in the Context of the Circular Bioeconomy and Climate Change" (Bio-OpTehPAS), implemented at the Technical University of Moldova.

F.2. OPTIMIZING PHENOLIC EXTRACTION AND FERMENTATION DYNAMICS IN AUTOCHTHONOUS RED WINES THROUGH THE SOFT SYSTEM® APPROACH

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Abstract. The maceration–fermentation stage represents a critical phase in red winemaking, governing the extraction dynamics of phenolic compounds, chromatic attributes and aroma precursors. Current oenological practices increasingly focus on process optimization to enhance both the qualitative and stability parameters of wines. Within this framework, the Soft System® method emerges as an advanced technological solution, integrating automated fermentation control, gentle cap management, and regulated oxygen exposure to maximize extraction efficiency while preserving phenolic integrity.

This study investigates the impact of the Soft System® maceration–fermentation approach on wines produced from two autochthonous red grape varieties, Băbească Neagră and Fetească Neagră, in comparison with conventional vinification techniques. Parallel experimental fermentations were carried out under standardized conditions, applying both technological variants to each grape variety, with subsequent evaluation of physico-chemical, phenolic, aromatic, and sensory parameters.

The findings demonstrate that the implementation of the Soft System® method promotes a more consistent and complete alcoholic fermentation, evidenced by lower residual sugar levels and an increased fermentation rate (by approximately 12–15%). Furthermore, enhanced phenolic extraction was observed, reflected in elevated total polyphenol content and higher anthocyanin concentrations, contributing to improved color intensity and chromatic stability.

In addition, wines obtained through the modern method exhibited a more refined aromatic profile, characterized by greater complexity, persistence, and varietal typicity. Sensory analysis supported these results, indicating superior balance, structural harmony, and overall quality.

In conclusion, the Soft System® method represents a highly effective and innovative approach in red winemaking, aligning with current trends focused on precision oenology, sustainability and production of high-quality wines with enhanced sensory expression.

Keywords: anthocyanins, aromatic profile, maceration–fermentation, red wine, Soft System®, phenolic compounds.

Acknowledgments: The research was supported by Institutional Project, subprogram 020405 “Optimizing food processing technologies in the context of the circular bioeconomy and climate change”, Bio-OpTehPAS, being implemented at the Technical University of Moldova.

F.3. INFLUENCE OF RAW MATERIALS ON THE MICROBIOME AND ORGANOLEPTIC DEFECTS OF NATURAL VINEGARS

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Abstract. The quality of raw materials significantly influences the microbiological stability and organoleptic characteristics of vinegar, thereby directly affecting the quality of the final product. In contrast to concentrated, frozen, or canned raw materials, natural raw materials retain a more diverse indigenous microflora, which may contribute both to favorable fermentation processes and to the emergence of organoleptic defects. The present study investigated the microbiome of two natural vinegars, apple vinegar and grape vinegar, in relation to organoleptic deterioration, with particular emphasis on the occurrence of a nonspecific odor uncharacteristic of high-quality

vinegar. Shifts in the microbial community may indicate disturbances during fermentation or storage, resulting in the formation of undesirable metabolites responsible for sensory deterioration. The analysis revealed the presence not only of potentially pathogenic bacteria, but also of yeasts, including *Brettanomyces*, which likely contributed to the development of the off-odor. The findings demonstrated that the quality and condition of natural raw materials, together with the biochemical transformations occurring during production, play a decisive role in shaping the final organoleptic profile of vinegar. Therefore, microbiome monitoring in vinegar produced from natural raw materials is essential for identifying the risks and ensuring consistent quality and safety.

Keywords: vinegar; quality; microbial community; safety; *Brettanomyces*.

Acknowledgments: The research was supported by Institutional Project, subprogram 020405 “Optimizing food processing technologies in the context of the circular bioeconomy and climate change”, Bio-OpTehPAS, being implemented at the Technical University of Moldova.

F.4. INFLUENCE OF SALT ON FERMENTATION, GLUTEN STRUCTURE, AND TEXTURAL CHARACTERISTICS OF BREAD

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Abstract. Salt is considered the "soul" of bread, representing an indispensable functional ingredient in bakery, exercising rigorous control over the rheological properties of the dough and over the dynamics of the fermentation processes that define the quality of the finished product. The aim of this study was to evaluate the influence of different concentrations of sodium chloride (NaCl) on bread quality by analyzing the changes in physical, textural, and structural properties, as well as the technological behavior of both dough and the final product. Five bread samples were prepared, differentiated by their NaCl content: 0 % (control sample), 0.4 %, 0.8 %, 1.2 %, and 1.6 %. Each sample was evaluated in terms of specific volume and crumb porosity (SR 91: 2007), technological losses during baking and cooling, and textural properties (hardness, elasticity, cohesiveness, and chewiness). A Stable Micro Systems TA.HD plus C analyzer, United Kingdom, was used for texture profile analysis. Increasing NaCl concentration led to noticeable changes in bread properties: specific volume and porosity decreased with higher salt levels due to the inhibition of yeast activity and reduced gluten extensibility. The control sample showed the highest porosity (72.53 %), while salted samples ranged between 67.76 % and 72.12 %. Technological losses decreased both during baking (from 14.94 % to 14.15 %) and cooling (from 3.86 % to 2.58 %), a trend associated with improved water retention and strengthening of the gluten network in the presence of salt. Textural properties of the crumb were significantly affected: at low NaCl concentrations, hardness decreased, whereas at higher levels (1.2–1.6 %), both hardness and chewiness increased considerably, indicating the formation of a denser and more rigid internal structure. Elasticity remained constant (~1.00), while cohesiveness showed a slight decrease from 0.696 (control) to 0.651 (1.6 % NaCl sample). Salt had a substantial impact on the physical, technological, and textural properties of bread. High NaCl concentrations (>1.0–1.2 %) inhibited fermentation, reduced bread volume and porosity, and led to a denser and more rigid crumb. In contrast, moderate salt additions contributed to maintaining an optimal balance between firmness, porosity, and overall structural quality of the bread samples.

Keywords: physical properties, texture, gluten network, yeast activity, water retention.

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F.5. LIPOSOMAL ENCAPSULATION AS AN ADVANCED STRATEGY FOR PRESERVING BIOACTIVE COMPOUNDS FROM PLANT-BASED MATRICES

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Abstract. The preservation of biologically active compounds derived from plant-based matrices remains a major challenge in contemporary food science and nutraceutical development, due to their pronounced sensitivity to environmental factors such as oxidation, light exposure, temperature variations, and enzymatic activity. Polyphenols, carotenoids, vitamins, and other phytochemicals exhibit well-documented functional and health-promoting properties; however, their instability during processing and storage limits their bioavailability and technological applicability.

This study investigates the potential of liposomal encapsulation as an advanced delivery system designed to enhance the stability, protection, and controlled release of plant-derived bioactive compounds. Liposomes, characterized by phospholipid bilayer structures, provide a biocompatible and versatile encapsulation matrix capable of incorporating both hydrophilic and lipophilic compounds, thereby reducing degradation processes and improving functional performance in complex food systems.

The research focuses on evaluating encapsulation efficiency, physicochemical stability, and the retention of antioxidant activity of selected plant extracts following liposomal incorporation. Key parameters, including vesicle size distribution, zeta potential, encapsulation yield, and oxidative stability, were systematically analyzed under different technological conditions. Additionally, the influence of processing variables such as homogenization intensity, temperature regimes, and storage duration on the integrity of encapsulated compounds was assessed.

The results indicate that liposomal encapsulation significantly improves the stability of bioactive compounds, preserving up to 70–90% of the initial antioxidant activity under controlled conditions, compared to non-encapsulated systems. Liposomal encapsulation represents a promising technological approach for the development of functional food products with improved nutritional value and extended shelf life, supporting the sustainable utilization of plant-based resources.

Keywords: liposomal encapsulation; bioactive compounds; plant-based matrices; phytochemicals; antioxidant activity; encapsulation efficiency

Acknowledgments: The research was supported by Moldovan Government within State project of Young Researchers no. 25.80012.5107.10TC “Stabilization of Bioactive Compounds from Horticultural Sources through Liposomal Encapsulation” running at Technical University of Moldova.

F.6. VALORIZATION OF ALFALFA FOR INNOVATIVE FOOD INDUSTRY APPLICATIONS

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Abstract. Alfalfa (*Medicago sativa L.*) is known for its rich composition of pigments, especially chlorophylls, which give the leaves their intense green hue. In this work, the chlorophyll content and color parameters of alfalfa, the Dimitra variety, harvested in the Republic of Moldova were analyzed. In the alfalfa sample, the total chlorophyll content was approximately 1768 mg/100 g

DW, with the predominance of α chlorophyll (1315 mg/100 g DW) over β chlorophyll (452.8 mg/100 g DW). These values are within the limits reported for plants harvested in the budding phase, when the leaves are metabolically active and rich in pigments. The CIELab color parameters of alfalfa highlight a chromatic profile specific to chlorophyll-rich plant materials. The parameter value L^* (30.30) indicates a low brightness, suggesting a relatively dark color, characteristic of leaves with a high content of photosynthetic pigments. The coordinate a^* (-21.99) reflects a pronounced shift towards the green area of the spectrum, confirming the predominance of chlorophylls. At the same time, the value b^* (19.40) highlights a moderate yellow component, associated with the presence of carotenoids and xanthophylls, pigments that contribute to color stability and overall hue. The ratio $-a^*/b^*$ (-1.13) suggests a balance between green and yellow tones, with a slight dominance of green. This ratio is relevant for evaluating color changes during processing or storage. The chroma value, C^* (29.32) indicates an intense and saturated color, which reflects good visual quality. The hue angle, h^* , (138.60 °) falls within the green color range, confirming the predominantly green character of alfalfa, with a slight tendency towards yellowish-green.

The chromatic profile highlighted by CIELab parameters confirms that alfalfa presents an intense, stable and well-defined green color, associated with a high content of natural pigments and bioactive compounds. These characteristics support the potential of alfalfa not only as a functional ingredient, rich in protein, but also as a natural coloring agent in the food industry. Its integration into food products can contribute both to improving the nutritional value and to obtaining attractive visual properties, responding to current demands for natural and sustainable ingredients.

Keywords: alfalfa, bioactive compounds, protein concentrate, functional proprieties.

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F.7. OPTIMIZATION OF TECHNOLOGICAL PARAMETERS OF A FUNCTIONAL SEA BUCKTHORN SAUCE

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Abstract. This study investigates the valorization of sea buckthorn (*Hippophae rhamnoides* L.) fruits for the development of a sweet sauce with enhanced biological value, with a particular focus on optimizing technological processing parameters. Sea buckthorn is characterized by a high content of bioactive compounds, including vitamin C (30–2740 mg/100 g), polyphenols (29.8–38.8 mg GAE/g), and carotenoids, which confer strong antioxidant properties.

The research aimed to develop a technologically optimized process and to evaluate the influence of thermal regimes on physico-chemical, rheological, and sensory properties of the sauce. Experimental trials were conducted under controlled temperature conditions of approximately 60–65 °C (mild thermal treatment) and 80–90 °C (intensified thermal treatment), with processing durations ranging from 10 to 30 minutes, in order to assess their impact on product quality.

The results demonstrated that increasing temperature and treatment time led to a progressive increase in dry matter content and viscosity, due to water evaporation and structural modifications of the polysaccharide matrix. At 80–90 °C, viscosity increased significantly, indicating improved textural consistency, especially in samples with added gelling agents. However, these conditions also resulted in a pronounced degradation of thermolabile compounds, particularly vitamin C, confirming its sensitivity to heat and oxidation. In contrast, total polyphenol content remained relatively stable (approximately 30–40 mg GAE/g), ensuring sustained antioxidant activity, as confirmed by DPPH analysis.

Rheological behavior indicated a non-Newtonian, shear-thinning system, with viscosity strongly dependent on both temperature and formulation. Sensory analysis revealed that samples

processed at moderate temperatures (60–70 °C) exhibited the best balance between nutritional preservation and desirable texture, achieving higher acceptability scores.

The novelty of the study lies in the development of a clean-label, functional sauce based on locally available raw materials, with reduced reliance on additives and improved nutritional profile.

Keywords: sea buckthorn, functional sauce, thermal processing, physicochemical properties, antioxidant activity, rheology.

Acknowledgments: The research was supported by Institutional Project, subprogram 020405 “Optimizing food processing technologies in the context of the circular bioeconomy and climate change”, Bio-OpTehPAS, being implemented at the Technical University of Moldova.

F.8. THE INFLUENCE OF SEA BUCKTHORN POMACE POWDER ON THE CHEMICAL AND MICROBIOLOGICAL STABILITY OF GLAZED CHEESE DURING STORAGE

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Abstract. Glazed cheese, a lipid- and moisture-rich fresh dairy dessert, is highly susceptible to oxidative deterioration and physicochemical changes during refrigerated storage. Extending shelf life while avoiding synthetic additives remains a major challenge, prompting interest in natural, bioactive-rich ingredients. Sea buckthorn (*Hippophae rhamnoides* L.) pomace, a by-product of cold-pressing, is rich in tocopherols, carotenoids, polyunsaturated fatty acids, and phenolic compounds, offering significant antioxidant potential for stabilizing lipid-containing dairy systems.

This study evaluated the effect of sea buckthorn pomace (SBP) at incorporation levels of 1.25%, 2.50%, 3.75%, and 5.00% (w/w) on the physicochemical properties of glazed curd cheese during 12 days of refrigerated storage, compared to a control sample (CS). The parameters analyzed included pH, peroxide index (PI), titratable acidity, water activity (a_w), and microbiological stability.

The pH values showed minor variations, ranging initially from 4.56 (CS) to 4.61 (SBP 5.00%) and decreasing slightly by day 12 (4.52–4.57), reflecting typical residual biochemical processes. The peroxide index exhibited the most significant differences: on day 1, the CS recorded 4.38 meq O₂/kg, while SBP-enriched samples showed markedly lower values (2.31–2.42 meq O₂/kg), corresponding to an approximate 46% reduction. This enhanced oxidative stability persisted throughout storage. Titratable acidity increased moderately in all samples, with the most balanced evolution observed at 2.50% SBP.

Water activity values were similar at the beginning (0.771–0.773) but remained slightly higher in enriched samples at the end of storage (0.767–0.769 vs. 0.762 in CS), likely due to the water-binding capacity of pomace components. Microbiological analysis confirmed product safety, with acceptable yeast counts and absence of moulds, coliforms, and *Salmonella* spp.

In conclusion, SBP incorporation, particularly at 2.50%, significantly enhances the oxidative stability of glazed curd cheese without adversely affecting its physicochemical or microbiological quality. The use of sea buckthorn pomace represents a sustainable approach aligned with circular bioeconomy principles and offers promising potential for application in dairy product development.

Keywords: dairy products; peroxide index; pomace; storage stability; sustainable valorisation

Acknowledgments: The research was supported by Institutional Project, subprogram 020405 "Optimizing food processing technologies in the context of the circular bioeconomy and climate change", Bio-OpTehPAS, being implemented at the Technical University of Moldova.

F.9. NON-TARGET GC–MS ANALYSIS OF MIGRATING COMPOUNDS FROM PET FOOD PACKAGING INTO LIPID-RICH FOOD MATRICES

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Abstract. The food packaging industry represents a dynamic and indispensable sector of the global economy. Among packaging materials, plastics are widely used due to their low cost, lightweight structure, flexibility, and excellent barrier properties. However, increasing concerns have emerged regarding the potential migration of chemical substances from plastic materials into food. These substances may include monomers, additives, and non-intentionally added substances (NIAS), which can migrate into food products throughout the entire life cycle of the packaging. Migration processes are strongly influenced by physicochemical factors such as temperature, light exposure, oxygen, and humidity. In addition, plastics used in food packaging are generally transparent to microwave radiation, which may facilitate the migration of packaging components into food during heating. The present study aimed to evaluate the migration of potentially toxic compounds from plastic food packaging into foods with high lipid content, including edible oils and complex food matrices. The extraction of potential migrants from packaging materials was performed using food simulants, namely ethanol solution (20% v/v) and iso-propanol (HPLC grade). The identification and quantification of migrated compounds were carried out by gas chromatography coupled with mass spectrometry (GC–MS), using a fused silica capillary column Rtx-5MS (5% diphenyl–95% dimethylpolysiloxane, 30 m × 0.25 mm internal diameter, 0.25 μm film thickness). The obtained spectra were interpreted using the NIST08 and FFNSC 1.2 spectral libraries. The results indicated that PET containers commonly used for edible cooking oils do not present significant contamination risks associated with conventional plasticizers. Nevertheless, trace levels of flame retardants, residual monomers, and other NIAS were detected. These compounds are not included among the authorized additives for food-contact materials and remain insufficiently characterized with respect to their migration behavior and toxicological profiles. The findings of this study highlight the importance of applying advanced non-target analytical approaches for the detection and characterization of unintentionally added substances and for assessing the potential combinatorial effects associated with chemical migration from food packaging materials.

Keywords: PET packaging; chemical migration; NIAS; lipid-rich foods; food simulants; GC–MS.

Acknowledgments: This work was supported by a project 25.80012.5107.19SE "Assessment of risks associated with the migration of potentially toxic components from plastic food packaging on the market of the Republic of Moldova".

F.10. EFFECT OF EXTRACTION CONDITIONS ON THE CIELAB COLOR PARAMETERS OF ALFALFA (*MEDICAGO SATIVA* L.) PROTEIN CONCENTRATE

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Abstract. The most important product derived from alfalfa (*Medicago sativa* L.) is alfalfa protein concentrate (APC), which contains 45–60% protein, along with essential amino acids, dietary fiber, unsaturated fatty acids, pigments, polyphenols, flavonoids, vitamins, and minerals. Since 1992, APC has been used as a food supplement in Mexico, Canada, and the United States, and in 2009 it received a positive opinion from the European Food Safety Authority. This study aimed

to investigate the effect of extraction conditions on the CIELab color parameters of APC. Eight APC samples were obtained: S1, S3, S5, and S7 by conventional extraction, and S2, S4, S6, and S8 by ultrasound-assisted extraction (UAE). The influence of extraction pH (5.6 for S1–S4 and 9.0 for S5–S8) and organic acid type used for isoelectric precipitation (lactic acid for S1, S2, S5, S6; citric acid for S3, S4, S7, S8) was evaluated. Color measurements were performed using a Chroma Meter CR-400 (Konica Minolta, Osaka, Japan). The following CIELab parameters were determined: lightness (L^*), red–green (a^*), yellow–blue (b^*), greenness ($-a^*/b^*$), and total color difference (ΔE^*). The paired t -tests were performed at a significance level of $p \leq 0.05$, to determine whether the differences observed between samples treated with organic acids with and without the application of UAE were statistically significant. Significant differences ($p \leq 0.05$) in L^* (48.26–53.97) and a^* (–22.80 to –13.17) were observed among all samples, indicating a predominance of green pigmentation associated with chlorophylls. The b^* values ranged from 32.09 to 44.26 and differed significantly among most samples ($p \leq 0.05$), except for S3–S4 ($p = 0.41$), suggesting limited influence of extraction conditions on yellow coloration linked to carotenoids. No significant differences ($p > 0.05$) in greenness ($-a^*/b^*$) were observed for pairs S1–S3 and S2–S4, indicating that acid type and ultrasound application at pH 5.6 had minimal impact on this parameter. The ΔE^* values indicated perceptible to pronounced color differences between selected sample pairs, with values of 4.31 (S1–S2), 5.60 (S3–S4), and 6.75 (S7–S8), while S5–S6 exhibited $\Delta E^* > 12$, corresponding to completely distinct coloration. These findings demonstrate that alkaline extraction conditions significantly influence the green coloration of APC, and that green pigments cannot be fully removed during isoelectric precipitation.

Keywords: alfalfa protein concentrate, CIELab color parameters, greenness, chlorophylls.

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F.11. MULTIVARIATE ANALYSIS OF PHYSICOCHEMICAL AND ANTIOXIDANT PROPERTIES OF ENCAPSULATED JOSTABERRY EXTRACT

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Abstract. Bioactive compounds in biopolymer matrices exhibit an emerging process that enhances stability and protects sensitive components from adverse environmental conditions, while ensuring controlled release of bioactive compounds. Encapsulation of josta extracts in wall materials, such as polysaccharides, can enhance physicochemical stability and preserve the biological potential and antioxidant activity of phytochemicals, while improving handling and storage. The aim of this study was to apply principal component analysis (PCA) and Person correlation (r) to determine the relationship between samples of microparticles from josta extract using combinations of biocompatible carrier agents: maltodextrin–nutrose (resistant dextrin)–pectin (MNPJ) and maltodextrin–nutrose–sodium alginate (MNAJ) and quality attributes, such as biological value, antioxidant potential, physicochemical properties and color parameters, during lyophilization and dark storage (12 months, MNPJ₁₂ and MNAJ₁₂) under ambient conditions. The first two principal components, PC1 and PC2, accounted for 88.0% and 11.5% of the total variance, respectively. It was highlighted that some parameters are closely associated, presenting extremely significant correlations ($p < 0.05$), such as: total soluble solids and hygroscopicity, solubility, oil holding capacity, titratable acidity, fat content ($r = 1.00$); hue angle and red–green component ($r = 0.97$), chroma ($r = 0.94$); pH and luminosity ($r = 0.98$), ash content ($r = 0.94$), moisture content ($r = 0.92$), bulk density and yellow–blue component ($r = 0.99$). PC1 was closely

associated with total soluble solids, oil holding capacity, titratable acidity, hygroscopicity, solubility, fat content, chroma, red-green component, brightness, pH, ash content, while PC2 was closely associated with bulk density, yellow-blue component, moisture content and hue angle. According to the PCA plot, depending on the biopolymer matrix and the storage time of the microparticles, the closest to each other are: MNPJ and MNPJ₁₂, which are located in the center, on the left of the plot, MNAJ and MNAJ₁₂ are also positioned in the center, but on the right of the PCA. Both PCA components distinguish MNPJ and MNPJ₁₂ from MNAJ and MNAJ₁₂, indicating an inverse correlation between microcapsules having different biopolymer matrix. The first component PC1 distinguishes MNPJ, MNPJ₁₂ from MNAJ, MNAJ₁₂, while the second component PC2 distinguishes MNPJ, MNAJ from the microcapsules MNPJ₁₂, MNAJ₁₂. Regarding the correlations of the microcapsules with the analyzed characteristics, it seems that MNPJ and MNPJ₁₂ are rather related to hygroscopicity, solubility, fat content, titratable acidity, oil holding capacity, total soluble solids, moisture content, red-green component, chroma, hue angle; MNAJ and MNAJ₁₂ are related to pH, moisture content, brightness and ash content. The yellow-blue component and bulk density are eliminated from all the analyzed samples. The microencapsulation of jostaberry phytochemicals represents an effective strategy for preserving the antioxidant potential of BACs during processing and storage.

Keywords: principal component analysis, maltodextrin-nutrose (resistant dextrin)-pectin, maltodextrin-nutrose-sodium alginate, jostaberry extract.

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F.12. BIOLOGICAL VALUE OF MICROCAPSULES WITH PHYTOCHEMICALS FROM JOSTABERRY DURING STORAGE

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Abstract. Phytochemicals in the jostaberry hybrid (*Ribes × nidigrolaria*) are characterized by high antioxidant activity (AA). Several studies have shown that the drying and freeze-drying process makes the fruit sticky and difficult to grind into powder, affecting its biological potential. In addition, flavonoids (including anthocyanins), vitamins and pigments also degrade under unfavorable storage conditions. The aim of this study was to improve handling properties and to evaluate the biological value of biopolymer microcapsules enriched with jostaberry bioactive compounds (JMC), during lyophilization and subsequent storage in the dark at ambient temperature (22±1°C, relative humidity ≤ 75%). Jostaberry fruits were extracted with 70% hydroethanolic solution, and the extracts (JE) were concentrated under vacuum to a dry matter content of 19.59%. The JE were mixed with an aqueous solution of maltodextrin (5%) and sodium alginate (2%) in a 1:1 (v:v) ratio. Subsequently, ascorbyl palmitate (0.5%) and refined, deodorized vegetable oil were added under continuous stirring to form an emulsion. Ionic crosslinking was performed using 0.1 M calcium chloride (CaCl₂). The resulting microcapsules were collected, rinsed with distilled water, freeze-dried, and packaged [Patent MD 1864 Z 2026.02.28]. The encapsulation efficiency was 65.67 %. The biological potential of JMC was evaluated by spectrophotometric determination of total polyphenol content (TPC) and by DPPH and ABTS assays in 60% hydroethanolic extracts of JMC pre-swollen in distilled water. Immediately after production, TPC was 16.5 mg GAE/g of JMC, while AA was 7.78 mg TE/g (DPPH) and 55.72 mg TE/g (ABTS). After 3 months, these values remained stable. After 6 months, TPC decreased by 2.7 %, while AA decreased by 4.2% (DPPH) and 2.8% (ABTS). No significant color changes were observed after 6 months; however, a slight rancid odor developed, attributed to oil oxidation. Microstructural analysis of JMC indicating non-adhesive particles. Some surfaces appeared porous due to ice crystal sublimation during lyophilization, which increased the exposure of the

oil phase to air and susceptibility to oxidation. In conclusion, encapsulation of JE in a biopolymer matrix followed by lyophilization effectively preserved its biological value and antioxidant potential during processing and up to 6 months of storage under ambient conditions.

Keywords: antioxidant activity, bioactive compounds, biopolymer, forest fruits, polyphenols.

Acknowledgments: The research was supported by Institutional Project, subprogram 020405 “Optimizing food processing technologies in the context of the circular bioeconomy and climate change”, Bio-OpTehPAS, being implemented at the Technical University of Moldova.

F.13. ADAPTATION OF ACID HYDROLYSIS-SOXHLET EXTRACTION METHOD FOR TOTAL FAT DETERMINATION IN GLUTEN-FREE MUFFINS FORMULATED WITH WAX-BASED OLEOGELS AS BUTTER REPLACERS

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Abstract. The growing use of wax-structured oleogels as solid fat replacers in bakery products creates a methodological gap in routine fat analysis: standard solvent extraction protocols, originally developed for conventional triglyceride-based fats, may yield systematically biased results when applied to wax-containing food matrices. This study evaluated and adapted the acid hydrolysis–Soxhlet extraction method (ISO 11085/AOAC 954.02) for accurate total fat determination in gluten-free muffins in which butter was replaced 100% by wax-based oleogels. Two gluten-free muffin series were investigated: sorghum flour-based muffins formulated with corn oil/sunflower wax oleogels (2, 4, 6, 8, and 10% wax), and buckwheat flour-based muffins with soybean oil/beeswax oleogel (2, 4, 6, 8, and 10% wax), alongside a butter-based control. Fat content was determined using three protocols: direct Soxhlet extraction with petroleum ether (b.p. 40-60 °C); acid hydrolysis (4 N HCl) followed by Soxhlet extraction with petroleum ether (40-60 °C), and acid hydrolysis followed by Soxhlet extraction with n-hexane (b.p. 68-70 °C) on a VELP SER 148 apparatus.

Results demonstrated that petroleum ether (40-60 °C) produced significantly underestimated fat values (up to 3.1-4.8% lower on a dry weight basis) compared to n-hexane extraction, particularly at higher wax concentrations ($\geq 6\%$). This discrepancy is attributed to the incomplete dissolution of wax crystalline networks at the solvent boiling point, which falls below the melting temperature of both sunflower wax (74-77 °C) and beeswax (62-65 °C). Furthermore, sorghum flour matrices required an extended hydrolysis time of 80-90 min due to the resistance of kafirin protein bodies to acid cleavage, whereas standard 60 min hydrolysis was sufficient for buckwheat and control formulations.

The adapted protocol – acid hydrolysis with matrix-specific duration followed by n-hexane extraction – yielded reproducible and complete fat recovery (RSD < 1.8%, recovery 97.2-99.6%). A correction for the wax ester contribution to the crude fat value is proposed for nutritional labelling purposes. These findings establish a validated analytical approach for fat analysis in the emerging category of wax-oleogel bakery products and highlight the critical importance of solvent selection in Soxhlet-based lipid extraction from non-conventional food fat systems.

Keywords: bakery products, buckwheat flour, lipid analysis, kafirin protein bodies, n-hexane, sorghum flour.

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F.14. BIOPROTECTIVE YEASTS AS AN ALTERNATIVE TO SULFITES IN WHITE MUST PRESERVATION

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Abstract. Consumer demand for “low-sulfite” wines requires alternative microbiological preservation strategies. Non-Saccharomyces yeasts (*Metschnikowia pulcherrima* and *Torulaspora delbrueckii*) suppress spoilage organisms through bioprotection (iron chelation, nutrient competition, oxygen depletion) without compromising fermentation. Bioprotective yeasts operate through an elegant ecological principle: inoculated directly into fresh grape must at the pre-fermentation stage, they rapidly colonize the available microbial niche before indigenous spoilage organisms can establish themselves. Operating at low pre-fermentation temperatures (10-16 °C), these non-Saccharomyces yeasts competitively consume fermentable sugars and nutrients, produce inhibitory metabolites, trigger oxygen-dependent stress responses that suppress acetic acid bacteria and lactic acid bacteria, and establish mechanisms of cell-contact inhibition. Essentially, they perform this protective action without initiating alcoholic fermentation - a role reserved for later inoculated *Saccharomyces cerevisiae* strains, which take over once the ethanol concentration exceeds the ethanol tolerance threshold (~5% v/v) of the bioprotectors. This study reports the results of field tests conducted under Moldovan conditions, validating the efficacy of bioprotector yeasts on white grape musts from the Codru region (Glera and Fetească Regală varieties). The results demonstrated a 32–50% reduction in sulfites compared to traditional methods. Volatile acidity levels (0.43–0.44 g/L) remained at approximately 40% of the EU quality threshold, demonstrating the successful suppression of acetic acid bacteria and other spoilage microorganisms during the critical pre-fermentative stage.

Keywords: bioprotection, non-*Saccharomyces* yeasts, *Metschnikowia pulcherrima*, *Torulaspora delbrueckii*, sulfite reduction, white grape must.

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F.15. THE INFLUENCE OF CLIMATE CHANGE ON TRADITIONAL EUROPEAN CUISINE

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Abstract. Climate change is one of the most important challenges of the 21st century, with significant effects on the environment, economy and culture, including the gastronomic heritage of Europe. Traditional European cuisine, known for its diversity and authenticity, is closely linked to local climatic conditions, seasonality and available natural resources. Climate changes, such as increasing temperatures, changing rainfall patterns and the frequency of extreme events, directly influence agricultural production and, implicitly, the basic ingredients of traditional dishes. In Mediterranean regions, for example, drought and high temperatures affect olive, grape and vegetable crops, essential elements for cuisines such as Italian, Greek or Spanish. In Northern and Central Europe, climate change is causing changes in cereal, potato and dairy crops, affecting traditional dishes such as bread, hearty soups or cheeses. Thus, some ingredients become rarer, more expensive or even unavailable at certain times of the year. Another important effect is the change in the agricultural calendar and the seasonality of food. Many traditional recipes are linked to specific seasons or holidays, and climate change disrupts this balance. For example, earlier or

later harvesting of some products can lead to the adaptation or reinterpretation of certain culinary dishes. At the same time, biodiversity is affected, leading to the disappearance of local plant varieties or animal breeds, essential for the authenticity of traditional cuisine. Climate change also influences food production and distribution practices. Farmers are forced to adopt methods that are more resistant to extreme conditions, such as efficient irrigation, drought-resistant crops or modern technologies. These changes can modify the characteristics of ingredients, influencing the taste and quality of dishes. In addition, increasing dependence on imports can reduce the regional specificity of European cuisines. However, the challenges brought by climate change also generate opportunities. Chefs, local producers and communities are rediscovering forgotten traditional ingredients, more resistant to difficult conditions, and promoting sustainable practices. The concept of “slow food” and the emphasis on local and seasonal products are becoming increasingly important in protecting culinary identity. In many European countries, there are initiatives that support organic farming and the conservation of biodiversity, thus contributing to the maintenance of gastronomic traditions.

Keywords: Traditional European cuisine, climate change, gastronomic heritage, essential elements for cuisines, cereal, potato, modern technologies.

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F.16. NUTRITIONAL AND MICRONUTRIENT PROFILING OF A FUNCTIONAL COMPOSITION BASED ON PUMPKIN AND SEA BUCKTHORN POWDERS

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Abstract. This analysis evaluates the nutritional value and micronutrient profile of a functional composition consisting of 1.5 g pumpkin (*Cucurbita* spp.) powder, 1 g sea buckthorn (*Hippophae rhamnoides*) powder, and 1 g of 0.6% pectin gel, with extrapolation to 100 g of product for standardization purposes. The objective of the study is to characterize the contribution of each ingredient to the intake of macronutrients, vitamins, and minerals, as well as to highlight the role of bioactive compounds, particularly provitamin A carotenoids. The results indicate that the product has a low energy value - 8.26 kcal per 3.5 g, being characterized by a low content of proteins - 0.22 g, lipids - 0.245 g and carbohydrates - 1.73 g. The pectin gel contributes insignificantly to caloric intake but provides a functional contribution of dietary fiber, potentially supporting beneficial effects on digestion and lipid metabolism. The micronutrient analysis highlights a profile rich in antioxidant vitamins. Vitamin C is predominant, reaching approximately 123 mg/100 g, due to the high content in sea buckthorn, which is known for its antioxidant and immunostimulatory properties. Vitamin A is present exclusively in the form of carotenoids, with an estimated total of 6.3 mg/100 g. The distribution of fractions indicates the predominance of β -carotene around 75%, followed by α -carotene and β -cryptoxanthin ~10% each. Conversion into retinol equivalents reveals an intake of approximately 446 μ g RAE/100 g, suggesting a significant contribution to the daily requirement of vitamin A. Vitamin E is present in a moderate amount approximately 1.4 mg/100 g, further contributing to the antioxidant capacity of the product. Regarding minerals, potassium is the dominant element around 360 mg/100 g, playing an essential role in regulating electrolyte balance and muscle function. Calcium (~31 mg/100 g) and iron (~1.3 mg/100 g) are present in moderate amounts, contributing to bone health and hematopoietic processes. Other identified minerals include magnesium (25–35 mg), phosphorus (50–70 mg), zinc (0.5–0.8 mg), sodium (5–15 mg), and copper (0.2–0.4 mg), which support various metabolic and enzymatic functions. The nutritional profile of the composition is dominated by bioactive compounds of plant origin, particularly carotenoids and vitamin C, suggesting a high antioxidant potential. Although the caloric and macronutrient intake is low, the micronutrient density is relevant, especially in the context of using the product as a dietary supplement or functional ingredient. In conclusion, the combination of pumpkin powder and sea

buckthorn powder, stabilized with pectin gel, results in a product with low energy value but rich in antioxidant vitamins and essential minerals. The predominance of provitamin A carotenoids and high vitamin C content confers a beneficial potential for supporting immunity and oxidative protection. This type of formulation can be utilized in the development of functional foods or health-oriented dietary supplements.

Keywords: provitamin A carotenoids, pumpkin (*Cucurbita* spp.), sea buckthorn (*Hippophae rhamnoides*), functional composition, nutritional profile.

Acknowledgments: The research was supported by Institutional Project, subprogram 020405 “Optimizing food processing technologies in the context of the circular bioeconomy and climate change”, Bio-OpTehPAS, being implemented at the Technical University of Moldova.

F.17. IN VITRO ANTIOXIDANT ACTIVITY OF LIPOSOMAL GRAPE POMACE EXTRACTS

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Abstract. This study investigates the antioxidant activity of liposomal formulations containing hydrophilic extracts obtained from grape pomace under simulated gastrointestinal conditions. Grape pomace represents a valuable by-product of the wine industry, rich in polyphenolic compounds with well-documented antioxidant properties. However, the stability and bioaccessibility of these compounds may be affected during digestion, necessitating the development of effective delivery systems such as liposomal encapsulation.

Liposomal formulations were prepared using polyphenol-rich grape pomace extracts and evaluated in comparison with their non-encapsulated counterparts. The antioxidant activity was assessed using the DPPH radical scavenging method during simulated gastric digestion (pH 1.8 ± 0.1) and intestinal digestion (pH 8.2 ± 0.1) over 2 h.

The results demonstrated that, during the gastric phase, all samples exhibited a progressive increase in antioxidant activity. Liposomal formulations showed a higher initial antioxidant activity ($90.6 \pm 1.8\%$ DPPH inhibition) compared to non-encapsulated extracts ($88.11 \pm 1.5\%$), increasing after 2 h to ($91.2 \pm 2.1\%$) and ($90.48 \pm 1.9\%$), respectively. These findings indicate that liposomal encapsulation enhances the stability of polyphenolic compounds in acidic conditions and protects them against degradation.

In contrast, during the intestinal phase, a decrease in antioxidant activity was observed for all samples. The antioxidant activity of liposomal extracts decreased from ($27.3 \pm 0.8\%$) to ($21.1 \pm 0.8\%$ DPPH inhibition) after 2 h, while non-encapsulated extracts showed higher retention, decreasing from ($33.1 \pm 0.8\%$) to ($29.00 \pm 0.7\%$). This behavior suggests that liposomal structures may undergo destabilization in alkaline conditions, leading to the release and partial degradation of encapsulated compounds.

This study demonstrates that liposomal encapsulation improves the stability and antioxidant activity of grape pomace extracts under gastric conditions, while further optimization is required to enhance their performance during intestinal digestion. These findings highlight the potential of liposomal systems for the valorization of agro-industrial by-products and the development of functional food ingredients with improved bioactive compound delivery.

Keywords: Grape pomace; liposomes; antioxidants; digestion; polyphenols.

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F.18. FERMENTED PSEUDOCEREALS AS A PROMISING MATRIX FOR FUNCTIONAL PLANT-BASED DAIRY ALTERNATIVES

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Abstract. The growing demand for plant-based foods has intensified research into sustainable and nutritionally enhanced alternatives to traditional dairy products. Fermented pseudocereals represent a particularly promising substrate due to their balanced amino acid profile, absence of gluten, and high content of bioactive compounds. Recent scientific evidence highlights that fermentation significantly improves protein digestibility, reduces antinutritional factors, and enhances the bioavailability of minerals and phenolic compounds, thus increasing the functional value of plant-based matrices.

This study evaluates the potential of selected pseudocereals and legumes – specifically amaranth (*Amaranthus spp.*), green buckwheat (*Fagopyrum esculentum*), and beans (*Phaseolus vulgaris*) – as raw materials for the development of fermented functional foods. Comparative analysis shows that amaranth has a high protein content (17-20%) and a favorable lysine profile. Green buckwheat is characterized by its high levels of flavonoids, especially rutin, which contribute to its strong antioxidant capacity. Beans provide additional protein (21-24%) and dietary fiber, and their fermentation reduces oligosaccharides and improves sensory acceptability. Fermentation also results in measurable improvements in physicochemical and nutritional properties across all matrices, including decreases in pH, increased soluble protein fractions, and enhanced antioxidant activity.

The fermentation process was conducted using a mixed culture of lactic acid bacteria, including *Lactobacillus plantarum* and *Lactobacillus casei*, applied at a target level of approximately 10^7 CFU/g of substrate. The inoculation strategy and bacterial reactivation protocol were optimized to ensure effective fermentation and metabolic activity. The use of a bacterial consortium enabled synergistic effects, including improved acidification kinetics and flavor development.

The results demonstrate that fermented pseudocereal-based matrices have significant potential for formulating plant-based dairy alternatives, such as yogurt-type products, fermented beverages, and spreadable analogues. These products combine enhanced nutritional value with desirable sensory properties, supporting their application in functional food development and contributing to sustainable dietary transitions.

Keywords: bioactive compounds, lactic fermentation, protein digestibility, pseudograins, non-dairy alternatives.

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F.19. COMPARATIVE STUDY OF THE TECHNOLOGICAL QUALITY OF PASTA OBTAINED USING TRITICALE FLOUR, BLONDE AND DARK FERMENTED BREWER'S SPENT GRAIN

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Abstract. The aim of this study was to analyze the influence of two types of brewer's spent grain (BSG) in a fermented form on pasta quality obtained from different triticale varieties cultivated in the Republic of Moldova. Triticale grains provided by the Institute of Genetics, Physiology and Plant Protection, Moldova (harvest 2023) were Ingen 35, Ingen 33, Ingen 93, Ingen 54, Ingen 40, Costel and Fanica. According to their chemical characteristics (moisture, ash, protein, wet gluten, fat content) all of them may be used for pasta-making. BSG obtained from dark (BSGD) and blonde (BSGB) lager beer brewing process, received from the Efes Moldova Brewery S.A., Chisinau, Moldova was dried up to a $6.3 \pm 0.1\%$ humidity value, milled and mixed with triticale flour in a 3:1 (w/w) ratio. A dough with a fluid consistency was obtained by adding water to this mixture, which was fermented at 30 ± 1 °C and refreshed with new portions of mixture until a final acidity of 8–10 degrees was reached. The fermented liquid doughs from dark and blonde brewer's spent grain were incorporated in 10% addition in triticale flour to prepare dough for pasta. The 14 rigatoni pasta samples obtained were analyzed. Water absorption (WA), optimal cooking time (OCT), swelling index (SI) and cooking loss (CL) were determined according to AACC 66–50 International Approved Method. The fracturability test was determined using the TVT-6700 texture analyzer (Perten Instruments, Hagersten, Sweden), whereas the sensory analysis was made using a nine-point hedonic scale (1 = “dislike extremely” to 9 = “like extremely”) to evaluate color, smell, taste, aroma, texture, and overall acceptability of each pasta sample. According to the data obtained OCT and SI values decreased by BSG addition whereas the values of WA and CL increased. Generally, the lowest values for OCT and SI were obtained for pasta with BSGD addition (ranged between 11.25-13 min and 1.57-1.83 respectively) whereas the highest values for WA and CL (ranged between 112.72-144.51% and 0.19-0.23% respectively) for pasta with BSGB incorporated in triticale flour. It may be concluded that the incorporation of BSG into triticale pasta significantly affected its cooking behavior probably due to the fact that fibers from BSG disrupted the gluten-starch matrix, resulting in faster cooking, reduced swelling, higher water absorption, and higher cooking loss values. The extent of these effects depended on the type of BSG used, with BSGD having the highest influence on cooking time and swelling, and BSGB on water absorption and cooking loss. Also, the pasta fracturability depended on the type of BSG. Generally, the BSGB decreased fracturability, whereas the BSGD increased pasta fracturability, probably due to insoluble fibers and roasted particles which may reinforce its structure. However, for some triticale varieties such as Ingen 33, Ingen 40 pasta fracturability decreased even when BSGD were incorporated in pasta-making. From the sensory point of view, pasta samples obtained with the addition of BSGD were appreciated with a higher score than pasta prepared with BSGB, which can be explained by the higher content of melanoidins from BSGD, that had a positive influence on the color, aroma and global acceptability of the pasta.

Keywords: triticale varieties, brewer's spent grain, pasta quality.

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F.20. RESEARCH ON DETERMINING THE QUALITATIVE PROPERTIES OF MEAT SNACKS WITH VEGETABLE ADDITIONS

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Abstract. The incorporation of fruit-processing by-products into meat product technology represents an innovative strategy for developing foods with added nutritional value and for the sustainable utilization of agri-food resources. Sea buckthorn (*Hippophae rhamnoides* L.) pomace, rich in carotenoids, organic acids, dietary fiber, and polyphenolic compounds with antioxidant

activity, constitutes a by-product with high potential for integration into meat processing technology. The aim of this study was to evaluate the effect of sea buckthorn pomace powder (SBPP) at concentrations of 0.75%, 1.25%, and 2.5% (w/w) on the physicochemical parameters and microbiological safety of fermented-dehydrated chicken meat snacks, in comparison with the control sample (CS). The products were fermented at $25 \pm 1^\circ\text{C}$ for 12 hours and dehydrated at $50 \pm 5^\circ\text{C}$ for 6 hours, after which they were subjected to analyses in accordance with ISO and AOAC standards. The results revealed significant changes in physicochemical indicators as a function of SBPP concentration. Moisture content decreased from 15.79% in the control sample to 7.93% in the sample with 2.5% SBPP, an effect attributed to the high dietary fiber content of the pomace, which promotes water removal during dehydration. Water activity (a_w) decreased from 0.455 to 0.358, indicating enhanced microbiological stability and effective inhibition of microbial growth – values consistent with those reported in the literature for low-moisture meat products. The absence of coliforms, moulds, yeasts, and *Salmonella* spp. across all samples confirmed the microbiological safety of the products obtained. Ash content increased slightly, from 8.36% to 9.09%, reflecting the mineral contribution of SBPP, which is rich in potassium, calcium, magnesium, and iron. Fat content showed an increase from 12.96% to 15.52%, associated with the presence of residual lipids in the pomace, including unsaturated fatty acids. Protein content remained relatively stable (58.31–61.75%), indicating that SBPP incorporation did not significantly affect the protein fraction of the meat snacks. pH values decreased from 6.16 to 5.65, reflecting the moderate acidifying effect of the natural organic acids present in sea buckthorn (citric, malic, and quinic acids), which favorably contributes to the microbiological stability of the final product. The peroxide value (1.60–1.70 meq O_2/kg) remained constant across all substitution levels, suggesting that SBPP did not promote lipid oxidation and exerted a protective antioxidant effect through its bioactive constituents. Color parameter analysis revealed a progressive shift from orange to light brown with increasing SBPP concentration. The findings demonstrate that sea buckthorn pomace powder can be employed as a clean-label functional ingredient to improve the storage stability, nutritional profile, and physicochemical characteristics of meat snacks. The valorization of this agri-food by-product in technological formulations represents a sustainable solution with concrete potential for industrial implementation within the framework of the circular economy.

Keywords: antioxidant activity; bioactive compounds; circular economy; food safety; pomace; sustainable valorization.

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F.21. THE PREDISPOSITION OF ORANGE WINES TO THE PINKING TEST

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Abstract. Oxygen, both in the atmosphere and dissolved in wine, has the ability to cause oxidative reactions in the phenolic compounds and proteins present in wine. This oxidation is not a benign process; on the contrary, it can compromise the stability of proteins, leading to their denaturation. As a result of these structural changes, protein breakdown can occur, forming cloudiness and precipitates in the wine. The oxidation of wines can lead to the phenomenon of pinkening, which gives Orange wine a pink hue instead of the amber tones characteristic of this type of wine. This may be due to the characteristics of the grape variety, production conditions such as temperature, contact time with the skins, the presence of oxygen, or other factors that affect oxidation and pigmentation. In his work, we researched Orange wines produced from Viorica and Rkațiteli grape varieties, focusing on the evolution of the long maceration process. To assess their susceptibility to pinkening, Orange wine samples were subjected to the Pinking test every month of maceration. The Pinking test is a complementary method for checking the susceptibility of wine to oxidation.

The spectrophotometric study of Orange wines with H₂O₂ in the Pinking test was performed at wavelengths between 400 and 700 nm. This approach allows for a more detailed highlighting of the chromatic changes that occur as a result of the oxidation process.

In the case of Orange wines made from the Viorica grape variety, the difference in absorption between the control samples and the treated samples gradually decreases as the maceration period is extended. In the first two months of maceration, a slight predisposition to pinking is still observed, but the values are still lower than the established limit. Thus, Orange wines after 1, 2, 3, 4, and 5 months of maceration show minor changes after oxidation, indicating superior chromatic stability and reduced susceptibility to pinkish discoloration. This effect may be due to the higher content of tannins and other antioxidant phenolic compounds extracted from the skin, which can act as inhibitors of the oxidative processes responsible for the appearance of pink hues. The absorption spectra recorded in the 400–700 nm range for the Rkațiteli wine samples, both control (untreated) and treated with H₂O₂, show significant changes in absorption, especially in the 400–500 nm range, indicative of oxidation reactions of phenolic compounds.

The results of the study confirm that prolonged maceration can contribute to increasing the oxidative and chromatic stability of Orange wines, reducing their susceptibility to the Pinking phenomenon. Thus, controlling the maceration duration represents an important technological factor in optimizing the quality and stability of these types of wines.

Keywords: Orange wines, grapes, pinkening phenomenon, oxidation, Pinking.

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F.22. TESTING THE ANTIRADICAL POTENTIAL AND ANTIOXIDANT STABILITY OF WHITE WINES FROM LOCAL GRAPES VARIETIES

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Abstract. Determining the antioxidant capacity of white wines makes it possible to estimate the wine's ability to resist oxidative processes over time, its shelf life, and also provides general information about the wine's physiological value for the consumer. The study included white wines made from the traditional Feteasca Albă and Feteasca Regală grape varieties, produced both through small-scale winemaking at the Department of Oenology and Chemistry (DOC) at UTM and through industrial production, as well as wines made from the newly selected Viorica, Riton, and Legenda grape varieties (with and without a 2-hour maceration). The antioxidant potential of the wines was assessed using various tests—DPPH and POM—which were compared with the total phenolic content and the content of various groups of phenolic compounds. To identify the substances responsible for the DPPH (diphenyl-p-pyrocatechol) and total antioxidant (POM test) activity, a combined method was applied: the DPPH test was performed on native wines as well as after their oxidation during the POM test. The influence of certain conditions on the results of the POM test was highlighted: temperature, heating time, the concentration of the oxidizing agent H₂O₂, and the concentration of Fe²⁺ ions—effective catalysts for the generation of OH and HO₂ radicals from H₂O₂. In the range of Fe²⁺ ion additions at concentrations of 0.5–5 mg/L, a strict dependence on the degree of wine browning was observed (A₄₂₀, R² = 0.968). It has been demonstrated that the pH of the wine does not affect the POM residue results. Pre-treatment with PVPP, undertaken to stabilize or correct the composition of wines, results in lower final POM test values. For Viorica wine, the addition of SO₂ in concentrations of 15–60 mg/L did not significantly alter the results of the antioxidant potential assessment. Some wines with similar levels of total cinnamic acids (Feteasca Albă, 20.9 mg/L caffeic acid equivalent, and Feteasca Regală DOC, 22.2 mg/L) show completely different results for both DPPH and H₂O₂: for FA, 16.3% and 436.8% (DPPH and POM, respectively), and for FR DOC, 81.5% and 194.4%, respectively. Otherwise, for the remaining wines, satisfactory correlations were observed between the total content of cinnamic phenolic substances (CPC) and DPPH (R² = 0.988), TPC

and POM ($R^2 = 0.9763$), DPPH and POM ($R^2 = 0.9552$), CPC and POM+DPPH ($R^2 = 0.9836$), and DPPH and POM+DPPH ($R^2 = 0.9652$). There is virtually no correlation between DPPH, POM, and POM+DPPH, on the one hand, and the Total Polyphenol Index (TPI) and total phenolic content (TPC) determined by the Folin-Ciocalteu method, on the other. This indicates a strong influence of certain individual substances on the ability to scavenge DPPH free radicals and to oxidize in the presence of H_2O_2 at temperature.

Keywords: white wines, oxidation, cinnamates, polyphenols, IPT, DPPH, POM test.

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F.23. EATING BEHAVIOR PROFILES, PHYSICAL ACTIVITY, AND SELF-PERCEIVED HEALTH DURING THE COVID-19 PANDEMIC: A CROSS-SECTIONAL STUDY OF STUDENTS AND ACADEMIC STAFF AT THE TECHNICAL UNIVERSITY OF MOLDOVA

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Abstract. The COVID-19 pandemic created conditions conducive to maladaptive eating behavior, physical inactivity, and psychological distress, particularly among university populations. Yet Eastern European contexts remain substantially underrepresented in the relevant literature, and no prior study has examined appetitive traits in a Romanian-speaking population using the Adult Eating Behavior Questionnaire (AEBQ). The present cross-sectional study characterizes eating behavior profiles, physical activity levels, and self-perceived health among students and academic staff of the Technical University of Moldova (TUM), and identifies independent predictors of emotional over-eating during the pandemic period. Data were collected between October and November 2021 via two parallel bilingual online questionnaires administered to 744 TUM-affiliated participants — 623 students (83.7%; 362 males, 261 females; 83.6% aged 18–23 years) and 121 academic staff members (16.3%; 42 males, 79 females; modal age group 41–50 years). Four measurement blocks were administered: demographics and COVID-19 history; physical activity, assessed via an adapted version of the Global Physical Activity Questionnaire (GPAQ) and classified according to World Health Organization (WHO) criteria using metabolic equivalent of task (MET) minutes per week; self-perceived health, adapted from the 36-Item Short Form Survey (SF-36); and eating behavior, measured using the full 35-item AEBQ across eight subscales — Enjoyment of Food (EF), Emotional Over-Eating (EOE), Emotional Under-Eating (EUE), Food Fussiness (FF), Food Responsiveness (FR), Slowness in Eating (SE), Hunger (H), and Satiety Responsiveness (SR). Statistical analyses included Mann-Whitney U tests, Kruskal-Wallis tests, Spearman correlations, and ordinary least squares (OLS) multiple and binary logistic regression, with Bonferroni correction applied to multiple comparisons. Internal consistency was adequate to excellent for EOE and EUE (Cronbach alpha = 0.905 and 0.899 in students, respectively), meeting reference values from the original validation. EF and H met the acceptability threshold of 0.70 in both cohorts, while FF, FR, and SR fell below it — a pattern consistent with prior cross-cultural adaptations in Mexican and Chinese samples. The SE subscale yielded systematically negative alpha values across all subgroups (students: alpha = -0.242; male staff: alpha = -0.612), indicating active item conflict and necessitating its exclusion from all inferential analyses. This constitutes the first documented failure of the SE subscale in a Romanian-speaking population and implies that cross-cultural revision is required prior to future use. EF was the highest-rated subscale in both cohorts, with food-avoidance and hunger-related subscales clustered in the lower-moderate range, suggesting that the pandemic context did not broadly dysregulate appetitive behavior in this population. Students scored significantly higher on EF than staff ($p < 0.001$, effect size $r = 0.213$), while staff reported higher EOE ($p = 0.003$, $r = 0.110$) and SR ($p = 0.006$, $r = 0.103$). Among students, female

participants scored significantly higher than males on EOE, EUE, H, and SR after Bonferroni correction, with uniformly small effect sizes ($r = 0.186\text{--}0.264$). Confirmed COVID-19 history was associated with elevated Hunger scores only among students (Kruskal-Wallis $H = 12.60$, $p = 0.002$, $\eta^2 = 0.018$). Physical activity showed a consistent inverse association with EOE across both continuous (Spearman $\rho = -0.175$, $p < 0.001$) and categorical analyses. Mental health score was the strongest inverse predictor of EOE (Spearman $\rho = -0.213$, $p < 0.001$) and H ($\rho = -0.317$, $p < 0.001$). OLS regression identified female gender ($\beta = 0.341$, $p < 0.001$), staff cohort membership ($\beta = 0.378$, $p < 0.001$), lower mental health score ($\beta = -0.185$, $p < 0.001$), higher EF ($\beta = 0.244$, $p < 0.001$), and lower EUE ($\beta = -0.150$, $p < 0.001$) as independent predictors of EOE ($R^2 = 0.165$). Binary logistic regression confirmed that female gender was associated with over three-fold higher odds of clinically elevated EOE (odds ratio = 3.42, 95% confidence interval: 2.04–5.72, $p < 0.001$), while better mental health (odds ratio = 0.693, $p = 0.003$) and better self-perceived health (odds ratio = 0.736, $p = 0.017$) were protective. These findings identify female academic staff with poor psychological well-being as a priority target group for integrated nutritional and mental health interventions within university occupational health programs. The study provides the first cross-cultural psychometric evaluation of the AEBQ in a Romanian-speaking Eastern European population, documenting both its strengths for emotional eating measurement and the need for subscale revision prior to broader application.

Keywords: Adult Eating Behavior Questionnaire; emotional over-eating; COVID-19; university population; physical activity; psychometric validation.

Acknowledgments: The research was supported by Institutional Project, subprogram 020405 “Optimizing food processing technologies in the context of the circular bioeconomy and climate change”, Bio-OpTehPAS, being implemented at the Technical University of Moldova.

F.24. CULTURAL FOOD IDENTITY, PLACE ATTACHMENT, AND SUSTAINABLE TOURISM SUPPORT: A CROSS-SECTIONAL ATTITUDINAL STUDY IN THE REPUBLIC OF MOLDOVA

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Abstract. Resident support constitutes a structural prerequisite for long-term tourism destination viability, yet the cultural and psychological determinants of this support remain poorly documented in post-Soviet, transitional-economy contexts. The Republic of Moldova — a country that has strategically invested in gastronomic heritage and wine routes as pillars of tourism development — has received no prior quantitative attention in the resident attitudes literature. This cross-sectional survey study addresses this gap by examining the attitudinal predictors of sustainable tourism support among urban Moldovan residents, with particular focus on cultural food identity, place attachment, pro-environmental worldview, and digital technology attitudes. Data were collected between April and November 2025 via a bilingual (Romanian and Russian) online questionnaire administered to adult residents of Moldova. A total of 182 valid responses were obtained (115 females, 63.2%; predominance of the 18–24 age cohort, 56.0%). Six psychometric instruments were administered comprising 48 Likert-type items rated on a seven-point scale. These instruments measured: (1) the Food Involvement Scale (FIS; 12 items), capturing personal relevance attributed to food purchasing and preparation; (2) the Traditional Products Attitudes scale (TPA; 12 items), a study-developed instrument assessing cultural identification with traditional food products, perceived quality, and trust in local producers; (3) the Place Attachment Scale (PAS; 6 items), operationalizing place identity and place dependence; (4) the Sustainable Tourism Attitude Scale (STAS; 6 items), measuring endorsement of responsible tourism development; (5) the New Ecological Paradigm scale (NEP; 6 adapted items), assessing pro-environmental worldview; and (6) the Digital Technology Attitudes scale (TECH;

6 purpose-built items), examining openness to digital and mobile platforms for heritage promotion. Open-ended responses regarding traditional product identification were analyzed via tokenization and diacritic normalization. Four scales demonstrated good to excellent internal consistency (Cronbach alpha ranging from 0.862 to 0.909). NEP and TECH showed suboptimal reliability ($\alpha = 0.523$ and 0.574 , respectively), necessitating cautious interpretation. Mean scores were highest for STAS ($M = 6.39$, $SD = 0.92$) and PAS ($M = 5.86$, $SD = 1.24$), indicating near-universal endorsement of sustainable tourism and strong place attachment. Bivariate analysis with Bonferroni correction ($k = 15$ comparisons) revealed a densely interconnected cluster comprising TPA, PAS, FIS, and STAS, with the TPA–PAS correlation ($r = 0.647$) being the strongest in the dataset. NEP showed no significant association with food or place constructs, yet was positively correlated with STAS ($r = 0.285$), indicating a structurally independent ecological pathway to tourism support. Multiple linear regression ($N = 159$ complete cases; $R^2 = 0.500$; $F(7, 151) = 21.54$, $p < 0.001$) identified TPA as the dominant independent predictor of sustainable tourism support (standardized $\beta = 0.439$, $p < 0.001$), followed by PAS ($\beta = 0.215$, $p = 0.008$), TECH ($\beta = 0.153$, $p = 0.008$), and NEP ($\beta = 0.144$, $p = 0.011$). FIS was non-significant once cultural food identity was controlled ($\beta = -0.003$, $p = 0.967$). Gender and age did not independently predict STAS. Content analysis of open-ended responses identified a compact consensual culinary canon anchored by sarmale (stuffed cabbage rolls; 38.5%), mamaliga (cornmeal porridge; 33.0%), and placinte (filled pastries; 22.0%), with a sharp frequency drop beyond the fifth-ranked product. These findings provide the first quantitative evidence that cultural food identity and place attachment constitute the primary attitudinal infrastructure for sustainable tourism support in a post-Soviet context, with pro-environmental worldview and digital technology openness constituting structurally independent, additive motivational pathways. Destination management strategies anchored in gastronomic heritage are likely to generate stronger and more durable resident support than economically framed arguments. Future research should employ probability-based sampling, structural equation modeling to formally test mediation pathways, and psychometrically refined versions of the NEP and TECH instruments.

Keywords: sustainable tourism attitudes; cultural food identity; place attachment; New Ecological Paradigm; digital heritage promotion; Republic of Moldova.

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F.25. PHTHALATE CONTAMINATION IN ENVIRONMENTAL MATRICES AND EFFICIENT REMOVAL USING METAL OXIDE–FUNCTIONALIZED APPLE WASTE BIOCHAR

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Abstract. The aim of the present study was to evaluate the contamination of environmental matrices - water, agricultural soil and grapes - with plasticizer residues, as well as to analyze the sorption process of phthalate residues from aqueous solutions on biochar derived from apple waste. The capacity of pollutant removal by sorption processes on biochar can be improved by activation processes, thus the biochar was functionalized with metal oxides (Fe_3O_4 and NiO). The synthesis of biochar-based nanocomposites allows combining the advantages of biochar with those of nanomaterials. The resulting composites present significant improvements in terms of surface functional groups, pore structure, surface active sites, catalytic degradation capacity and

degree of separation. Studies have shown that DBP and DEHP are the phthalate residues most frequently detected in the environmental samples considered. Although the water from Chisinau city sources is generally not problematic, significant residual concentrations of phthalates were detected in some vineyard soils, attributed to agricultural practices and treatments. Analysis of grapes from various plantations during the harvest period confirmed the presence of these residues. In order to prevent contamination of the food chain, it is essential to develop efficient sorbents capable of reducing the cumulative effects of exposure to environmental residues on human health. The adsorption behavior of DBP and DEHP on the developed biochar differs considerably due to the specific molecular properties of each compound: water solubility (11.2 mg/L for DBP and 0.003 mg/L for DEHP), molecular dimensions (length/width: 1.265/1.229 nm for DBP and 1.388/1.032 nm for DEHP), octanol-water partition complexation and hydrophobic interactions. DBP was predominantly adsorbed, probably due to steric factors and the compact structure of the DBP molecule. This observation is consistent with the L-shaped adsorption isotherms, which indicate that the molecules are arranged parallel to the biochar surface. The results of the study demonstrate that the nanometal oxide-biochar composites combine the distinct advantages of biochar and nanometal oxides, demonstrating considerable potential as adsorbents.

Keywords: water, pollutants, residual phthalates, nanometal oxides.

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F.26. DIFFERENTIAL IMPACT OF SULFUR DIOXIDE ON PHENOLIC EXTRACTION AND STABILITY IN LOCAL RED WINES UNDER VARIABLE CONDITIONS

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Abstract. Sulfur dioxide (SO₂) is widely used in red winemaking due to its antioxidant and antimicrobial properties, with a direct impact on phenolic extraction, oxidation control and color stabilization. The efficiency of SO₂ depends on variety specific phenolic potential and technological conditions, particularly temperature. Rară Neagră and Fetească Neagră varieties exhibit distinct phenolic profiles, which may respond differently to sulfiting strategies. This study aims to quantify the influence of SO₂ on chromatic parameters. Experimental variants included wines from Rară Neagră and Fetească Neagră obtained under two conditions: spontaneous and controlled (25 °C) temperature, with and without SO₂ addition. Spectrophotometric measurements led to color intensity (Ic) and hue (Hc) calculation, as well as percentage of red, yellow and blue color.

Color intensity showed a consistent increase in the presence of SO₂, with cultivar- and condition-specific responses. In Rară Neagră wines, SO₂ addition led to an increase in color intensity up to 7% under laboratory conditions and up to 10% at 25°C. This enhancement was primarily driven by a significant increase in absorbance at 520 nm (anthocyanin fraction), which rose by 20% at 25°C, indicating improved extraction and protection against oxidation. In Fetească Neagră wines, the effect of SO₂ was more variable. Under laboratory conditions, color intensity increased with 12%, with a 10% increase in anthocyanin-related absorbance. However, at 25°C, the increase in overall color intensity was up to 2%, while the absorbance at 520 nm decreased by 7%, suggesting partial degradation or altered equilibrium between free and polymerized anthocyanins under these conditions. Regarding both varieties, SO₂ contributed to enhanced absorbance at 420 nm (yellow-brown fraction), with increases ranging between 6% and 18%, which confirms the stabilizing role of SO₂ against oxidative browning. Variations at 620 nm (blue fraction) were less consistent, indicating a limited impact on polymeric pigment formation in early stages. These findings support the hypothesis that SO₂ acts not only as a protective agent but also as a modulator of

phenolic equilibrium. Optimizing SO₂ dosage according to cultivar and temperature conditions is essential for maximizing phenolic quality while minimizing chemical inputs, particularly in the context of sustainable red wine production.

Keywords: antioxidant, anthocyanins, phenolic compounds, wine.

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F.27. MIXING AND PASTING BEHAVIOR OF WHEAT DOUGH WITH SALT AND SALT SUBSTITUTE ANALYZED BY MIXOLAB DEVICE

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Abstract. Nowadays the sodium reduction in bakery products is of a high interest due to the fact that the World Health Organization (WHO) recommends a daily sodium consumption of a maximum of 2 g/day sodium equivalent to 5 g/day of sodium chloride, a consumption that is much higher today. Due to the fact that bread is one of the main sources of salt in the world many countries are trying to reduce the sodium content from populations consumption by reducing it from bread products. In bakery products, sodium chloride is a raw material that influences all the stages of the technological process for bread-making. Sodium chloride replacement with other types of salts should be carefully analyzed since it impact on bread technological characteristics is significant. The aim of this study was to analyze the impact of a salt (SS) with a less sodium content < 100 mg which contains KCl and rice flour and to compare its effect with NaCl addition in wheat flour. The salt with a less sodium content was produced by NuTek Natural Ingredients with a commercial name SFL 100 RF G3 for a healthier nutrition balance with the same functionality as regular salt. To analyze the impact of SS and NaCl in different additions levels (0, 0.4, 0.8, 1.2 and 1.6%) in wheat flour on dough behaviour during mixing and pasting a Mixolab device was used. The following parameters were recorded according to ICC No. 173 standard method: water absorption (WA), dough development time (DDT), dough stability (ST) and torques during mixing and heating C1-C5. According to the data obtained water absorption value have been reduced for both types of salt used in dough recipe with 2.96% for NaCl and 1.57% for SS. The dough stability increased with 77.2% for NaCl and 27.2% for SS whereas dough development time had increased with 61.7% for NaCl and 9.87% for SS which indicates that dough become stronger as both types of salts are added in dough recipe. Mixolab torques during heating C2 and C3 had decreased for both types of salt addition in wheat flour whereas the C4 and C5 increased. According to the data obtained both types of salts had a similar effect on dough behaviour during mixing and heating which indicates that from technological point of view SS salt may successfully replace NaCl in bread-making.

Keywords: Mixolab, sodium chloride, potassium chloride, dough rheological behavior.

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F.28. PRODUCTION OF RAW DISTILLATES WITH INCREASED AROMATIC QUALITIES THROUGH THE UNITARY DISTILLATION PROCESS

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Abstract. The classic process of making wine distillates, used as mandatory in the manufacture of the famous aged distilled wine beverages "Cognac", provides for alcoholic fermentation of grape wine, optional partial separation of them from the liquid yeast precipitate and periodic "double" fractional distillation of raw wine in special installations, with the receipt, at the first distillation - of the primary distillate with a strength between 28-32% vol., and the alcohol-free residue - vinasse, which is removed from the "cognac" manufacturing cycle. The primary distillate is subjected to fractional redistillation (at the same or other installations) with the separation of the "head" fraction (at the beginning of the process), the "tail" fraction (at the end of the process) and the wine distillate with an alcoholic strength of 62-70% vol., which is the basic raw material, after aging in oak barrels, "Cognac" is produced. The process developed under the conditions of the micro-wine section of the Department of Oenology and Chemistry provides an unitary distillation of the raw material wines, the addition of vinasse before pre-heating and maintaining the heated wines, followed by their distillation in continuous flow in a vertical column installation. This process ensures an initial alcoholic concentration of 9 – 11% vol. and a pH of 3.0-3.5, which improves the quality of wine distillates.

Physico-chemical characteristics	Parameter values through the procedure		Admissibility norm according to CS "Divin"
	classic	innovative	
Alcoholic strength, % vol.	69,3	68,5	62-72
Volatile substances, total, g/dm ³ a. a.	6,30	8,34	
Summary concentration of higher alcohols, g/dm ³ a. a.	3,52	4,12	1,8-5,0
2-phenylethanol concentration, g/dm ³ a. a.	0,082	0,141	
Aldehyde concentration, total, g/dm ³ a.a., including acetic propionic	0,213 0,158 0,055	0,279 0,186 0,093	0,03-0,50
Ethyl acetal concentration, g/dm ³ a.a.	0,062	0,105	
Volatile acid concentration, g/dm ³ a.a.	0,335	0,565	0,02- 0,80
Methyl alcohol concentration, g/dm ³ a.a.	0,65	1,05	Max. 1,5
Furfurol concentration, g/dm ³ a.a.	0,019	0,024	Max. 0,03
Organoleptic assessment, points	76	79	

This positive effect is presented through an organoleptic improvement (enriched with aromatic substances), with a stable style (organoleptic indices) and composition (physico-chemical indices), as a result of enriching the raw material wine, before preheating, with substances, potentially forming aromatic compounds from the vinasse, as well as creating optimal conditions and composition for the formation of new volatile substances and for their fractionation and the volatile substances existing in the raw material wine.

Keywords: raw wine, unitary technological distillation, aromatic compounds of vinasse.

Acknowledgments: The research was supported by Institutional Project, subprogram 02.04.05 Optimizing food processing technologies in the context of the circular bioeconomy and climate change, Bio-OpTehPAS, being implemented at the Technical University of Moldova.

F.29. UTILIZATION OF RED GRAPE POMACE EXTRACT IN THE PRODUCTION A FERMENTED FUNCTIONAL BEVERAGE WITH HIGH BAS CONTENT

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Abstract. The promotion of a healthy lifestyle has led in recent years to an explosive growth in consumer interest in functional products with beneficial health effects. As a result, researchers and manufacturers in the food industry are trying to make the most of the bioactive compounds in these products and diversify their food ranges.

The objective of this study is to produce a functional fermented beverage using anthocyanin extract from red grapes. The elucidation of the principles of anthocyanin extract incorporation and its impact on the chemical, physicochemical, and microbiological transformations of the resulting functional product was studied. Under laboratory conditions at the Department of Oenology and Chemistry, 2 samples of functional fermented beverage with the addition of red grape extract in 5 % proportions were developed. The study samples were examined at the level of physico-chemical and specific indices regarding the content of biologically active substances within the Oenological Research Center/Department of Oenology and Chemistry.

Table 1. Colorimetric indices of samples.

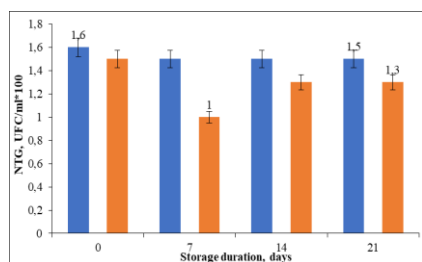


Figure 1. Dynamics of the UFC microbiological test in experimental samples

Figure 1 shows that the fermented beverage had a high level of microbiological contamination, between 100 - 160 CFU/ml, this level, according to the requirements of R.E.2073/2005, is in the limits between 100 and 1000 CFU/ml of non pasteurized fermented beverage.

The values of the color indices L^* , a^* , and b^* included in Figure 1, indicate that the experimental functional beverage had a color with medium brightness, shades of red-orange and yellow with stable intensity. The brightness (L^*) remained constant throughout the storage period within the CIE $L^*a^*b^*$ color space.

Keywords: bio-functional drink, grape by-products, technological properties.

Acknowledgments: The research was supported by Institutional Project, subprogram 02.04.05 Optimizing food processing technologies in the context of the circular bioeconomy and climate change, Bio-OpTehPAS, being implemented at the Technical University of Moldova.

F.30. NATURAL SURFACTANTS OBTAINED FROM PLANT AND PROTEIN RESOURCES FOR ECO-FRIENDLY FOOD SURFACE DECONTAMINATION APPLICATIONS

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Abstract. This study focused on the optimization, synthesis, and primary characterization of natural surfactants intended for eco-friendly washing formulations for fruits and vegetables. Several classes of bio-based surfactants were evaluated, including plant-derived saponins, microbial biosurfactants, and collagen hydrolysate-based amphiphilic compounds, selected according to biodegradability, food compatibility, and technological feasibility. Plant materials such as *Medicago sativa* and *Beta vulgaris* leaves were processed using conventional thermal extraction and microwave-assisted extraction with aqueous and hydroalcoholic solvents. The obtained extracts were concentrated, fractionated, and characterized by UV-Vis spectrophotometry and LC-MS analysis. Higher extraction efficiencies were observed for microwave-assisted and hydroalcoholic systems, while sugar beet leaves showed the highest total saponin content among the tested materials. In parallel, collagen hydrolysate-based surfactants were synthesized through controlled fatty acid acylation reactions, highlighting their potential for scalable production. The developed surfactants showed promising properties for reducing surface tension, emulsifying hydrophobic contaminants, and supporting the removal of pesticide residues and microbial contaminants from fresh produce surfaces. These results demonstrate the potential of natural surfactants as sustainable alternatives for food decontamination applications.

Acknowledgement. This work was supported by a grant of the Ministry of Research, Innovation and Digitization (Ministry of Education and Research – National Authority for Research), CCCDI—UEFISCDI, project number PN-IV-P7-7.1-PTE-2024-0607, contract 57PTE/2025, within PNCDI IV. The authors also acknowledge the support of the Ministry of Research, Innovation and Digitization (Ministry of Education and Research – National Authority for Research), through INCDCP-ICECHIM Core Program PN 23.06.01.01 (AQUAMAT).

F.31. INNOVATIVE AND CONVENTIONAL APPROACHES FOR THE EXTRACTION AND CHARACTERIZATION OF BIOACTIVE COMPOUNDS FROM BEE PRODUCTS

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Abstract. Bee products are widely recognized as valuable sources of bioactive compounds with proven nutritional and therapeutic effects. In this study, several bee matrices were preliminarily evaluated in terms of their physicochemical profiles and bioactive performances. Based on these initial findings, bee bread was selected as the target matrix for further investigation due to its superior bioactive potential, including mineral content, total phenolics, flavonoids, and antioxidant activity potential. The morphology of the bee bread was investigated using scanning

electron microscopy (SEM) and the molecular structure analyzed using Fourier-transform infrared spectroscopy (FTIR).

This study comparatively explores conventional maceration, ultrasound-assisted extraction (UAE), and microwave-assisted extraction (MAE) for the retrieval of bioactive compounds from bee bread. The experimental design included three solid-to-liquid ratios (1:5, 1:10, and 1:15, g/g), two extraction times (15 and 30 min), two ultrasound power levels (80% and 100%), and two microwave power levels (600 W and 900 W). Extraction efficiency was evaluated based on the antioxidant activity.

Furthermore, process modeling and optimization were performed to identify the optimal extraction conditions maximizing the yield of bioactive compounds, therefore the antioxidant activity. The results highlight the significant influence of operational parameters on extraction performance, with UAE and MAE showing enhanced efficiencies compared to conventional maceration, mainly due to improved mass transfer and structural disruption of the matrix. This work provides an integrated approach linking the initial characterization of bee bread with extraction efficiency, contributing to the development of efficient, time-saving, and sustainable strategies for the valorization of bioactive compounds.

Keywords: bee products, bee bread, bioactive compounds, ultrasound-assisted extraction, microwave-assisted extraction

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F.32. EFFECTS OF PROCESS FACTORS ON THE ULTRASOUND-ASSISTED EXTRACTION OF BIOACTIVE COMPOUNDS FROM SEA BUCKTHORN FRUITS

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Abstract. The study aimed at evaluating the effects of process factors on the ultrasound-assisted extraction (UAE) of phenolic compounds and carotenoids from sea buckthorn (*Hippophae rhamnoides* L.) fruits. Liquid/solid ratio (R_{LS}), ethanol/acetone ratio (R_{EA}), temperature (t), and time (τ) were selected as process factors, whereas total phenolic content (TPC), total flavonoid content (TFC), total carotenoid content (TCC), and antioxidant capacity (AC) of the fruit extracts were response variables. TPC , TFC , TCC , and AC were experimentally determined and predicted at different levels of R_{LS} , R_{EA} , t , and τ . The effects of UAE factors were quantified using polynomial models obtained by processing experimental data. UAE optimization was performed using the desirability function approach. Sea buckthorn fruit extract prepared under optimal extraction conditions will be used as an ingredient in food and/or nutraceutical products

Keywords: antioxidant capacity; carotenoids; phenolic compounds; sea buckthorn (*Hippophae rhamnoides* L.); ultrasound-assisted extraction (UAE)

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F.33. THE EFFECT OF THERMAL PROCESSING ON FUNCTIONAL PROPERTIES OF YELLOW PEA FLOUR

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Abstract. The present study aimed to investigate the effect of oven roasting at 100, 120 and 140°C for 20, 40 and 60 minutes, on some functional properties of the yellow pea flour, that could contribute to its technological and nutritional quality. Water and oil binding capacities, emulsifying capacity, swelling power and water-solubility index, CIELAB color, DPPH scavenging activity and trypsin inhibitors content were determined to assess the quality of the heat-treated flours. Results showed that roasting affected color characteristics, decreasing lightness and yellowness, while redness increased. Also, roasting lead to a significant decrease in Emulsifying Capacity (from 258 to 138 ml oil/100 ml), while water and oil binding capacities increased. Water Solubility Index increased with temperature in the entire tested range, while Swelling Power decreased. A slight increase of the trypsin inhibitors (from 7.15 to 8.3 TIU/g DM) quantified in the pea flour was noticed when increasing the roasting temperature. The obtained results suggest that dry thermal treatment applied to pea flour, as preliminary treatment for obtaining various types for food products, might be a suitable tool for modulating its functionality.

Keywords: Roasting, pulses, trypsin inhibitor, color, water-related properties

Acknowledgments

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F.34. FROM GENERAL CONSIDERATIONS TO A CONCRETE CASE ON RHEOLOGY AS A POWERFUL RESEARCH METHOD IN CHEMICAL ENGINEERING AND MEDICAL SCIENCES

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Abstract. The monitoring of rheological properties, by establishing the correlation between viscosity and shear rate, regards an important tool in food and drug industry during the development of semisolid dosage forms since it sheds light on why some formulations flow, while others retain structure under shear [1]. Fluids or food or drug formulations that deform after exceeding a threshold value of the deformation effort are fluids of the real plastic type,

respectively Bingham [2]. The equation of rheological state of a viscous fluid relates the strain stress to its strain rate through relation (1). This can define almost all fluids except those with viscoelastic behavior [2]. In this relationship, the viscosity can be constant or dependent on the rate of deformation (dw_x/dy).

$$\tau_{yx} = \tau_{0p} + \eta \left(\frac{dw_x}{dy} \right)^n \quad (1)$$

When the viscosity of a fluid evolves over time, it shows that a chemical or biochemical process is taking place inside it. Such a situation happens with food fluids when enzymes arrive in them that cause hydrolysis reactions of its components. In cases of pancreatic insufficiency the supplementing with digestive enzymes, for hydrolysis of food, is supported by specific drugs [3], as in the case of Triferment and Colebil

The present work proposes the in vitro hydrolysis of gelatine protein and starch media in the presence of Triferment drug. The method for highlighting hydrolysis consists in registration of time dynamics of apparent viscosity of the gelatin or starch solutions, in which Triferment was dosed. With respect to concentration of the hydrolysable species, the pH and the temperature of the hydrolysis medium it shows that they were fixed to reproduce the digestion conditions of. The part of the mathematical modeling related to the experimental investigation is focused on the determination of the kinetic parameters, which characterize the hydrolysis with Triferment of specific gelatin or starch media. In this sense to create a relation between medium viscosity and medium composition it admit that both the concentration of biopolymer in the medium and the degree of polymerization, linearly depend on the biopolymer conversion (the conversion of gelatin respectively of starch into amino acids constituents respectively sugars). The finding that Triferment tablets over 1 year old lose a lot of their ability to hydrolyze gelatin solutions is quantitatively expressed by comparing the values of the constants of the hydrolysis model for comparing casses.

Keywords: rheology, nonnewtonian fluids, gelatine hydrolysis, triferment, starch hydrolysis.

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F35. INFLUENCE OF BOVINE COLLAGEN AND KONJAC GLUCOMANNAN ON THE RHEOLOGICAL PROPERTIES OF DOUGH

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Abstract. Although hydrolyzed collagen (HC) and konjac glucomannan (KGM) have been individually investigated as functional ingredients in bakery products, information regarding their combined effects on dough and bread characteristics is still limited in the literature. On one hand, HC contributes to improving the protein profile and textural properties of bread. On the other hand, KGM provides soluble dietary fiber, reduces the glycemic potential of the product, increases water-holding capacity, and influences the structure of the gluten network. During dough formation, a three-dimensional gluten network is developed through hydrogen bonds,

disulfide bonds, and non-covalent interactions, which entraps starch granules, lipids, and other components. The simultaneous incorporation of HC and KGM into dough may therefore have significant beneficial effects on dough and bread properties. In this study, bovine-derived HC and bio-based KGM were used as low-cost and biocompatible substitutes for conventional additives in bread formulation.

Rheological analysis of the samples was performed using a Chopin Mixolab Profiler. The results highlighted: higher values of the water absorption index (WAI) and amylase index (AI), and lower values of the Gluten⁺ index (GI) in samples containing HC and KGM compared to the control sample; a lower viscosity index (VI) in the sample with higher concentrations of HC and KGM compared to the other samples; and similar values of the mixing index (MI) and retrogradation index (RI).

Keywords: bread dough properties, hydrolyzed collagen, konjac glucomannan, rheological analysis.

F36. INFLUENCE OF THE ADDITION OF WAXY WHEAT FLOUR ON THE BEHAVIOR OF BAKERY YEAST IN FROZEN MINI BAGUETTES DOUGH

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Abstract. The present study investigates the influence of partial substitution of wheat flour with waxy wheat flour (10%, 15%, and 20%) on the behavior of baker's yeast and on the final quality of mini baguettes obtained from frozen dough, stored for up to 56 days. Yeast activity was evaluated after 60 and 120 minutes of fermentation, being correlated with the specific volume, textural properties, and overall acceptability of the finished products. The samples with the addition of waxy wheat flour showed a better-preserved fermentative activity, especially at the substitution levels of 15% and 20%, both at 60 and 120 minutes. This higher yeast activity was directly reflected in higher specific volume values, indicating a better gas retention capacity in the dough. Textural analysis revealed an increase in hardness and gumminess during storage, along with a decrease in cohesiveness and resilience, but these changes were attenuated in the case of samples with waxy flour. Also, samples with higher yeast activity presented a more aerated and less dense texture, an aspect reflected in higher overall acceptability scores. In conclusion, the use of waxy wheat flour contributes to maintaining yeast activity in frozen dough, positively influencing the specific volume, texture, and sensory acceptability of mini baguettes. The results support the potential of this raw material in optimizing the quality of frozen bakery products.

Keywords: fermentative activity, rheological properties, technological properties, texture, viability

F37. INNOVATIVE COLLAGEN MATRICES LOADED WITH SULFONAMIDE HYBRIDS FOR ADVANCED WOUND CARE: CHARACTERIZATION AND HPLC EVALUATION OF DRUG RELEASE

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Abstract. Chronic wounds remain a major therapeutic challenge due to impaired healing, persistent inflammation, and high susceptibility to infection. Collagen-based biomaterials are widely used in advanced wound care because of their biocompatibility, moisture-retention capacity, and ability to support cell adhesion and tissue regeneration. By mimicking the extracellular matrix, collagen promotes fibroblast proliferation and accelerates the healing process, making it an essential component in the design of modern wound dressings [1]. Sulfonamide-based small molecules, particularly pyrrole-sulfonamide hybrids, provide complementary antimicrobial and antioxidant activity, addressing infection and oxidative stress associated with chronic wounds [2].

In this study, we developed a novel collagen-sulfonamide formulation and performed its physicochemical characterization using IR spectroscopy, rheology, SEM, and DSC-TG analyses. The controlled release of sulfonamide hybrids from collagen-based systems was investigated by HPLC analyses to define their release profile. Ongoing biological investigations are focused on evaluating its antimicrobial, antibiofilm, and healing-promoting potential.

Keywords: sulfonamide hybrids; collagen-based biomaterials, controlled release, HPLC, rheology.

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F.38. RIPENING-DEPENDENT CHANGES IN KEY BIOACTIVE COMPOUNDS OF SOME SEA BUCKTHORN CULTIVARS IMPLICATIONS FOR HARVEST OPTIMIZATION

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Abstract. Sea buckthorn is a sun-loving species prized for its nutrient-dense orange berries, which are extensively utilized in the pharmaceutical, food, and agricultural sectors. This study investigated four cultivars—Dora, Cora, Mara, and Clara—cultivated in the Republic of Moldova over a 60-day period (August to September), with a focus on the evolution of key ripening indicators: vitamin C, total carotenoids, and organic acids.

Ascorbic acid, a crucial bioactive compound, declined steadily as the fruits matured. The Clara, Dora, and Mara cultivars showed an approximately 2.5-fold reduction in concentration, whereas the Cora cultivar exhibited a more pronounced, nearly fourfold decrease, indicating notable genetic differences in nutrient retention. Carotenoid accumulation, responsible for the berries' antioxidant properties, displayed cultivar-specific patterns: Clara, Dora, and Mara reached peak levels in late August, followed by a decline due to overripening, while the Cora cultivar showed a continuous increase, reaching its maximum at the end of the study period.

Malic acid was identified as the predominant organic acid. In addition to shaping the berries' characteristic tart and astringent flavor, it contributes to stabilizing the antioxidant matrix and enhancing the bioavailability of polyphenols.

Overall, the results highlight that the stage of ripening plays a decisive role in defining the biochemical profile of sea buckthorn. The distinct responses observed among the cultivars suggest that harvest timing should be carefully tailored to the intended industrial purpose, whether to maximize vitamin C content or to optimize carotenoid extraction.

Keywords: bioactive compounds, biochemical profiles, total carotenoids, vitamin C.

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F.39. EFFECTS OF SUGAR-FREE APPLE CONCENTRATE ON THE PHYSICOCHEMICAL PROPERTIES OF ARTISANAL ICE CREAM

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Abstract. The incorporation of natural sweeteners in ice cream production has the potential to satisfy the growing consumer demand for natural and nutritionally balanced foods. This study aimed to address the limited foundational knowledge regarding the effects of sugar-free apple concentrate, used as a natural sugar substitute, along with rose petal jam and oat milk, on the properties of artisanal ice cream. A reference sample (REF) was formulated using a base of oat milk sweetened with sugar-free apple concentrate and rose petal jam. Subsequently, formulations were modified by increasing the proportions of apple concentrate and oat milk while proportionally reducing the amount of rose petal jam.

The physicochemical properties evaluated included acidity, pH, water activity, total soluble solids, protein content, ash content, and overrun. Color characteristics were assessed using the parameters L*, a*, b*, chroma (C*), and hue angle (h*). The formulation containing the highest levels of sugar-free apple concentrate and oat milk exhibited significantly higher pH, fat content, and overrun values, contributing to improved stability and desirable textural attributes, such as a creamy and aerated consistency.

Overall, the findings provide practical guidance for the effective use of sugar-free apple concentrate, rose petal jam, and oat milk in specialized artisanal ice cream formulations, including unsweetened or low-calorie variants. This approach not only enhances sensory quality but also aligns with consumer preferences for healthier dessert options.

Keywords: low-calorie formulation, natural sweeteners, physicochemical properties, stability, texture.

F.40. USE OF CLAY-BASED MATERIALS AND PLANT EXTRACTS IN MOUTHWASH FORMULATIONS

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Abstract. Oral hygiene products have undergone significant evolution over recent decades, driven by growing interest in natural, biocompatible ingredients with therapeutic effects. Mouthwashes play a key role in preventing caries, gingivitis, and halitosis, with modern formulations often incorporating antibacterial, anti-inflammatory, and remineralizing compounds.

In this context, mineral clays and plant extracts have emerged as major research subjects in oral care product development. Clays provide adsorption capacity and remineralizing effects, while plant extracts offer antimicrobial, antioxidant, and anti-inflammatory activities.

Their combination in a mouthwash can yield an effective, natural, and well-tolerated product.

The present study aims to actively incorporate clay-based materials into innovative and efficient mouthwash formulations. Clays exhibit notable potential in oral hygiene due to unique properties, including high adsorption of toxins, volatile compounds, and microorganisms; antibacterial activity via pH modulation and bacterial membrane interactions; ion-exchange capacity for enamel remineralization; soothing and anti-inflammatory effects on oral mucosa; and biocompatibility in purified forms.

The plants targeted in this study include: *Mentha piperita* (peppermint) – antibacterial and disinfectant effects, pleasant aroma; *Salvia officinalis* (sage) – anti-inflammatory and antifungal properties; *Matricaria chamomilla* (chamomile) – soothing, healing, and anti-irritant; *Thymus vulgaris* (thyme) – rich in thymol, potent antiseptic; *Calendula officinalis* (marigold) – regenerative and anti-inflammatory; and Aloe vera – hydrating, healing, and mucosa-protective. Combining clays with plant extracts in mouthwashes is expected to produce complementary and synergistic effects, such as adsorption of unwanted compounds by clays paired with bacterial inhibition by extracts; enamel remineralization via clay minerals combined with mucosal protection from plants; suspension stabilization through clay colloidal properties; and enhanced bioavailability of plant compounds via surface fixation on clays.

In developing these innovative mouthwashes, products must adhere to stringent purity standards for clays, limits on heavy metals (Pb, Cd, Hg), microbiological testing, and assessments of irritation and cytotoxicity. Studies indicate that clay- and plant-based formulations are well-tolerated, with low risk of adverse reactions.

Clay-based materials and plant extracts represent a promising direction for developing natural and effective mouthwashes. The adsorptive, antibacterial, and remineralizing properties of clays, combined with the anti-inflammatory and antimicrobial effects of plants, offer a safe and sustainable alternative to conventional formulations. Current research supports the potential of these ingredients in enhancing oral health and fostering innovative cavity hygiene products.

Keywords: clays, plant extracts, plant extract-functionalized clays, mouthwashes.

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F.41. APPLICATIONS OF NATURAL AND MODIFIED CLAY MINERALS FOR THE TREATMENT OF FOOD INDUSTRY WASTEWATER

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Abstract. The food industry generates large volumes of wastewater containing heavy metals, synthetic dyes, phenolic compounds, nutrients and other persistent pollutants, whose inadequate management poses serious risks to aquatic ecosystems and public health. Conventional treatment technologies, such as coagulation–flocculation, chemical oxidation and biological processes, often show limited efficiency for complex effluents and may involve high operating costs and the generation of secondary sludge.

This paper provides an overview of recent research on the use of natural and modified clay minerals as low-cost, high-performance adsorbents for the remediation of food industry wastewater. Particular emphasis is placed on cationic clays (montmorillonite and its acid-activated forms K10 and KSF) and anionic clays of the layered double hydroxide (LDH) type. The structural, textural and surface properties of these materials are described, together with typical characterization methods (X-ray diffraction, FTIR spectroscopy, SEM/EDS, thermal analysis and BET surface area), which allow correlation between porosity, surface chemistry, layer charge and adsorption performance.

Special attention is devoted to advanced composite systems based on montmorillonite–vanadium- β -cyclodextrin and hydrotalcite-type LDH modified with vanadium and β -cyclodextrin, which couple broad-spectrum adsorption with catalytic oxidative degradation of organic pollutants, enabling the simultaneous removal of metal cations, inorganic anions and organic contaminants.

Literature data indicate that natural clays typically achieve adsorption capacities of about 15–90 mg/g for heavy metal cations, whereas acid-activated, organophilic and pillared clays reach 100–200 mg/g for organic dyes and values of a few mg/g for phenolic compounds; LDH-based materials often exceed 50–100 mg/g for phosphates, nitrates and anionic dyes.

Regeneration strategies (thermal, chemical and biological) allow 70–90% of the initial capacity to be retained over several cycles, supporting the technical and economic feasibility of clay-based adsorbents as key components of integrated and sustainable treatment schemes for food industry wastewater.

Keywords: clay minerals, montmorillonite, layered double hydroxides, food industry wastewater, adsorption, regeneration.

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F.42. CLAY-BASED MATERIALS UTILIZED FOR THE REMOVAL OF UNDESIRABLE COMPOUNDS IN THE WINE STABILIZATION PROCESS

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Abstract. Amid global concerns regarding the creation of materials capable of meeting the demands of modern society, the science of nanomaterials is experiencing increasingly significant development. Within this complex field, the study of clays has become, in recent decades, a particularly relevant research direction.

Clays are materials composed of natural minerals, and their versatility has led to a wide range of applications. Due to their remarkable physicochemical properties, they are successfully integrated into numerous sectors, such as the ceramic industry, ion-exchange systems, sensors, textile bleaching processes, heterogeneous and homogeneous catalysis, as well as the pharmaceutical and medical fields, where they serve as supports for various active principles. Cationic clays are mineral materials that possess a remarkable adsorption capacity and are widely used in various environmental protection strategies. They function as natural traps that effectively bind contaminants such as heavy metals, pesticides, mycotoxins, or organic pollutants, reducing their mobility and toxicity in ecosystems. Anionic clays are those known in the specialized literature as layered double hydroxides or hydrotalcite-type compounds, having a positively charged lamellar structure balanced by exchangeable anions positioned in the interlayer space. The objective of this paper is to study the possibilities of implementing clays in the food industry, more precisely in the winemaking industry during the wine stabilization and conditioning stage. For conditioning and stabilization, wine clarification represents an essential stage in the winemaking process, aiming to remove colloidal particles, unstable proteins, and compounds that may affect the stability and clarity of wine. In this context, clay-based mineral materials have become widely used fining agents due to their adsorbent properties and ion-exchange capacity. This study intends to evaluate the efficiency of two distinct categories of clay: cationic clays, particularly montmorillonite (the primary component of bentonite), and anionic clays (hydrotalcite), a material featuring a layered structure and anionic exchange properties. These materials are valued for their effectiveness in wine stabilization and their minimal impact on organoleptic composition. Cationic clays of the montmorillonite type are expected to adsorb unstable proteins and colloidal particles, forming aggregates that sediment easily. This process reduces the risk of protein haze, especially in white wines. The expected results are high efficiency in protein stabilization, low cost, wide availability, and minimal impact on aromas. Anionic clays of the hydrotalcite type are layered anionic materials (Layered Double Hydroxides – LDH), with a complex lamellar structure and anion-exchange capacity. Their use in wine clarification is due to their adsorption properties for oxidized polyphenols, unstable tannins, anionic pigments, and compounds responsible for browning. The expected results consist of high selectivity for anionic compounds, improved color stability of white and rosé wines, and a reduced risk of oxidation. By creating a complex material formed from the two types of clays, it is intended to achieve a synergy of properties capable of targeting several undesirable components in wine. Materials based on cationic and anionic clays are considered efficient and

safe solutions for wine clarification. Cationic clays develop good properties for protein stabilization, being traditional and highly effective agents. Anionic clays, due to their anionic lamellar structure, offer additional advantages in controlling oxidized compounds and maintaining color stability. The integration of both types of clays into winemaking technology can lead to more stable, clearer, and higher-quality wines.

Keywords: innovative materials, cationic clays, anionic clays, wine stabilization

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F.43. CLAY-BASED COMPOSITES - ADSORBENTS FOR THE PURIFICATION OF WATER POLLUTED WITH FOOD DYES

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Abstract. The food industry uses a wide range of colorants to improve the appearance of products, increase their attractiveness, and standardize the color of finished products. Dyes are indispensable, especially in the sectors that produce sweets, soft drinks, confectionery and pastries. However, a significant part of these substances ends up in wastewater, generating environmental problems and difficulties in wastewater processes. Water contaminated with food dyes has an intense color, contains organic compounds that are difficult to biodegrade, and can affect aquatic ecosystems even at low concentrations. Frequently used in sweets, due to their stability and color intensity are: Tartrazine (yellow), Ponceau 4R (red), Brilliant Blue FCF (blue), Sunset Yellow (orange). These compounds are very stable, resistant to light and temperature, which makes them difficult to eliminate by classical methods.

In the present study, we propose the use of clay-chitosan composite materials for the depollution of these wastewaters, which combine the adsorption capacity of clay with the polymeric properties of chitosan, coupled with advanced oxidation processes using V₂O₅-impregnated clays or photocatalytic destruction processes using clays on which TiO₂ or ZnO are deposited. By combining the pollutant retention properties developed by clay with those of chitosan, a synergistic effect is expected to be achieved, favorable to the depollution of water in the food industry. Clay is a natural, abundant and inexpensive material with a high specific surface area, presents negative charges that attract positively colored molecules, and can be modified to

increase adsorption capacity. Chitosan is a natural, biodegradable, non-toxic and biocompatible biopolymer. Thanks to its amino groups, it can fix and retain dyes, especially anionic ones. The combination of clay with chitosan, in organo-inorganic composite materials, leads to an increase in the active surface area, greater mechanical and chemical stability and ultimately to a superior adsorption capacity compared to single materials. Another advantage lies in the possibility of regeneration and reuse, but also in reduced costs and minimal ecological impact. Thus, the implementation of modern technologies that use composites based on clay and chitosan to retain and destroy pollutants in the food industry, represents a promising direction for reducing pollution and environment protection.

Keywords: clay, chitosan, wastewater, food dyes.

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F.44. CLAY-BASED FUNCTIONALIZED MATERIALS INVOLVED IN THE DEPOLLUTION OF WATERS WITH PHARMACEUTICAL WASTES

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Abstract. Pharmaceutical pollutants represent one of the most emerging and problematic classes of aquatic environment contaminants. Medicines used in human and veterinary medicine reach waters through: insufficiently treated discharges of urban wastewater, agricultural activities (livestock farming, fertilization with manure), improper disposal of medicines, pharmaceutical industrial processes. These compounds are often bioactive, persistent, soluble and can affect aquatic ecosystems even at very low concentrations (ng/L – µg/L). Conventional wastewater treatments are not designed for their removal, which imposes the development of advanced depollution technologies. Natural clay-based materials and clays modified with β-cyclodextrins represent promising solutions due to low cost, high availability and efficiency in the adsorption of complex organic molecules. The most frequent types of pharmaceutical pollutants that pollute waters are: antibiotics (tetracyclines, sulfonamides, fluoroquinolones), analgesics and anti-inflammatories (ibuprofen, diclofenac, paracetamol), hormones and endocrine disruptors (estradiol, ethinylestradiol), antiparasitics and veterinary antipyretics, beta-blockers, as well as antiepileptics, antidepressants. These polluting medicinal substances can have negative effects on the environment, effects that manifest in the disruption of endocrine systems in fish and amphibians, the development of antimicrobial resistance, chronic toxicity on microorganisms and bioaccumulation in the food chain.

In the present paper, solutions are proposed for the retention of pharmaceutical pollutants, clay-

based materials chemically modified as well as advanced depollution materials also based on clay functionalized with beta-cyclodextrins (alpha, beta and gamma).

Clays are natural minerals with a layered structure, negative surface charge and large specific surface. In our study, montmorillonite and bentonite were selected and are used, due to relevant properties for depollution: high specific surface (up to 800 m²/g), large cation exchange capacity, chemical stability and, last but not least, low cost and wide availability.

To increase adsorption efficiency, clays are functionalized with β -cyclodextrins (β -CD), which are cyclic oligosaccharides with a toroidal structure, having a hydrophobic interior and hydrophilic exterior. β -cyclodextrins have special properties that recommend their addition to clay-based materials, such as: the ability to form inclusion complexes with organic molecules, high selectivity for aromatic and hydrophobic compounds, biodegradability and non-toxicity. The complex retention mechanisms of pollutants are highlighted through: dual adsorption, both on the clay surface and in the β -CD cavity, selective complexation of hydrophobic pharmaceutical molecules, increase in active surface and affinity for aromatic compounds. Clay-based materials functionalized with β -CD show increased efficiency in the retention of pharmaceutical pollutants by recording increases in adsorption capacity by 50–300% compared to plain clays, reduced equilibration times and increased selectivity for aromatic and hydrophobic compounds.

Another important aspect is that these materials can support multiple operating cycles, and regeneration is achieved at moderate parameters. The depollution of waters contaminated with pharmaceutical pollutants represents a major challenge for environmental protection. Clay-based materials, especially those modified with β -cyclodextrins, offer an efficient, sustainable and economical solution. Their adsorption capacity, combined with the selectivity of β -CD for complex organic molecules, transforms them into promising materials for modern purification technologies.

Keywords: clay-based functionalized materials, water depollution, pharmaceutical pollutants.

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F.45. VALORIZATION OF AGRI-FOOD BY-PRODUCTS IN THE DEVELOPMENT OF FUNCTIONAL PROBIOTIC BEVERAGES

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Abstract. The valorization of food waste represents a key modern direction in the development of a circular economy. Transforming agri-food by-products into functional products, such as

probiotic beverages, provides both nutritional benefits and ecological advantages. Bran, traditional fermented wheat bran broth (borș), grape pomace, and damaged or unsellable wild berries are nutrient-rich resources well suited for fermentation and for producing value-added probiotic beverages. Probiotic beverages are fermented products that contain live beneficial microorganisms, primarily lactic acid bacteria (*Lactobacillus*, *Bifidobacterium*) and non-pathogenic yeasts. The fermentation process transforms raw materials into products that are more digestible and microbiologically stable, while enabling microorganisms to synthesize essential compounds, including vitamins (such as B-complex vitamins), polyphenols, carotenoids, and organic acids (lactic, acetic), which exert prophylactic effects on human health. These bioactive compounds primarily improve digestion by promoting a healthy gut microbiota, suppressing putrefactive microorganisms, and supporting intestinal microbial balance. Fermentation also creates a prebiotic environment that promotes the proliferation of beneficial bacteria, enhances intestinal barrier function, and reduces systemic inflammation.

Recent studies demonstrate that plant-based fermented beverages also reduce blood pressure, cholesterol levels, and insomnia symptoms due to their antioxidant activity. Moreover, these products support the reduction of adipose tissue and body weight by enhancing sugar metabolism and stimulating intestinal thermogenesis. For example, polyphenols from sea buckthorn and resveratrol from grape seeds inhibit lipid peroxidation, contributing to obesity management by promoting lipolysis and modulating gut microbiota composition.

In the academic context, the valorization of agro-industrial waste aligns these beverages with the principles of the circular economy by minimizing post-harvest losses. Current research focuses on optimizing fermentation parameters to maximize probiotic viability, which is essential for substantiating health claims in accordance with EU Regulation 1924/2006. Thus, fermented beverages not only diversify the sustainable food supply but also support public health through integrative nutritional prevention. We consider that probiotic beverages obtained from bran, borș, grape pomace, and wild berries represent an innovative and sustainable solution for the valorization of food waste. They combine the tradition of fermentation with modern demands for healthy, functional, and environmentally friendly products. The development of such technologies can significantly reduce environmental impact while creating new economic opportunities within the agri-food industry.

Keywords: probiotic beverages, fermentation, agri-food waste.

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F.46. EVALUATION OF THE THERMAL BEHAVIOR OF APRICOT AND PLUM COLD PRESSED OILS

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Abstract. The present study investigates the thermal properties of apricot and plum cold pressed kernel oils through thermal analysis (differential scanning calorimetry and thermogravimetric analysis) to elucidate their complex thermal behaviors. By linking the triacylglycerol profiles with their corresponding thermal properties, this research establishes novel structure–thermal behavior relationships for these high-value stone fruit oils. These findings enhance the understanding of the oils stability and polymorphism, providing critical insights into their performance and applications that surpass the information gained from fatty acid analysis alone. Different thermal protocols were used to discriminate between the complex nature of the two samples, in an attempt to attribute the observed peaks to different polymorphic forms and to better

establish the influence of the major fatty acids. The broad crystallization peaks, accompanied by bimodal melting peaks observed in the lower temperature range in the second heating scan, indicate a complex triacylglycerol composition, particularly characterized by a high concentration of polyunsaturated and monounsaturated fatty acids.

Thermogravimetric analysis showed that plum kernel oil exhibits a higher thermal stability compared to apricot kernel oil, characterized by distinct weight loss correlating to changes in fatty acid composition. The thermal protocols applied allowed a better understanding of the changes corresponding to the melting and crystallization phenomena. Furthermore, the investigation highlights the potential of thermal analysis as a predictive tool for assessing oil quality and stability, with implications for food processing and product development. This research contributes to a better understanding of the thermal behavior of natural oils, paving the way for their optimized use in various applications.

Keywords: apricot, plum, kernel oil, thermal properties, differential scanning calorimetry, thermogravimetric analysis.

F.47. ULTRASOUND-ASSISTED EXTRACTION OF PHENOLIC COMPOUNDS FROM *JUGLANS REGIA* LEAVES: EXPERIMENTAL AND MODELLING

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Abstract. In this study, the effects of independent variables on the performance of ultrasound-assisted extraction (UAE) of phenolic compounds from *Juglans regia* L. leaves were evaluated. According to a Box-Behnken design (BBD), 15 experiments were performed in an ultrasonic bath, using aqueous ethanol solutions as extractants. Liquid/solid ratio (R_{LS}), concentration of ethanol solutions (c_{et}), and temperature (t) were chosen as independent variables of the UAE process, whereas total phenolic content (TPC), total flavonoid content (TFC), and antioxidant capacity (AC) of the leaf extracts were selected as dependent (response) variables. The effects of R_{LS} , c_{et} , and t on TPC , TFC , and AC were quantified using second-order polynomial models based on experimental data. The desirability function approach was applied to determine the optimal levels of R_{LS} , c_{et} , and t . The leaf extract obtained under optimal UAE conditions will be used as an ingredient in cosmetic products.

Keywords: antioxidant capacity; Box-Behnken design; *Juglans regia* L.; phenolic compounds; ultrasound-assisted extraction (UAE).

F.48. EGGPLANT PEEL EXTRACT AS A PROMISING FUNCTIONAL INGREDIENT FOR ENHANCING THE BIOACTIVITY AND PHYTOCHEMICAL PROFILE OF BEER

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Abstract. The eggplant peels represent an important source of bioactive compounds, with many potential health benefits, that can be used as natural antioxidants and colorants in food industry. In the present study the antioxidant-rich eggplant (*Solanum melongena* L.) peels extract (EPE)

was used to increase the biological value of beer. The beer supplemented with 1, 5 and 10 mg EPE/mL was characterized in terms of total phenolic content (TPC), total flavonoids content (TFC), total monomeric anthocyanins content (TMA) and radical scavenging activity. Beer supplementation with EPE resulted in significant increase of TPC and TFC from 43.9 to 63.1 mg GAE/100 mL, and from 7.5 to 17.1 mg CE/100 mL, respectively. Similarly, the TMA of beer samples gradually increased from 0.11 to 0.84 mg D3G/100 mL with increasing the addition level of EPE. Since EPE is rich in anthocyanin pigments, beer acquired a reddish color. As expected, the radical scavenging assay indicated the linear increase of the antioxidant capacity of beer with the increase of EPE. The incorporation of EPE resulted in increased level of bioactive compounds, which suggest the possibility of using the EPE as promising functional ingredient for brewing specialty beers.

Keywords: bioactive compounds, eggplant peels, beer, antioxidants, functional ingredients.

F.49. MICROENCAPSULATION OF EGGPLANT PEEL PHYTOCHEMICALS AND THEIR APPLICATION IN VALUE-ADDED PASTRY PRODUCTS

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Abstract. This study focuses on the microencapsulation of an anthocyanin-rich extract derived from eggplant peel and its incorporation into pastry cream as a functional ingredient. The microencapsulated anthocyanin extract (MAE) was obtained using whey protein isolate and pectin as the encapsulation matrix. The resulting powder, along with the MAE-enriched pastry cream, was further evaluated in terms of phytochemical profile and antioxidant activity. Total monomeric anthocyanins (TMA), total phenolic content (TPC) and total flavonoid content (TFC) were determined. The antioxidant effect was evaluated by radical scavenging activity. A purple colored powder, rich in phytochemicals was obtained, with a 94% encapsulation efficiency. The addition of MAE (5 and 10%) in pastry cream resulted in a linear increase of phytochemicals content (TMA: 0.061 and 0.136 mg D3G/g DW; TFC: 0.195 and 0.345 mg CE/g DW; TPC: 3.836 and 7.473 mg GAE/g DW), as against control (no MAE added; TMA - not detected; TFC 0.113 mg CE/g DW; TPC 0.949 mg GAE/g DW). The antioxidant assay indicated linear increase in antioxidant potential reported to control (0.063 mM TE/g DW) with values of 0.983 and 2.010 mM TE/g DW, following MAE additions. The results indicate a promising use of microencapsulated eggplant extract as a functional ingredient in pastry products.

Keywords: microencapsulation, anthocyanins, phenolic compounds, pastry products, antioxidant activity.

F.50. PRODUCTION OF ANTIMICROBIAL HYDROLYSATES VIA ENZYMATIC HYDROLYSIS OF RAW MILK FATS BY *YARROWIA LIPOLYTICA*

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Abstract. *Yarrowia lipolytica* play an important role in the fermented food and nutraceuticals production. It produce specific enzymes which contribute to the obtainment of substrate-derived bioactive compounds such as peptides, fatty acids, oligosaccharides and free polyphenols. Their enzymatic potential so that they could hydrolyze milk proteins and fats to release bioactive compounds (peptides and fatty acids) with antioxidant, prebiotic or antimicrobial activity. Antimicrobial activity of milk fat hydrolysates obtained through solid-state cultivation using selected *Yarrowia lipolytica* strains was evaluated. A preliminary assessment of the lipolytic activity of three *Yarrowia lipolytica* strains, as well as the solid-state enzymatic hydrolysis of different milk fats (goat, mare, and buffalo) at a water activity of 0.98 for 96 hours, was also performed. The lipase produced by the *Yarrowia lipolytica* RO13 strain showed enhanced lipolytic activity toward goat milk fat, whereas the PO1 strain demonstrated higher activity toward buffalo milk fat. Furthermore, the antimicrobial activity of the obtained hydrolysates against selected food spoilage microorganisms was investigated. As expected, the hydrolysates resulting from the enzymatic hydrolysis of goat and mare milk fats using the RO13 strain showed higher antimicrobial activity compared to the other samples. These results provide evidence supporting the potential use of enzymatically hydrolyzed milk fats as natural biopreservative agents.

Keywords: *Yarrowia lipolytica*, antimicrobial hydrolysates, enzymatic hydrolysis, milk fats.

F.51. INFLUENCE OF SOLVENT TYPE ON ULTRASOUND-ASSISTED EXTRACTION OF EGGPLANT PEEL PHYTOCHEMICALS AND THEIR ANTIOXIDANT ACTIVITY

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Abstract. Eggplant peel (*Solanum melongena*) represents an abundant agro-industrial byproduct rich in bioactive compounds, particularly anthocyanins and phenolic compounds, with significant antioxidant potential. This study aimed to evaluate the efficiency of ultrasonic-assisted solvent extraction in recovering phytochemicals from eggplant peel and to assess the antioxidant activity of the obtained extracts. Freeze-dried eggplant peel powder was subjected to extraction using 70% ethanol, methanol, and acetone. The extraction process involved centrifugation and ultrasonic treatment (40 kHz, 40°C, 30 minutes). The phytochemical profile of the extracts was characterized by determining total monomeric anthocyanins (TAC), total phenolic content (TPC), and total flavonoid content (TFC). Antioxidant activity was evaluated using DPPH and ABTS radical scavenging assays. The results indicated that 70% ethanol was the most effective solvent, yielding the highest concentrations of anthocyanins and phenolic compounds, as well as superior antioxidant activity. In comparison, methanol and acetone extracts showed lower extraction efficiency and antioxidant potential. These findings highlight the potential of eggplant peel as a valuable source of natural antioxidants and support the use of green extraction techniques for the valorization of vegetable byproducts. The recovered bioactive compounds may serve as natural alternatives to synthetic additives in food applications.

Keywords: bioactive compounds, antioxidant activity, eggplant peels, ultrasound treatment.

F.52. THE SENSORY CHARACTERISTICS OF VEGAN MUFFINS WITH RICE FLOUR AND ALMOND MILK

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Abstract. Vegan muffins are related to alternatives for people with lactose intolerance, as they completely eliminate dairy ingredients responsible for digestive side effects.

The study investigates the production of vegan muffins using rice flour (60%) and almond milk (30%), as a gluten-free alternative to traditional pastries. The research highlights the properties of rice flour, appreciated for its high digestibility and low allergen content. At the same time is analysed the role of almond plant-based milk in optimizing the texture and improving the nutritional profile of the final product.

The sensory analysis was carried out on a panel of 22 semi-trained evaluators, using a 9-point hedonic scale (1 = unpleasant, 9 = extremely pleasant). The nutritional and sensory parameters were evaluated: appearance, colour, aroma, taste, texture and overall acceptability. The product obtained an average score of 8.1 ± 0.6 for appearance, being appreciated for its uniformity of colour and adequate volume. The aroma recorded 7.9 ± 0.7 , with predominant notes of almond and vanilla. The texture was rated 7.6 ± 0.8 , with some reviewers reporting a slight friability specific to rice flour. The overall acceptability reached an average score of 8.0 ± 0.5 , indicating a high level of preference and favourable commercial potential. The results indicate the achievement of a product with adequate structure, pleasant taste and balanced energy value.

The conclusions support the potential of this formula in the development of vegan products for people with gluten intolerance and improving the quality of life of these consumers.

Keywords: functional product, gluten free, muffins, rice flower, vegan

F.53. DEFINING SAFE THERAPEUTIC WINDOW: THE ROLE OF *ALLIUM CEPA* TEST IN THE TOXICOLOGICAL VALIDATION OF MEDICINAL PLANTS EXTRACTS

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Abstract. The safety profile of medicinal plants is intrinsically linked to the dosage and frequency of consumption, as complex interactions between bioactive compounds can accidentally trigger toxic responses. Consequently, there is an imperative scientific requirement to establish precise safety thresholds and therapeutic windows for herbal extracts.

The *Allium cepa* assay serves as a premier *in vivo* cytogenetic model for this purpose, offering a highly sensitive first-tier assessment of dose-dependent genotoxicity and cytotoxicity.

By examining the mitotic activity and chromosomal integrity of onion root meristematic cells, researchers can identify specific cellular disruptions – such as chromosomal bridges, fragments, and c-mitosis – induced by herbal compounds.

This plant-based system effectively bypasses the logistical and ethical constraints of animal models while providing data that correlates strongly with results from higher organisms. Consequently, the *Allium cepa* test represents a reliable, cost-effective, and reproducible standard for the preliminary safety screening of plant-derived extracts, ensuring that only the most viable candidates proceed to advanced clinical evaluation.

The ongoing evolution and standardization of the *Allium cepa* test continue to reveal its significant scientific utility, offering a streamlined alternative to more complex bioassays. In recent years, the trend toward sustainable 'green toxicology' has prioritized the development of such plant-based systems to reduce reliance on sophisticated, high-cost experiments. This shift underscores the assay's role as a versatile tool that balances environmental responsibility with rigorous scientific inquiry.

Keywords: *Allium cepa* L., plant extracts, safety, sustainable green toxicology.

F.54. MORPHOLOGICAL AND STRUCTURAL TRANSFORMATIONS IN EGGSHELL-DERIVED BIOSORBENTS FOLLOWING HEAVY METAL EXPOSURE

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Abstract. The increasing presence of heavy metal ions in industrial wastewater remains a critical global environmental challenge. Conventional treatment methods are often cost-prohibitive and chemically intensive, necessitating the development of "green" alternatives. Eggshells, common by-products of the food industry, offer a high-potential solution due to their significant calcium carbonate content and porous architecture.

The biosorption capacity of eggshell powder for the removal of lead and zinc from aqueous solutions was investigated, along with the specific morpho-structural changes undergone following exposure of the biosorbent to heavy metal ions.

In this view, the samples were analyzed using a multi-analytical approach. Fourier-Transform Infrared (FTIR) and Raman spectroscopies were employed to identify shifts in functional groups, specifically carbonates. Surface topography and elemental distribution were mapped using Scanning Electron Microscopy coupled with Energy-Dispersive X-ray Spectroscopy (SEM-EDX), while phase transformations and crystallinity were monitored via X-ray Diffraction (XRD).

Analytical data reveal some morphological variations, including surface roughening. By correlating structural modifications with adsorption efficiency, this research validates the use of eggshell powder as a high-performance, low-cost, and eco-friendly biosorbent, contributing to the circular economy and sustainable wastewater management.

Keywords: food by-product, heavy metal, biosorption, FTIR, RAMAN, SEM-EDX, X-ray diffraction.

F.55. BRIDGING HERITAGE AND SUSTAINABILITY: A REASSESSMENT OF ANCIENT DYEING TECHNIQUES FOR MODERN APPLICATIONS

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Abstract. For millennia, natural dyes derived from botanical and mineral sources represented the pinnacle of human ingenuity, blending artistic expression with complex chemical processes. While the late 19th century shift toward synthetic colorants offered industrial efficiency, it introduced significant environmental toxicity. Today, the global imperative for biodegradable and renewable alternatives has sparked a renaissance of natural pigments. This study proposes an interdisciplinary framework that integrates the analysis of historical manuscripts with contemporary chemical investigations. The goal is to decode ancestral dyeing protocols and evaluate their viability as sustainable solutions for the modern textile and cosmetic industries. The research adopts a dual-track methodology. First, historical documents and recipes are scrutinized to reconstruct ancient dyeing technologies and mordanting practices. Second, these processes are analyzed through a chemical lens to identify the bioactive compounds, such as flavonoids, anthraquinones, etc., responsible for color fastness and hue. The subjected plant dyes were madder (for reds/oranges), weld (for yellows) and woad or dyer's pastel (for blues). Our review revealed that ancient artisans possessed an empirical understanding of pH-dependent reactions and metal-complexation (mordanting) that mirrors modern coordination chemistry. By rediscovering these forgotten chemical pathways, circular coloring processes that prioritize non-toxicity and low environmental impact can be developed. This study concludes that the fusion of historical heritage and green chemistry provides a robust foundation for the next generation of sustainable colorants.

Keywords: natural dyes, ethno-chemistry, sustainable colorants.

F.56. ENHANCING H₂ MASS TRANSFER IN EX-SITU BIOMETHANATION: THE ROLE OF MICROBIAL CONVERSION

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Abstract. Biological methanation of CO₂ using H₂ is a key enabling process for Power-to-Gas (PtG) technology [1] and biogas upgrade [2]. However, its efficiency is strongly limited by the gas–liquid mass transfer of hydrogen due to its low solubility and diffusivity in aqueous media [3]. This study investigates hydrogen mass transfer dynamics under thermophilic biomethanation conditions (45 °C) using an enriched mixed microbial culture dominated by methanogenic *Archaea*.

Experiments were performed in a 1,060 cm³ pressurized, double-jacketed stainless-steel reactor with a 500 mL working volume and a constant stirring speed of 300 rpm. A modified basal anaerobic medium (BA) [4] supplemented with NaHCO₃ at 6.72 g/L and reduced by introducing 0.3 g/L of Na₂S 9H₂O was employed to ensure both pH stability and optimal nutrient availability for the microbial consortium.

A dual experimental approach was implemented: volumetric mass transfer coefficient (k_{La}) was

first determined in sterile medium using the classical dynamic gassing–degassing method [5], and then evaluated in the presence of active biomass.

A central contribution of this work is the development of a coupled modelling framework for the simultaneous estimation of the mass transfer coefficient (k_{La}) and the volumetric hydrogen consumption rate (r_{H_2}). With increasing gas flow rates from 100 to 200 mL·min⁻¹ at a CO₂/H₂ ratio of 4, the model revealed specific hydrogen consumption rates ranging from 103.5 ± 0.5 to 109 ± 1 μmol g⁻¹ s⁻¹ (0 bar). Under active culture conditions, performance significantly exceeded that of abiotic controls, with k_{La} values reaching 0.038 s⁻¹ compared to 0.025 s⁻¹ respectively, while exhibiting an upward trend with rising gas flow rates. These results underscore the high metabolic activity of the mixed culture and confirm that the biological reaction is strongly governed by hydrogen bioavailability and reactor operating conditions. To characterize the gas-liquid interfacial area, a dedicated visualization cell was utilized to capture high-frequency images of bubble dynamics. A YOLO-based multitask architecture (YOLO26x-HBB and OBB) was implemented to automate bubble detection and volume estimation, enabling accurate determination of bubble size distribution and Sauter mean diameter (D_{32}) under turbulent conditions. Overall, this study demonstrates that combining direct dissolved hydrogen measurements with robust modelling is essential for accurately characterizing and scaling biomethanation reactors. It provides new insights into the coupling between mass transfer limitations and microbial kinetics in mixed-culture systems.

Keywords: biomethanation, gas-liquid mass transfer, (microbial kinetics), volumetric mass transfer coefficient, hydrogen consumption rate, bubble size analysis, Sauter mean diameter

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F.57. CENTRAL COMPOSITE DESIGN OPTIMIZATION OF POLYPHENOL AND MINERAL REMOVAL FROM OLIVE MILL WASTEWATER BY ACIDIC CALCIUM CHLORIDE TREATMENT

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Abstract. The use of calcium chloride (CaCl₂) for olive mill wastewater (OMW) treatment is a simple and low-cost alternative to more advanced technologies such as adsorption (e.g. resins like Amberlite, activated carbon, biochar), electrochemical processes, biological treatments, or advanced oxidation. Although traditional, it remains relevant for developing scalable and low-energy treatment strategies. In practice, it enables the simultaneous removal of mineral species and polyphenols through precipitation and co-precipitation mechanisms driven by complexation

and adsorption onto formed solids. A key limitation is the formation of calcium sulfate (CaSO_4) as a by-product. Although stable and non-toxic, its reuse is strongly dependent on purity, which is often compromised in real OMW matrices due to residual organic matter and phenolic compounds. This can restrict valorization and may require additional handling steps. Despite this, calcium carbonate remains attractive for OMW treatment due to its simplicity, robustness, and low cost, particularly in contexts where advanced technologies are not economically or operationally feasible.

This study investigates the treatment of OMW under acidic conditions by the addition of calcium chloride (CaCl_2) in the presence of sulfuric acid (H_2SO_4). This effluent is characterized by an acidic pH (~ 4.5), along with high levels of turbidity (1680.00 ± 0.02 NTU), electrical conductivity (7.83 ± 0.01 dS/m), mineral content (10.10 ± 0.01 g/L), and phenolic compounds (4.01 ± 0.02 g/L, expressed as gallic acid equivalents). Under these conditions, the process is primarily governed by a precipitation mechanism arising from chemical interactions between calcium ions and dissolved species present in the effluent.

This mechanism promotes the removal of dissolved compounds, particularly phenolic compounds, while also reducing mineral content through the formation of insoluble calcium sulfate (CaSO_4) precipitates, which can be readily separated by sedimentation.

A parametric study was conducted to assess the influence of key operating variables on the efficiency of the pretreatment process. Process performance was evaluated based on the removal of phenolic compounds and mineral matter. The experimental design was developed using Response Surface Methodology (RSM) with a Central Composite Design (CCD), enabling the simultaneous analysis of the effects and interactions of the studied factors.

The results indicate that several operating parameters, particularly pH (X_1), the solid-to-liquid ratio (X_2), temperature (X_3), and treatment time (X_4), significantly affect process performance, with notable interactions between variables. The RSM models developed for phenolic compounds (Y_1) and mineral content (Y_2) were found to be highly significant and reliable, with coefficients of determination of $R^2 = 0.971$ and 0.989 , respectively. Statistical analysis using ANOVA confirms the significance and the robustness of the model, as well as its strong agreement with the experimental data. Overall, the RSM-based approach provides deeper insight into the process and facilitates the optimization of operating conditions for effective wastewater treatment.

Keywords: olive mill wastewater, calcium chloride, sulfuric acid, Response Surface Methodology.

F.58. ELECTROCHEMICAL CHARACTERIZATION AND ROTATING DISK ELECTRODE CEMENTATION OF CU(II) ON IRON AND ZINC: MASS-TRANSFER CONTROL AND LIMITED BENEFITS OF GALVANIC COUPLING

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Abstract. Cementation of copper(II) by sacrificial metals is widely used for metal recovery, yet its rate-limiting steps and the role of galvanic interactions between mixed metals remain system-dependent [1]. Here, an electrochemical study was conducted under conditions representative of a pilot cementation unit (initial $[\text{Cu(II)}] \approx 250$ ppm, pH 2.5, sulfate medium, 20°C) to (i) determine the diffusion coefficient of Cu(II), (ii) establish Evans (mixed-potential) diagrams for Cu(II)/Fe and Cu(II)/Zn, and (iii) quantify temperature effects and possible galvanic-coupling benefits using a rotating disk electrode (RDE) setup and a controlled galvanic circuit. The Cu(II) diffusion coefficient was evaluated by two complementary approaches. RDE voltammetry exhibited a diffusion–convection limiting plateau attributable to Cu(II) reduction, after correcting for oxygen reduction, enabling Levich analysis and yielding $D = 5.96 \times 10^{-10} \text{ m}^2 \cdot \text{s}^{-1}$ under the standard solution conditions. Chronopotentiometry on a stationary electrode, interpreted through Sand's law and transition-time measurements, provided a consistent mean value ($D \approx 6.23 \times 10^{-10} \text{ m}^2 \cdot \text{s}^{-1}$), supporting adoption of the voltammetric estimate for subsequent analysis [2].

Evans diagrams were constructed by superimposing cathodic Cu(II) reduction curves with anodic dissolution curves of iron and zinc. For rotation rates spanning approximately 500-1500 rpm, the anodic branches intersected the Cu(II) cathodic curve on the diffusion-convection plateau, indicating that cementation rates for both Cu(II)/Fe and Cu(II)/Zn are governed by mass transfer rather than charge-transfer kinetics [3].

Cementation experiments on RDE further assessed temperature dependence at high rotation (notably 1500 rpm). Iron displayed two apparent first-order regimes with a later acceleration phase, whereas zinc did not show a pronounced kinetic break under the tested conditions. Arrhenius analysis produced low apparent activation energies (reported values around 13.7-19.7 kJ·mol⁻¹, with a representative overall value near 14.9 kJ·mol⁻¹), consistent with diffusion-limited control. Scanning electron microscopy (SEM) revealed a dendritic copper deposit morphology comparable to that observed at pilot scale.

Finally, a galvanic-coupling configuration connecting iron and zinc electrodes through an external resistance was implemented to test whether zinc could cathodically protect iron. Although coupling altered electrode potentials and generated a measurable coupling current that decreased over time, charge-balance estimates showed that the associated zinc dissolution corresponded to only 0.03-2.6 ppm (depending on resistance), and the overall reduction in dissolved iron remained negligible. Kinetic differences under coupling were within experimental reproducibility, indicating no practically effective galvanic protection of iron in this system; thus, mixed-bed operation offers limited benefit regarding galvanic effects, though it may still mitigate acid attack on iron media.

Keywords: cementation; copper (II); rotating disk electrode; diffusion coefficient; Evans diagram; mass-transfer limitation; galvanic coupling; iron; zinc.

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F.59. RECENT ADVANCES IN THE DECADMIATION OF PHOSPHATE FERTILIZERS: REVISITING A PERSISTENT CHALLENGE

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Abstract. Chronic exposure to cadmium can lead to renal dysfunction and bone demineralization. A major pathway for cadmium entry into the food chain is the application of phosphate fertilizers, as sedimentary phosphate rocks, the primary raw material, often contain elevated Cd concentrations. During the conventional wet-process production of phosphoric acid, cadmium is not efficiently removed, leading to its persistence in downstream fertilizers and subsequent accumulation in soils and crops.

To address these concerns, a range of strategies has been proposed to reduce cadmium content at different stages of the production chain, including pre-treatment of phosphate rock, purification of phosphoric acid, and modifications to fertilizer manufacturing processes. This talk presents a comprehensive review of cadmium abatement techniques reported in both the scientific literature and patent landscape, with particular emphasis on sulfur-based precipitation processes. The discussion highlights their underlying mechanisms, removal efficiencies, operational limitations, and potential for integration into current industrial practices.

F.60. FERMENTATION OF PLANT-BASED SUBSTRATES FOR FUNCTIONAL FOOD DEVELOPMENT

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Abstract. At present, an increasing number of individuals exhibit lactose intolerance, which has intensified the food industry's efforts to develop alternative products situated at the interface of food chemistry, microbiology, and marketing. A major objective of these efforts is the development of functional foods, defined as products that, beyond providing basic nutrition, may exert beneficial health effects by improving physiological functions and reducing the risk of certain disorders. In this context, plant-based substrates are being extensively investigated as raw materials for functional food formulation, representing a viable alternative to conventional dairy products and lactose-free dairy products. A diverse range of plant-based beverages is currently available on the market, produced from soy, almonds, coconut, oats, or rice, and used both as substitutes for animal-derived milk and as ingredients in various food products. An analysis of consumer behavior over a 14-day period indicated an increased preference for plant-based beverages based on soy, almonds, coconut, and rice. These products are frequently used as ingredients in confectionery and bakery products, as additions to coffee or tea, and for direct consumption. The primary aim of this study is to use plant-based beverages as raw materials for the development of functional foods with improved nutritional value through appropriate technological processing. The selection of plant raw materials, such as almonds and cashew nuts, was supported by their content of high-quality lipids, proteins, dietary fiber, and bioactive compounds, as well as by their potential to be valorized into products with a balanced and sustainable nutritional profile. In this paper, almond and cashew seeds were used to produce plant-based beverages, which were subsequently transformed into functional fermented foods by inoculation with selected lactic acid bacteria cultures. Lactic fermentation, used as a technological operation, may offer advantages such as improved nutrient digestibility, reduction of certain anti-nutritional compounds, generation of potentially beneficial metabolites, and enhancement of the sensory profile of the products. The lactic fermentation process was conducted under mesophilic conditions, resulting in fermented products with good technological performance and improved functional properties. From the perspective of consumer acceptability, formulation optimization is required through the addition of stabilizers, sweeteners, or flavor enhancers in order to improve texture, taste, and overall stability of the final products.

Keywords: almonds, cashews, lactic acid bacteria, lactic fermentation, sensory analysis, titratable acidity.

F.61. INTEGRATION OF THE CONCEPTS OF SUSTAINABLE CHEMISTRY AND CIRCULAR ECONOMY IN THE CURRICULUM OF SCHOOL ACTIVITIES AT MIDDLE LEVEL EDUCATION

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Abstract. The transition to a circular economy requires an educational paradigm shift that integrates resource efficiency and green chemistry into students' early training. The development of ecological competencies in pre-university education represents an essential pillar for the success of the circular economy. This study investigates the effectiveness of active learning methodologies in developing ecological competencies at the lower secondary education level. Through a quasi-experimental design, the research compares traditional learning methods with a modern, STEM-integrated approach focused on the concepts of circular economy and sustainable chemistry. The results demonstrate a significant evolution in student performance, with success rates increasing from the initial testing stage to the post-testing stage. The obtained results confirm that, although both methods improve theoretical knowledge, the STEM approach superiorly facilitates critical thinking and the ability to apply concepts in real-world contexts. Furthermore, the study emphasizes the importance of fostering an environmentally friendly attitude among students, encouraging a commitment to sustainability as well as their active involvement in pollution prevention.

Keywords: sustainable chemistry, circular economy, ecological competencies, traditional learning methods, modern learning methods, STEM

F.62. PHARMACEUTICAL MIXTURES IN AQUATIC SYSTEMS: DEVELOPMENTAL DISRUPTION BY IBUPROFEN AND VALPROIC ACID IN ZEBRAFISH LARVAE

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Abstract. Pharmaceutical residues are increasingly recognized as emerging contaminants in aquatic ecosystems, where their simultaneous presence may pose risks to early developmental stages of aquatic organisms. Ibuprofen (Ibu) and valproic acid (VPA) are widely used drugs that can reach freshwater environments through wastewater discharge, yet the effects of their combined exposure remain poorly understood. This study evaluated the individual and mixture effects of environmentally relevant concentrations of Ibu (20 µg/L) and VPA (3 µg/L) on the behavior of *Danio rerio* larvae. Newly hatched zebrafish larvae (72 hpf) were exposed for 96 hours, after which behavioral responses were assessed using a light/dark experiment to examine locomotory activity and anxiety-related parameters across both photoperiods. The results revealed that both pharmaceuticals altered larval behavior, with significant changes in swimming activity and anxiety indices. While single exposures produced measurable disruptions, the mixture of Ibu and VPA induced more pronounced behavioral impairments, suggesting potential additive or synergistic effects. These findings indicate that the co-occurrence of such pharmaceutical pollutants in natural waters may exacerbate neurobehavioral disturbances in early stages of aquatic organisms, potentially compromising their survival, predator avoidance, and overall developmental success.

Keywords: valproic acid, ibuprofen, mixture, zebrafish, pollution.

F.63. BEHAVIORAL ASSESSMENT OF CEFTAZIDIME AND POLYSTYRENE MICROPLASTICS IN ZEBRAFISH USING THE NOVEL TANK TEST

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Abstract. Antibiotics and microplastics are increasingly recognized as emerging pollutants of concern, yet their combined biological effects in aquatic organisms remain insufficiently characterized. This study investigated the behavioral impact of ceftazidime (CAZ 50 µg L⁻¹), polystyrene microplastics (PS MPs 1 mg L⁻¹), and their mixture on adult zebrafish using the Novel Tank Test, a sensitive tool for detecting alterations in anxiety-like behavior, locomotion, and exploratory patterns. Following a 96-hour exposure, behavioral endpoints were quantified from both top and side views, including thigmotaxis, time spent in the upper and bottom side of the tank, mobility states, total distance moved, velocity, and rotational behavior.

Exposure to either CAZ or PS MPs independently altered zebrafish behavior, while the mixture induced the most pronounced behavioral disturbances. Both contaminants significantly increased thigmotaxis, a hallmark of elevated anxiety-like responses. Vertical exploration was likewise reduced, with fish from the mixture group showing a marked reduction in time spent in the upper-zone of the tank. Additionally, rotational behavior (clockwise and counterclockwise) was elevated in all exposed groups.

Overall, the mixture consistently produced additive or potentially synergistic effects across behavioral parameters, compared with individual exposures. These findings highlight the sensitivity of the Novel Tank Test for detecting sublethal behavioral alterations and underscore the relevance of zebrafish as an animal model for environmental contamination. Importantly, this work emphasizes the need for integrated assessment approaches that consider combined pollutant interactions when evaluating ecological risks and designing strategies for environmental protection.

Keywords: ceftazidime, polystyrene microplastics, zebrafish behavior.

F.64. EQUILIBRIUM INSIGHTS INTO AZO DYE REMOVAL USING A WASTE-DERIVED POLYMER COMPOSITE ADSORBENT

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Abstract. This study reports the development of a novel adsorbent material based on an inert polymer matrix loaded with cherry stone powder, an underutilized agricultural byproduct. The resulting composite was characterized as porous, and structural analyses confirmed the successful incorporation and stable immobilization of the biomass within the polymeric framework. The adsorption performance of the material was investigated using a model azo dye, demonstrating

efficient and rapid removal from aqueous solution under the studied conditions. Equilibrium behavior was thoroughly examined through a comprehensive isotherm analysis using Langmuir, Freundlich, Jovanović, Temkin, Toth, Sips, Redlich–Peterson, and Khan models, all of which showed generally good agreement with the experimental data. Among them, the Khan isotherm provided the best fit, while the Sips model predicted the highest adsorption capacity. Overall, the results indicate a heterogeneous adsorbent surface and a multilayer adsorption mechanism consistent with Freundlich-type behavior, highlighting the material's potential for wastewater dye remediation applications.

Keywords: adsorption, cherry stone powder, polymer composite, azo dye removal, isotherm modeling.

F.65. EMPIRICAL MODELING OF DENSITY IN AQUEOUS ETHYLENE GLYCOL SOLUTIONS AS A FUNCTION OF TEMPERATURE AND CONCENTRATION

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Abstract. Ethylene glycol – water mixtures are employed in a variety of industrial applications ranging from heat transfer fluids in heating, ventilation and air conditioning systems to solvents used in chemical processing. Their extensive application and the need for accurate thermophysical property data – particularly density – for efficient design, optimization and safe operation motivate the present study. The analyzed thermophysical property was modeled as a function of temperature and solute concentration, which are the primary variables influencing mixture behavior and phase characteristics.

Tabular data collected over a relevant range of temperatures and concentrations were correlated using a second-order polynomial model. The model demonstrated high accuracy across the investigated conditions. Its performance was evaluated using several statistical error metrics, including the sum of squared errors, average relative error, root mean square error, standard deviation of relative error, sum of absolute errors, and the coefficient of determination. The low deviation values and strong correlation confirm that the proposed model is reliable, accurate and suitable for process simulation and engineering applications.

Keywords: ethylene glycol – water mixture, density, mathematical modelling.

F.66. UVOLOGICAL EVALUATION OF SIX GRAPE VARIETIES FOR WHITE AND RED WINES GROWN IN NORTH-EAST ROMANIA

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Abstract. Uvological analysis aims to evaluate the mechanical composition of grapes, expressed through the gravimetric and numerical ratios between their structural elements, defined as uvological units: berries, clusters, skins, pulp, and seeds. This research focuses on investigating the mechanical structure and uvological indices of four white grape varieties: *Fetească albă* (FA), *Fetească regală* (FR), *Galbenă de Odobesti* (GO), and *Chasselas Doré* (CD), alongside two red varieties: *Cabernet Sauvignon* (CS) and *Merlot* (M). The analyzed samples were harvested from

vineyards within Vrancea County, Romania, during the interval of September 25 to October 15, 2025. The technological potential of the selected cultivars was assessed via their constituent uvological units. The proportions of each structural component within the clusters and berries were

quantified, alongside must yields. Based on these measurements, the primary uvological indices were calculated: the structure index (SI), expressing the ratio of berry weight to stalk weight; the berry index (BI), representing the number of berries per 100 g of grapes; the berry composition index (BCI), defined as the mesocarp-to-epicarp ratio; and the yield index (YI), indicating the ratio between must and pomace. Additionally, the sugar content, total acidity, and gluco-acidimetric index of the berries were systematically measured.

The average bunch weight was 129.83 g (FA), 200.6 g (FR), 188 g (GO), 151.75 g (CD), 143.15 g (CS), and 156.83 g (M). Among the six cultivars studied, the highest sugar concentration was identified in the FA variety, averaging 233 g/L with a total acidity of 7.2 g/L tartaric acid. Conversely, the lowest sugar content was observed in the GO variety, with an average of 210 g/L and a total acidity of 5.7 g/L tartaric acid.

The technological suitability of the studied grape varieties (FA, FR, GO, CS, and M) in the Vrancea viticultural region, as reflected by their uvological indices, confirms their high potential for the production of wines with protected designation of origin status (PDO).

Keywords: berry, bunch, grape maturity indices, wine grapevine varieties, yield index.

F.67. ANIMAL-DERIVED MATERIALS USED IN MILK COAGULATION. CONSIDERATIONS REGARDING KOILIN AS AN ENZYMATIC BIOMATERIAL

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Abstract. Milk coagulation is a fundamental step in dairy technology, especially in cheese making, which consists in transforming the colloidal system of casein into a three-dimensional gel, under the action of enzymatic or acidic factors. Traditionally, coagulation is performed using proteolytic enzymes of animal origin, but the development of the food industry and consumer demands have led to the exploration of plant and microbial alternatives. În acest context, cercetările recente investighează și alte surse biologice de activitate enzimatică, inclusiv structuri naturale precum koilina din pipota păsărilor [1], analizată din perspectiva unui posibil biomaterial funcțional.

Chymosin, the main enzyme in animal rennet, acts specifically on the Phe105–Met106 bond in κ -casein, initiating the coagulation process [1]. The specificity of this reaction is essential for obtaining a curd with optimal textural properties and yield.

In addition to chymosin, other proteolytic enzymes, such as pepsin, can also be used. However, they have lower specificity and can generate excessive proteolysis, negatively affecting the texture and flavor of cheeses [2].

Koilina, from a structural point of view, is a natural biomaterial composed of proteins and polysaccharides, organized in a matrix resistant to mechanical and chemical actions, but indicates the presence of chitinolytic enzymes in the pith, such as: endochitinases, β -N-acetylglucosaminidases [1], which degrade food proteins, plant debris, prevent tissue autodigestion and regulate contact between enzymes and the mucosa.

Therefore, koilin cannot be considered a coagulant per se, but can be interpreted as a functional biomaterial with a supporting role for enzymatic activity, similar to immobilized enzyme systems used in biotechnology [3].

Research has shown that the coagulation dynamics of koilin were comparable to food chymosin, a preparation marketed specifically for cheese coagulation, and a much lower efficiency (approx. 40%) of CaCl₂. This aspect highlights the possibility of using koilin in food preparations based on casein coagulation.

Keywords: koilin membrane, gizzard, milk coagulation

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F.68. STUDY ON PDO AND PGI CERTIFICATIONS IN THE ROMANIAN WINE SECTOR

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Abstract. In the European Union, wine is not a simple agricultural product, it is an expression of place, climate and tradition. Precisely to defend this identity and to offer consumers the guarantee that what they are buying is authentic, the PDO (Protected Designation of Origin) and PGI (Protected Geographical Indication) certification systems were established.

Romania is among the Member States with one of the most structured legislative frameworks in this field. The vitivinicultural sector is regulated by the Vine and Wine Law no. 244/2002 (republished), as well as by EU Regulations no. 1308/2013 and no. 1151/2012. The authority responsible for control and certification is the National Office for Vine and Vitivinicultural Products (ONVPV), which manages the Vineyard Register, approves product specifications, and issues certification documents prior to the release of wines for consumption.

The certification system in Romania has two distinct levels, each with its own requirements and philosophy. Wines with a Controlled Designation of Origin (DOC), the equivalent of PDO, represent the highest level of certification. The link between wine and territory is strict: the grapes must come entirely from a delimited area, vinification and bottling are carried out exclusively in that area, and yields are capped by the specifications, usually between 6,000 and 10,000 kg/ha, precisely to favor quality over quantity.

A distinctive feature of the Romanian model is the additional classification according to the moment of harvest: DOC-CMD (Harvested at Full Maturity, minimum sugar content 187-190 g/L), DOC-CT (Late Harvest, minimum sugar content 213-220 g/L) and DOC-CIB (Harvested after Noble Rot, with Botrytis cinerea infection, minimum sugar content 240 g/L), intended for exceptional sweet wines.

Wines with Geographical Indication (IG), the equivalent of PGI, occupy an intermediate tier. Requirements are less stringent: at least 85% of grapes must originate from the indicated area, yields may be higher, and permitted oenological practices are more flexible. These wines capitalize on regional reputation without the strict constraints imposed on DOC wines. Romania benefits from remarkable pedoclimatic diversity, distributed across eight officially recognized wine regions. The main areas with DOC certifications include: Moldavian Hills, Transylvanian Plateau, Muntenia and Oltenia Hills, Dobrogea Hills. PDO/PGI certifications have concrete and complementary roles. Legally, they function as a protection mechanism against counterfeiting, protecting both producers and consumers. Economically, the impact is direct: European studies indicate that certified wines sell, on average, at twice the price of similar uncertified wines.

Overall, the DOC and PGI system has given Romania the opportunity to rediscover its oenological identity and protect heritage varieties: Feteasca Neagră, Grasa de Cotnari, Crâmpoșia

de Drăgășani, Negru de Drăgășani, under internationally recognized designations of origin. The future direction is clear: educate consumers and, where appropriate, progressively raise standards, in order to consolidate the position of Romanian wines in the premium segment.

Keywords: PDO, PGI, Romanian wine sector, DOC, EU regulations, indigenous varieties

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F.69. VALORISING OF RED GRAPE SEED POWDER IN THE PRODUCTION OF FUNCTIONAL GOAT MILK YOGURT

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Abstract. The increasing consumer interest in functional and sustainable foods has led to the development of innovative dairy products with high biological value. In this context, the present study investigates the use of red grape seed powder, obtained as a by-product of the wine industry, in the formulation of a functional goat milk yogurt. Red grape seed powder represents an important source of bioactive compounds, especially polyphenols, flavonoids and dietary fiber, with antioxidant effect and potential beneficial effects on human health. The aim of the research was to evaluate the influence of the addition of red grape seed powder (0% - 2%) on the physicochemical, microbiological and sensory properties of goat milk yogurt. The results showed that the addition of grape seed powder contributed to improving the structural stability of the yogurt, by reducing syneresis and water retention capacity. At the same time, powder additions between 0.5–1% maintained a high level of sensory acceptability, giving the product a slightly fruity aroma and an attractive colour. From a microbiological point of view, the total germ count (NTG) was within appropriate limits, which demonstrates the stability and microbiological safety of the product. The study demonstrates the potential of valorising by-products from the wine industry in the development of sustainable functional foods and highlights the possibility of obtaining an innovative goat milk yogurt with improved nutritional properties.

Keywords: goat milk, functional yogurt, red grape seed powder, sustainability.

F.70. NANOEMULSIONS: FORMULATION AND PROPERTIES

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Abstract. Nanoemulsions are liquid-liquid systems, either water in oil (W/O) or oil in water (O/W) droplets stabilized by an amphiphilic surfactant, with droplet sizes ranging from 20 nm to 500 nm. The small particle size provides a high surface area per unit volume, stability in time, transparent/translucent appearance and adjustable rheological properties. Nanoemulsions are widely used in various fields such as food engineering, cosmetics, pharmaceuticals, and material synthesis for emerging applications, including thermal energy storage and advanced cooling systems. In the food industry, nanoemulsions are increasingly applied to improve the stability, bioavailability, and organoleptic properties of functional ingredients such as flavors, vitamins, and nutraceuticals, while also enhancing product texture and extending shelf life. In the cosmetic industry, nanoemulsions are used for the controlled delivery of active ingredients and for improved dispersion of functional compounds, particularly within the skin layers, enhancing their efficacy and absorption. They can be formulated in various forms such as creams, foams, liquids, and sprays. The main nanoemulsion preparation techniques, classified in low and high energy methods, are reviewed, namely phase inversion temperature (PIT) and emulsion inversion point (EIP) as well as high pressure homogenization (HPH) and ultrasonication. Furthermore, recent methods are presented including air bubble-bursting at oil/water interface, evaporative ripening or aqueous phase condensation on an oily liquid film. An important aspect in obtaining nanoemulsions is the droplet size control. The major influencing parameters are the residence time, the relative viscosity of the dispersed phase to that of the continuous phase, the surfactant concentration and the surfactant length. The most relevant nanoemulsion characteristics are reviewed and discussed, with a focus on important parameters for food engineering applications, namely pH, viscosity, stability, appearance, and their influence on product quality, shelf life, and the controlled delivery of bioactive compounds.

Keywords: nanoemulsions, influencing factors, characteristics.

F.71. DEVELOPMENT OF AN ELECTROCHEMICAL SENSOR FOR THE SIMULTANEOUS DETECTION OF Cd(II) AND Hg(II) WITH MACHINE LEARNING-BASED PARAMETER OPTIMIZATION

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Abstract. This study describes the development and optimization of an electrochemical platform for the simultaneous detection of Cd(II) and Hg(II) in aqueous media. The analytical system is based on a glassy carbon rotating disk electrode (GC-RDE), modified with Bi₂O₃ nanoparticles embedded in a hybrid polymer matrix of chitosan and polyvinyl alcohol (Chit:PVA), selected for its superior stability and adhesion to the electrode surface. The use of bismuth as an environmentally friendly alternative to mercury-based electrodes enables efficient metal detection through distinct deposition and stripping mechanisms. The optimization of the platform targeted both the composition of the modifying layer and the experimental conditions, highlighting superior performance in ammonium buffer (pH 9), due to improved deposition kinetics and enhanced stability and intensity of the voltammetric signal. A key step involved the generation of an experimental dataset comprising 200 voltammograms, obtained by varying the modulation amplitude (0.01–0.1 V) and frequency (12.5–26.5 Hz), while other parameters, such as rotation speed, deposition time, and deposition potential, were kept constant. This dataset was used to train a Machine Learning model capable of identifying the optimal combination of electrochemical parameters, in order to simultaneously maximize current intensity and achieve a shift of peak potentials toward more negative values for both analytes. The optimized parameters were subsequently employed to construct calibration curves in the concentration range of 0–100 μM, showing good linearity and sensitivity, with limits of detection in the micromolar range. The integrated approach, combining electrochemical detection with Machine Learning-assisted

optimization, provides a robust tool for heavy metal monitoring and opens perspectives for the development of intelligent systems for water quality assessment.

Keywords: electrochemical detection, stripping voltammetry, bismuth oxide nanoparticles, machine learning, environment.

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F.72. AMPHIPHILIC CYCLODEXTRIN DERIVATIVES: DESIGN, SYNTHESIS AND EVALUATION AS AMYLOID-B AGGREGATION INHIBITORS FOR ALZHEIMER’S DISEASE

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Abstract. Neurodegenerative diseases are characterized by the accumulation of amyloid plaques in the brain, resulting from the degradation of amyloid- β 42 (A β 42) peptide, a process driven by its central α process hydrophobic KLVFF motif. β -cyclodextrin (β -CD), due to its biocompatibility, its ability to improve the solubility of hydrophobic molecules, and its potential to cross the blood-brain barrier, is a promising platform for the delivery and development of therapeutic compounds intended for the treatment of neurodegenerative diseases such as Alzheimer's disease (AD). The objective of this project is to design an A β 42 inhibitor based on mono-amino- β -CD conjugated to a KLVFF-mimetic peptide, while improving its solubility and penetration into the brain. In this study, the KLVFF-mimicking peptides will be synthesized from the original sequence and improved variants, then combined with modified β -CD. Consequently, a series of conjugates will be obtained and evaluated in terms of their ability to inhibit A β 42 aggregation. This work is currently in progress. The KLVFF- β -CD conjugates and their mimetic versions will undergo analysis to identify those most effective in preventing aggregation and neutralizing toxicity linked to soluble forms of A β . The present project has the potential to contribute to the development of new therapeutic approaches targeting the preliminary stages of Alzheimer's disease (AD).

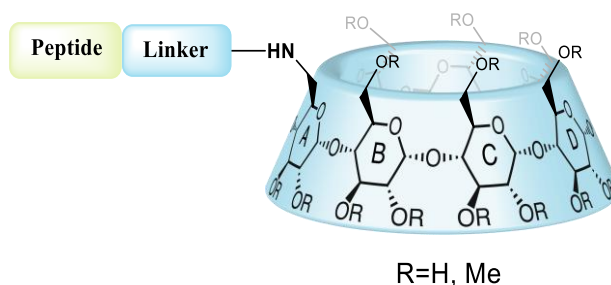


Figure 1. This is a model of target molecules against Amyloid A β 42 aggregation

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F.73. STUDY OF THE IMPACT OF COMPLEXATION OF B-CYCLODEXTRINE WITH ETHANOLIC EXTRACT OF CINNAMOMUM VERUM, ZINGIBER OFFICINALE AND PIMPINELLA ANISUM ON THEIR BIOLOGICAL ACTIVITIES

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Abstract. Cyclodextrins (CD) are cyclic oligosaccharides containing 6, 7 or 8 units of glucose (α , β or γ cyclodextrine) which are bound together by a glycosidic bond (1-4), they result from the degradation of starch by enzymes. Cyclodextrins (CD) are widely used as a drug carrier in pharmaceutical industries to improve their solubility, bioavailability and stability and have been approved by the FDA (Food and Drug Administration). Encapsulation of bioactive compounds can also offer other benefits in addition to protection from external factors such as water, oxygen, heat and light, in addition, encapsulation can improve shelf life and avoid interference with product performance by masking unwanted odors and flavors. In this study we prepared inclusion complexes of ethanolic extract of *Cinnamomum verum*, *Zingiber officinale* and *Pimpinella anisum* in β -cyclodextrin and evaluated their antioxidant activity by DPPH and ABTS test, the antidiabetic activity by inhibition of α -amylase and α -glucosidase and at the end we evaluated the neuroprotective activity by inhibition of acetylcholinesterase and Butylcholinesterase. All samples showed a biological activity (antioxidant, antidiabetic and neuroprotective activity). Comparing the results of ethanolic extracts of *Cinnamomum verum*, *Zingiber officinale* and *Pimpinella anisum* with those of inclusion complexes, we observed an increase in their biological activity. CD complexation of a biologically active extract is advantageous as it protects bioactive molecules from light, pH, the moisture induced degradations phenomena which serve to increase their bioavailability and it protects them even from elevated temperature.

Keywords: β -cyclodextrine, *Cinnamomum verum*, *Zingiber officinale*, *Pimpinella anisum*, inclusion complexes, biological activity.

F.74. DESIGN AND OPTIMIZATION OF A GREEN EXTRACTION PROCESS FOR POLYPHENOLS FROM VIOLA TRICOLOR

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Abstract. Polyphenols are among the most abundant bioactive compounds in the human diet, naturally occurring in various plant matrices, including fruits, vegetables, and flowers. Characterized by multiple phenolic structural units, these compounds exhibit strong antioxidant properties and an exceptional capacity to neutralize free radicals. Beyond their nutritional role, polyphenols are associated with a wide range of health benefits, including anti-inflammatory, anticancer, cardioprotective, and antidiabetic effects, as well as contributions to gut health and metabolic regulation. By protecting essential biomolecules such as proteins, lipids, and carbohydrates from oxidative damage, they play a key role in reducing the risk of chronic diseases. Among polyphenols, flavonoids represent a major subclass of secondary metabolites in

plants, distinguished by their structural diversity and a broad spectrum of biological activities, including antioxidant, anti-inflammatory, and antiviral effects, which further enhances their importance as valuable nutraceuticals. *Viola tricolor* L., commonly known as heartsease or wild pansy (family *Violaceae*), is a medicinal plant rich in bioactive compounds, particularly polyphenols (up to 109.32 ± 1.29 mg gallic acid equivalents/g extract), and is widely recognized for its diverse pharmacological properties, including antioxidant, anti-inflammatory, antimicrobial, cytotoxic, sedative, immunomodulatory, anxiolytic, and anticonvulsant activities, attributed to the presence of flavonoids, phenolic acids, catechins, coumarins, and polysaccharides. The extraction and isolation of polyphenols, including flavonoids, from plant matrices is a critical step for their valorisation. Conventional extraction methods typically rely on organic solvents such as methanol, acetone, or ethyl acetate, as well as techniques like ultrasonic- or microwave-assisted extraction. Although these approaches can provide satisfactory yields, they present several limitations, including environmental concerns, solvent toxicity, high operational costs, and the potential degradation of sensitive bioactive compounds. Moreover, conventional solvents often show limited efficiency in extracting compounds with varying polarities and may leave undesirable residues, thereby affecting the safety and quality of the final extracts. These drawbacks highlight the need for the development of greener, safer, and more efficient extraction strategies. In this context, Deep Eutectic Solvents (DESs) have emerged as promising alternatives within the framework of green chemistry. DESs are formed through hydrogen bond interactions between hydrogen bond donors and acceptors, resulting in systems with tunable physicochemical properties, such as low toxicity, high biodegradability, and adjustable solvation capacity. These characteristics enable DESs to enhance extraction efficiency while reducing environmental impact and preserving the structural integrity and bioactivity of polyphenols and flavonoids. The performance of DES-based extraction is strongly influenced by parameters such as solvent composition, extraction time, temperature, and solid–liquid ratio, making process optimization essential for maximizing yield and selectivity. Therefore, this study focuses on the extraction of polyphenols and flavonoids from *Viola tricolor* using natural deep eutectic solvents, aiming to develop a sustainable and efficient extraction process. Five types of natural deep eutectic solvents (DESs – Table 1), based on betaine, were prepared using a heating-assisted method. Initially, the two DES components were combined in a glass flask and stirred on a magnetic stirrer under controlled temperature conditions (80 °C). The mixture was continuously stirred for 60 minutes until a homogeneous phase was formed. Subsequently, the system was allowed to equilibrate at room temperature for 30 minutes, resulting in a clear, transparent, and colorless concentrated NADES solution. Polyphenols present in the samples were extracted employing both agitation-assisted and ultrasound-assisted extraction techniques, and analyzed using Folin-Ciocalteu method.

Abbreviation	HBA	HBD	Composition ratio (mol/mol)	Plant
NADES1	Betaine	1,3-Propanediol	1:3	
NADES2	Betaine	1,3-Propanediol	1:4	
NADES3	Betaine	1,3-Propanediol	1:6	
NADES4	Betaine	Glycerol	1:2	
NADES5	Betaine	Urea + Water	1:1:3	

The experiments primarily evaluated the influence of different solvents on polyphenol yield, leading to the selection of the optimal extraction solvent, in the case of using the maceration in vibrational field and extraction assisted with ultrasounds as extraction methods. For the most effective solvent, using a single-factor experimental design, the effects of key independent variables, including liquid-to-solid ratio (1:10, 1:15 and 1:25) extraction time (15, 30, 45 and 60 min), extraction temperature (25, 45, 60°C), for water content 40% w/w, were systematically investigated with respect to polyphenol and flavonoid content as the response variable. The results demonstrate that NADES are efficient and sustainable alternatives for the extraction of polyphenols and flavonoids from *Viola tricolor*. Among the tested systems, the betaine–propanediol NADES (1:3 molar ratio) with 40% (w/w) water content exhibited the highest extraction performance, providing the optimal yield under the investigated conditions. These results highlight the strong influence of solvent composition and hydration level on extraction efficiency, likely due to improved mass transfer and enhanced solvation capacity at reduced

viscosity. The maximum TPC value obtained was 15.66 mg GAE/mL extract following sonoextraction with NADES 1 with the parameters: S/L=1:25, T= 25 °C and 15 min. extraction time. In conclusion, the Betaine–propanediol (1:3) DES with 40% water represents a promising green solvent system for efficient recovery of polyphenols and flavonoids from *Viola tricolor*, with potential for further optimization and scale-up in sustainable extraction applications.

F.75. MECHANISTIC INVESTIGATION OF MALACHITE GREEN BIOSORPTION ON SAWDUST-ALGINATE BIOCOMPOSITES USING FTIR AND NONLINEAR KINETIC ANALYSIS

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Abstract. Understanding the biosorption mechanism is essential for the correct interpretation of adsorption performance and for the rational design, optimization, and scale-up of efficient biosorbent materials for wastewater treatment. Beyond removal efficiency, mechanistic investigations provide insight into the nature of adsorbent-adsorbate interactions, the role of surface functional groups and surface heterogeneity, as well as the processes governing adsorption rate and capacity.

In this context, the present study focuses on elucidating the biosorption mechanism of the Malachite Green cationic dye onto a sustainable biocomposite obtained by immobilizing sawdust within a calcium alginate matrix.

The mechanistic interpretation is based on the combined analysis of Fourier Transform Infrared (FTIR) spectroscopy and nonlinear kinetic modeling, with emphasis on identifying the interactions responsible for dye retention.

Comparative FTIR spectra recorded before and after biosorption show noticeable shifts and changes in intensity for bands associated with hydroxyl (–OH), carboxylate (–COO[–]), and ether (C–O) functional groups, indicating their involvement in the biosorption process. These spectral modifications confirm the participation of surface functional groups derived from both alginate and lignocellulosic components in the interaction with Malachite Green molecules.

Furthermore, the presence of lignin-derived aromatic structures within the biocomposite favors π - π interactions with the aromatic rings of the dye, while additional n- π interactions involving lone electron pairs of oxygen atoms, together with hydrogen bonding, contribute to stabilizing the adsorbate-adsorbent complex. Under weakly acidic conditions, these non-electrostatic interactions play a dominant role in the biosorption mechanism, while electrostatic effects are of secondary importance.

Nonlinear kinetic modelling shows that the biosorption process is best described by the pseudo-second-order model. This kinetic behavior indicates that the biosorption rate is governed by surface interactions and the availability of active binding sites rather than by external mass-transfer limitations. The strong consistency between nonlinear kinetic behavior and FTIR observations supports a complex biosorption mechanism involving multiple concurrent phenomena, including surface interactions and diffusion within the porous structure of the biocomposite.

Overall, the results demonstrate that Malachite Green biosorption onto sawdust-alginate biocomposites proceeds through a synergistic mechanism dominated by hydrogen bonding, π - π and n- π interactions, and pore-diffusion effects, providing valuable mechanistic insight into the

performance of lignocellulosic-polysaccharide biosorbents for environmentally sustainable dye removal.

Keywords: biosorption mechanism; Malachite Green; sawdust–alginate biocomposite; FTIR spectroscopy; nonlinear kinetics

Acknowledgments: This research was funded by WOODGRADE Company Romania under the SustenWood research project, number 2/2024 (beneficiary registration number 46/20.02.2024; executor registration number 2738/22.02.2024)

F.76. NOVEL TRIFLUOROMETHYL DIHYDRO-PYRROL-2-ONE DERIVATIVES WITH ANTIMICROBIAL POTENTIAL

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Abstract. Dihydro-pyrrol-2-one derivatives are important heterocyclic scaffolds with promising antimicrobial properties [1, 2]. In this study, a one-pot, three-component Doebner-type synthesis was employed to obtain nineteen novel compounds bearing trifluoromethyl and methyl groups. The compounds were synthesized efficiently in ethanol using trifluoroacetic acid as catalyst and characterized by FT-IR, NMR, MALDI-MS, and X-ray diffraction.

Biological evaluation revealed that several derivatives exhibited antimicrobial activity against Gram-positive and Gram-negative bacteria, as well as yeast, with activity influenced by substituent variation. Notably, compounds 4i, 4s, and 4l showed a favorable balance of antimicrobial efficacy, low cytotoxicity, and good hemocompatibility. These results highlight the potential of this scaffold for the development of new antimicrobial agents targeting chronic wound infections.

Keywords: dihydro-pyrrol-2-one, Doebner synthesis, trifluoromethyl, antimicrobial activity.

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F.77. BIOCOMPATIBLE BOVINE SERUM ALBUMIN HYDROGELS COVALENTLY CROSS-LINKED WITH OXIDIZED INULIN FOR BIOMEDICAL APPLICATIONS

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Abstract. This research aims to design and characterize a new hydrogel based on biopolymers obtained through covalent interactions between bovine serum albumin (BSA) and oxidized inulin, intended for use in advanced biomedical engineering applications. The motivation for this study is the need to develop sustainable biomaterials that combine the bioactive properties of globular proteins with the versatility of functionalized polysaccharides. In this context, inulin, a natural fructan, was oxidized with sodium periodate to produce reactive dialdehyde groups. These groups can serve as natural macromolecular crosslinking agents. The presence of aldehyde groups in the modified oligosaccharide was confirmed by FT-IR and ¹H-NMR spectroscopy. The synthesis of the three-dimensional network was achieved through the formation of Schiff bases between the primary amino groups of lysine residues in the BSA structure and the aldehyde groups of oxidized inulin, thereby eliminating the need for potentially toxic synthetic cross-linking agents. The investigation of the hydrogel's physicochemical properties revealed that both the crosslink density and the porous morphology can be modified by adjusting the molar ratio of the components. The obtained hydrogels were characterized using FT-IR spectroscopy and scanning electron microscopy, and the degree of swelling was determined. The release kinetics of encapsulated quercetin were studied in two different pH environments, at pH = 7.4 and pH = 5.5, and it was found that the active principle can be released in a controlled and sustained manner over time.

Keywords: biocompatible hydrogels, bovine serum albumin, oxidized inulin.

F.78. HIGH-SENSITIVITY TXRF-BASED MULTIELEMENT SCREENING FOR ELEMENTAL COMPOSITION AND METAL IMPURITIES IN SUPPLEMENTS AND VITAMIN FORMULATIONS

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Abstract. Ensuring the quality and safety of pharmaceutical supplements requires a rigorous evaluation of their elemental composition and potential metal contaminants. Total Reflection X-Ray Fluorescence (TXRF) was used to analyze the elemental composition and metal contaminants in a range of commercial pharmaceutical supplements and vitamin formulations. Products containing Vitamin C, Vitamin D₃, B₁, B₆, zinc, propolis, and magnesium were analyzed across multiple dosage forms, including tablets, capsules, effervescent powders, and injectable solutions, using a Bruker S4 T-Star spectrometer. TXRF enables rapid multielement detection with minimal sample preparation and high sensitivity. The study identified significant differences between manufacturers regarding inorganic profiles and trace metal content. Magnesium-based supplements demonstrated strong conformity with labeled values, while some injectable Vitamin C samples contained detectable impurities, including Al, Ti, Zn, and trace Cd. Complex

formulations with natural ingredients (e.g., propolis) showed broader elemental variability. Toxic metals remained below regulatory limits. Overall, TXRF proved to be a reliable, fast, and non destructive method for routine quality control, ensuring safety, purity, and regulatory compliance of nutraceutical and pharmaceutical products.

Keywords: TXRF, trace metals, impurity screening, quality control.

F.79. A DRUG DELIVERY SYSTEM FOR BRAIN TUMOR TREATMENT USING FUNCTIONALIZED HUMAN SERUM ALBUMIN NANOPARTICLES PREPARED BY SELF-ASSEMBLY AND COVALENT CROSSLINKING WITH OXIDIZED PECTIN

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Abstract. The nanoparticles were obtained by self-assembly of human serum albumin (HSA) functionalized with low-molecular-weight protamine (LMWP) to enhance cellular permeability across the blood-brain barrier (BBB). They were subsequently crosslinked with oxidized pectin to improve their structural stability. The drug delivery system thus synthesized enabled the co-encapsulation of curcumin and temozolomide, two active principles with synergistic therapeutic effects, and achieved higher curcumin immobilization efficiency. FT-IR and NMR spectroscopy confirmed the covalent binding of LMWP to the free thiol group of the Cys34 residue in HSA, and the reduction of disulfide bonds with β -mercaptoethanol facilitated hydrophobic interactions between the active principles and the exposed hydrophobic domain of HSA, thereby leading to the formation of self-assembled nanoparticles (smaller than 200 nm). FT-IR spectroscopy confirmed the formation of Schiff bases between the free NH₂ groups in HSA and the aldehyde groups in oxidized gelatin. Kinetic release studies showed a more efficient release of temozolomide at pH 4 and curcumin at pH 7.4. In vitro tests indicated greater cytotoxicity against the C6 tumor cell line than against VT-79 after treatment with nanoparticles co-encapsulating temozolomide and curcumin, as well as increased antioxidant activity for the encapsulated curcumin compared to the free polyphenol. PAMPA-BBB tests demonstrated that HSA-LMWP nanoparticles can cross the BBB, with higher permeability for formulations containing both co-encapsulated active ingredients.

Keywords: functionalisation of human serum albumin, HSA-based nanoparticles| overcoming blood-brain barrier, oxidized pectin cross-linking, target delivery, synergic effect of co-encapsulated curcumin and temozolomide.

F.80. CONTAMINANT TRANSFER FROM ENVIRONMENT TO PRODUCT: EVALUATION OF POLLUTION-DERIVED RISKS IN DIETARY SUPPLEMENTS

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Abstract. Environmental pollution contributes significantly to the presence of contaminants in raw materials used for dietary supplement production, creating a direct pathway for human exposure. This study provides a qualitative assessment of contaminant transfer from environmental sources to dietary supplements, focusing on heavy metals, pesticides, and microplastics, and introduces a comparative analysis of contamination across supplement types and processing methods. A systematic review was conducted using Scopus, PubMed, and Web of Science databases in accordance with PRISMA guidelines. Studies reporting quantitative contaminant levels in dietary supplements or their raw materials were selected based on strict inclusion criteria. A meta-analysis was performed to estimate pooled concentrations and to evaluate the influence of raw material origin (plant-based vs. marine-derived) and processing technologies on contamination levels. Additionally, a novel comparative framework was applied to assess relative contamination risks associated with different supplement categories. The results reveal statistically significant differences in contaminant levels between supplement types, with marine-derived products showing higher concentrations of arsenic and mercury, while plant-based supplements exhibited elevated levels of cadmium and pesticide residues. Processing techniques such as extraction and concentration were found to amplify contaminant levels in certain cases, indicating a critical role of technological factors in contaminant transfer. Furthermore, the study identifies consistent patterns of co-occurrence of multiple contaminants, suggesting cumulative exposure risks not sufficiently addressed in current regulatory assessments. These findings provide new insights into the mechanisms of contaminant transfer along the production chain and highlight the need for integrated risk evaluation approaches that consider both environmental and technological factors. Strengthening quality control strategies and optimizing processing conditions are essential to minimize contamination and ensure product safety. The study contributes to the development of more sustainable and safer dietary supplement production systems by linking environmental pollution with technological processing and human exposure pathways.

Keywords: bioaccumulation, contaminants, dietary supplements, environmental pollution, human exposure, microplastics, pesticides, toxic metals.

F.81. PHENANTHRIDINIUM MONOQUATERNARY SALTS

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Abstract. Monoquaternary salts of heterocycles have attracted increasing interest in biomedical research due to their structural versatility and diverse biological activities. Nitrogen-containing heterocycles, present in over 75% of FDA-approved drugs, are key elements in medicinal

chemistry, improving properties such as solubility, lipophilicity, and hydrogen bonding, and enabling a wide range of therapeutic effects, including antimicrobial and anticancer activity [1]. Among these, phenanthridine derivatives are particularly valuable due to their cytotoxic, DNA-binding, and antimicrobial properties, including activity against drug-resistant microorganisms [2].

In this study, ten new phenanthridinium monoquaternary salts were synthesized via *N*-alkylation of phenanthridine with substituted benzyl halides in acetone under reflux. Various substituents with different steric and electronic properties were introduced to assess their influence on reactivity and physicochemical characteristics. The structures were confirmed by NMR (including 2D techniques), IR, and mass spectrometry.

Antimicrobial activity was evaluated using disk diffusion, MIC, and MBC assays. Compounds 3e and 3f exhibited broad-spectrum activity, with the lowest MIC (0.15 mg/mL) observed for 3e against *C. albicans*. Other compounds (3f, 3b, 3a) also showed notable activity. Overall, the results reveal clear structure–activity relationships and highlight these compounds as promising scaffolds for new antimicrobial agents.

Keywords: phenanthridinium salts; monoquaternary salts; antimicrobial activity; nitrogen heterocycles.

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F.82. HEAT TRANSFER MECHANISMS IN PARAFFIN MELTING USING 2D MODELS

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Abstract. The current study focuses on the development and validation of two 2D analytical models for analyzing the melting process of paraffin within a rectangular cavity subjected to a horizontal temperature gradient. The models target two regimes: thin layers, of the order of millimeters, where thermal diffusion and, after melting, thermocapillary convection dominate, and thicker layers, of the order of centimeters, where natural convection becomes significant once melting is sufficiently advanced. Both models are based on stream function–vorticity equations and were implemented in MATLAB to solve the differential equations using the finite difference method. This approach allowed for the calculation of the paraffin melting rate, a key quantity directly correlated with the thermal energy storage (TES) rate. The simulation results were validated through comparisons with data reported in the literature. The study also investigates the influence of physical parameters, i.e. layer thickness, temperature difference, and cavity length, on the melting process. For thin paraffin layers, natural convection is weak or negligible, while thermocapillary convection (caused by the variation of surface tension with temperature) is strongly activated by the temperature gradient applied along the layer. This convection drives the movement of the liquid phase from hotter regions to colder regions, effectively transporting the melted paraffin in a direct and efficient manner. The results show that the melting rate increases with the applied temperature difference. However, despite the increase in heat flux, the estimated heat transfer coefficients, calculated analytically based on the melting rates, decrease. This indicates a need for system modifications to improve the thermo-physical properties and overall

performance. These findings are highly relevant, as they offer a fast and flexible tool for investigating and designing TES systems without relying on experimental setups. Tailoring the modeling approach based on the paraffin layer thickness - depending on whether conduction or convection dominates - and accounting for the influence of cavity length on thermal stratification, enables optimized system configurations aimed at maximizing energy density and response time.

Keywords: natural convection, thermocapillary convection, thermal storage, modeling phase change materials.

F.83. EVALUATION OF POTENTIALLY TOXIC ELEMENTS IN RICE USING X-RAY FLUORESCENCE (XRF) FOR FOOD SAFETY AND ENVIRONMENTAL PROTECTION APPLICATIONS

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Abstract. Contamination of agricultural products with heavy metals and metalloids with a negative impact on environmental engineering and food safety, due to their toxicity and bioaccumulation capacity, is always a current topic [1]. Rice, being a staple food globally, constitutes an important source of exposure to these contaminants [2]. This paper evaluates the presence of elements with toxic potential in three types of rice (long-grain white, round-grain white, and brown). The samples were subjected to the calcination process and analyzed by X-ray fluorescence (XRF) [3]. The obtained results indicate the presence of essential elements (K, Ca, Fe, Mn, Zn) and arsenic in low concentrations (<10 ppm), with no detection of Cd, Pb, and Hg. Variations in concentrations for elements were found among the analyzed samples, influenced by environmental and agricultural factors. These results highlight the need for the implementation of effective methods for monitoring and controlling contaminants in the agri-food chain. The study highlights the need for continuous monitoring of consumable agricultural products for the protection of health and of the environment.

Keywords: rice, heavy metals, X-ray fluorescence, food safety, bioaccumulation.

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F.84. ANTIOXIDANT HPTLC-DPPH ANALYSIS OF MEDICINAL PLANT SPECIES AND TRACKING OF ANTIOXIDANT CONSTITUENTS

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Abstract. The chemical compositions of *Basella* and *Ocimum* spp. were highlighted using HPTLC analysis and spectrometric determination of Total Phenolic Content (TPC) and Total Flavonoid Content (TFC). The biologically active properties were investigated by antimicrobial assay and the DPPH spectrometric and HPTLC-DPPH assay. Plants from *Basella* spp. is a popular alternative to regular spinach in warm climates, valued for its succulent leaves, rich in vitamins and antioxidants. Plants from *Ocimum* spp. genus including about 60 species, are native from Asia and Africa, and are rich in bioactive compounds, with antibacterial, antiviral and adaptogenic potential. *Basella* spp. revealed low TPC and TFC values, while *Ocimum* spp. showed high levels of TPC and TFC. *Basella* spp. demonstrated a low inhibition of the DPPH radical in both of the methods used, while *Ocimum* spp. showed promising results regarding its compounds with high antioxidant potential. *Ocimum* spp. demonstrated good antimicrobial activity. In conclusion, *Ocimum* species are rich in different compounds with proven antioxidant activity, while *Basella* species do not possess the same high antioxidant potential.

Keywords: *Basella* spp., *Ocimum* spp., biological activity, antioxidant properties

Acknowledgement: This work was partially supported by ADER grant 5.2.1. – “Conservation and valorization of the genetic heritage of aromatic and medicinal species that can be cultivated on the territory of Romania” and “Targeted therapeutic molecules, anti-inflammatory and antitumor, isolated from exotic plants acclimatized in Romania”, funding contract no. 7956/31.03.2025.

F.85. THE FRACTIONATION OF PROTEINS AT THE ELECTROACTIVATION OF WHEY IN CONTINUOUS- FLOW MODE

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Abstract. The fractionation of whey proteins at the electroactivation of whey in a continuous-flow regime of the working and secondary liquids into the cathode and anode cells depends mainly on the design and geometric aspects of the diaphragm electrolyzers used. The content of protein fractions (Qp, %) extracted from whey into protein mineral concentrates was analysed by electrophoresis using sodium dodecyl sulfate polyacrylamide gel (SDS-PAGE) with a 15% acrylamide gel. The use of the EDP-2 electrolyzer with a parallelepiped-shaped casing indicates maximum extraction of β -Lg (50–79%) during the first minutes of processing, and this concentration remains stable throughout the whole processing period. The electroactivation of whey in the EDC-3 electrolyzer, with a semi-cylindrical casing, allows for a pronounced differential fractionation of the whey's protein fractions, namely: the maximum extraction of β -Lg is reached at the beginning of the process (around 77%), but it decreases towards the end; α -La shows an ascending accumulation trend in the protein mineral concentrates towards the end of the process (around 66%). The differential recovery of whey proteins in mineral protein concentrates during whey electroactivation depends on the properties of each protein fraction and their behaviour during electroactivation, in accordance with the mechanisms involved in the formation of protein aggregates.

Keywords: continuous mode, electroactivation| electrolyzers, fractionation| whey, whey proteins.

F.86. FOOD WASTE ACROSS THE FOOD SYSTEM IN LEBANON: FROM HOUSEHOLDS TO HOSPITALS - DRIVERS, DETERMINANTS, AND OPPORTUNITIES FOR SUSTAINABLE INTERVENTION

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Abstract. Food waste is a pressing challenge at the intersection of food security, nutrition, and environmental sustainability, particularly in resource-constrained contexts. Our presentation will highlight the work of our team in the area of food waste, which got published so far in more than 10 publications in the last 5 years. Our research presents a comprehensive assessment of food waste generation in Lebanon across households, food service establishments, and healthcare institutions, while offering insights relevant to the Eastern Mediterranean region. Drawing on cross-sectional studies, observational research, and reviews, the findings identify key behavioral, cultural, and operational drivers of food waste. At the household level, attitudes, planning practices, and socio-economic pressures play a central role, with notable shifts observed during the COVID-19 pandemic and the ongoing economic crisis. In restaurant settings, particularly those serving Mediterranean mezze, portion size, dining culture, and consumer behavior, as well as religiosity, significantly influence post-consumer waste. In healthcare institutions, our research provides some of the first empirical evidence from Lebanon and the Arab region on hospital food waste. High levels of plate waste were observed, driven by factors such as meal quality, patient preferences, and service delivery systems, with implications for nutritional intake, costs, and environmental impact. Overall, our research highlights food waste as a multi-dimensional and context-specific issue, requiring integrated interventions across the food system. This work will present the findings and offer practical insights for improving resource efficiency and sustainability outcomes, and inform the development of targeted strategies to reduce food waste.

F.87. A VIEW ON PETASITES HYBRIDUS FLOWER EXTRACT; IN SILICO ADMET AND MOLECULAR DOCKING STUDIES ON KEY PHENOLICS FROM BUTTERBUR

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Abstract. Considering the clinical data regarding the efficacy of extractive products from the roots and leaves of butterbur in the prophylaxis of allergies and migraines in humans, the *Petasites* genus is of great interest for pharmaceutical chemistry and medicine today. The present work aimed to study general compositional, antioxidant and antimicrobial quality of the ethanolic extract from the floral part of *Petasites hybridus*, which is less studied. Secondly, studies aimed to better understand the biological activity of extractive products from *Petasites*, by correlating analytical data on the major and key active compounds with computational data on their bioavailability, potential metabolic interferences, and efficacy on a pivotal protein disease molecular target, cyclooxygenase 2 (COX-2) respectively. Briefly, from the perspective of in silico studies, ADMET analysis indicated that both, petasin derivatives and small phenolic acids are able to pass de GI and BBB, while alcoholic and petasin enriched extracts are more likely to induce toxicity in humans. The results of the molecular docking studies indicated that both series of active phenolics have the ability to inhibit the activity of COX-2, while fukinolic acid was the most active compound in the series, superior to the native ligand, diclofenac.

Keywords: Butterbur, flower extract, HPTLC fingerprint, major and key phenolics, in silico ADMET analysis, molecular docking, COX-2 molecular target.

Acknowledgements: This work was carried out through the NUCLEU Program within the National Research Development and Innovation Plan 2022-2027, carried out with the support of MCID, project no. PN 23-28 04 01 and PN 23-28 01 01.

F.88. PYRROLO-FUSED HETEROCYCLES

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Abstract. Cancer remains one of the leading causes of death worldwide, despite significant advances in therapy. Its complexity, driven by genetic mutations, tumor heterogeneity, and the ability to develop resistance, continues to limit treatment success [1]. Moreover, tumors differ significantly between patients, leading to variable responses to standard treatments and emphasizing the need for personalized therapeutic approaches. Drug resistance is another major challenge, as cancer cells can adapt through mechanisms such as target modification, drug efflux, or activation of alternative pathways, reducing treatment efficacy. Consequently, new therapeutic strategies are being explored, including immunotherapy, gene therapy, and the development of novel small molecules. Among these, fused polyazaheterocyclic compounds have attracted attention due to their ability to interact with multiple biological targets and exhibit diverse biological activities, including antimicrobial and anticancer effects. Their structural versatility allows fine-tuning of their properties, making them promising candidates for selective anticancer drug design [2]. In this context, we synthesized new 2,2'-bipyridyl derivatives via [3+2] cycloaddition. The synthesis involved the formation of monoquaternary salts and the in situ generation of cycloimmonium ylides, which reacted with dipolarophiles such as ethyl propiolate or fumaronitrile, followed by aromatization. The resulting compounds were obtained in good yields, fully characterized by NMR, IR, and MS, and further evaluated for antitumor activity and cytotoxicity.

Keywords: 2,2'-Bipyridyl, Antiproliferative Activity, [3+2] cycloaddition.

Acknowledgment This work was supported by a grant of the Romanian National Authority for Scientific Research, CNCS – UEFISCDI, project PN-IV-P7-7.1-PED-2024-1008. (76PED/05.05.2025).

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F.89. THE DESIGN AND DEVELOPMENT AND BIOLOGICAL ACTIVITY EVALUATION OF SOME QUINOLONE COMPOUNDS

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Abstract. The paper presents original contributions in the drug design, molecular docking, synthesis and evaluation of biological activity of some quinolone compounds. The obtained compounds have been analyzed by physicochemical methods (¹H-NMR, ¹³C-NMR, IR, thin layer chromatography). The biological activity has been evaluated against *C. albicans*. Among the tested compounds, a series of non-fluorinated quinolones showed activity against *C. albicans*, confirming the specificity of antimicrobial activity against microfungi. It was observed that there is a correlation between the results of the molecular docking study and those obtained experimentally.

Keywords: quinolones, organic synthesis, drug design, molecular docking.

Acknowledgements: This work was carried out through the NUCLEU Program within the National Research Development and Innovation Plan 2022-2027, carried out with the support of MCID, project no. PN 23-28 01 01 and PN 23-28 04 01.

F.90. HYBRID TETRAHYDRO-PYRROLO DERIVATIVES: SYNTHESIS AND STRUCTURAL CHARACTERIZATION

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Abstract. Hybrid compounds, combining multiple pharmacophores in a single molecule, are gaining attention due to their enhanced biological properties. Among these, tetrahydro-pyrrolo derivatives are particularly interesting because of their diverse activities, including anticancer, antimicrobial, anti-inflammatory, and antiviral effects [1]. The main objective of this work was to synthesize and characterize new hybrid derivatives, based on a tetrahydro-pyrrolo scaffold and using a newly formed 1,2,3-triazole ring as a spacer to another pharmacophore [2]. This was achieved via [3+2] dipolar cycloaddition and click chemistry. Using this approach, nine novel hybrids were obtained, and their structures were confirmed by spectroscopic analyses, including FT-IR, NMR, and X-ray diffraction.

Keywords: tetrahydro-pyrrole, click chemistry, cycloaddition.

Acknowledgment This work was supported by a grant of the Romanian National Authority for Scientific Research, CNCS – UEFISCDI, project PN-IV-PCB-RO-MD-2024-0018. (43PCBROMD/2025).

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G. INDUSTRIAL POWER ENGINEERING & COMPUTER SCIENCE

G.1. AN OPTIMIZATION APPROACH FOR SITE SELECTION AND TECHNOLOGY ALLOCATION IN RENEWABLE ENERGY-BASED MICROGRID SYSTEMS UNDER NET-ZERO ENERGY TARGETS

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Abstract. The increasing use of renewable energy sources and the transition from centralized to decentralized energy systems have increased the importance of microgrid structures. This study proposes an integrated optimization approach for the design of self-sufficient, renewable energy-based microgrid systems supported by energy storage systems. Within the scope of the model, optimal site selection and technology allocation are performed using diverse geographical data, demand profiles, and meteorological time series. To ensure system reliability, supply–demand balance is maintained, and energy storage systems are integrated into the model. By jointly considering investment costs and operational costs, a model is developed to solve the site selection and technology allocation problem with the objective of minimizing the payback period. The proposed approach aims to enhance the self-sufficiency of renewable energy-based microgrid systems while contributing to the reduction of carbon emissions. This study provides a decision-support framework applicable at national and multi-country levels for the design of sustainable and cost-effective microgrid systems.

Keywords: Modeling and Optimization, Microgrid Planning, Net-Zero Energy Targets, Renewable Energy, Site Selection

G.2. DESIGN AND IMPLEMENTATION OF AN IMAGE TRACKING-BASED AUGMENTED REALITY SYSTEM FOR INTERACTIVE EDUCATIONAL APPLICATIONS

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Abstract. This paper presents the design and implementation of an augmented reality (AR) solution aimed at optimizing educational processes by creating interactive learning environments. The proposed system employs advanced image recognition techniques to identify graphical elements in the physical environment through mobile device cameras and trigger associated digital content. The recognition algorithm is based on feature detection and matching, converting physical images into unique digital feature sets that allow precise activation of AR elements. Within the content creation workflow, augmented elements are developed using graphics engines and digital content editors, including interactive application platforms (Unity), 3D modeling software (Blender), and graphic design and animation tools (Figma, Adobe Illustrator, Adobe After Effects). These tools enable the integration of 3D objects, animations, and interactive visual content into a coherent environment compatible with image recognition techniques. The paper details the system architecture, development and integration stages of AR content, as well as usage scenarios applied in real educational contexts. The analysis demonstrates that introducing interactive digital elements increases engagement, motivation, and accessibility of information, contributing to the efficiency of the learning process. Moreover, the proposed solution is scalable and adaptable, allowing rapid development of innovative educational applications and providing a technical framework for the future expansion of AR platforms in education. The obtained results confirm that image recognition and AR integration technologies constitute a viable direction for

modernizing educational systems, offering both flexibility in instructional material design and the possibility of interactive assessment of user progress.

Keywords: augmented reality, image tracking, computer vision, interactive educational applications, learning process optimization, interactive digital content, mobile technologies

G.3. 4DENVAR-DRIVEN AIR QUALITY MODELING AND FORECASTING OF PARTICULATE MATTER

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Abstract. Air pollution caused by particulate matter (PM) remains a major environmental and public health concern in urban areas, particularly in Chisinau, which ranks among the most polluted cities in the region. This study presents a novel, integrated computational framework for air quality modeling, statistical analysis, and short-term forecasting based on four-dimensional ensemble-variational (4DEnVar) data assimilation and quasi-dynamic simulations of particulate matter concentrations. The proposed framework assimilates observational data for PM₁, PM_{2.5}, and PM₁₀ collected from the eALERT research monitoring station over the period 3-28 February 2025. Unlike traditional four-dimensional variational (4DVar) approaches, the 4DEnVar method dynamically estimates background error covariance, incorporates fully anisotropic ensemble-based uncertainty, and eliminates the need for adjoint models. These features enable efficient handling of nonlinear processes and improve the physical realism of modeled air pollution dynamics, particularly under limited computational resources. The system is implemented in a cost-effective, Python-based environment and integrates multiple components, including real-time data assimilation, quasi-dynamic modeling, ensemble-based data assimilation, statistical diagnostics, and forecast evaluation. Pearson correlation analysis is employed to quantify the coherence among PM fractions and their relationships with meteorological variables. Results reveal strong interdependence between PM₁, PM_{2.5}, and PM₁₀, suggesting common emission sources. Diurnal cycle analysis indicates elevated particulate concentrations during morning hours and reduced levels in the late afternoon, primarily associated with traffic-related emissions. Model validation demonstrates improved forecasting performance, with reduced root mean square error (RMSE) and positive skill scores across all monitored indicators. The hybrid 4DEnVar framework effectively captures multivariate dependencies among particulate matter fractions and environmental drivers, enhancing both forecast accuracy and computational efficiency. Furthermore, the incorporation of correlation-based diagnostics strengthens the estimation of background error covariance and supports more robust ensemble representations of atmospheric uncertainty. The proposed approach offers a scalable and practical solution for urban air quality monitoring and forecasting, particularly in regions with limited computational capabilities. It also provides a foundation for future extensions, including the integration of multi-station eALERT observational networks, LiDAR backscatter data, and simplified advection-diffusion models for improved representation of pollutant transport processes. Overall, this work demonstrates that ensemble-variational data assimilation methods such as 4DEnVar can significantly enhance the accuracy, efficiency, and physical consistency of particulate matter forecasting systems. The framework supports improved environmental risk assessment, evidence-based decision-making, and the development of effective air quality management strategies aimed at protecting public health.

Keywords: Air pollution monitoring, modeling, and forecasting, Particulate matter, Big data

G.4. SATELLITE IMAGERY AND MACHINE LEARNING FOR HIGH-RESOLUTION SOIL MOISTURE ESTIMATION

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Abstract. Satellite imagery acquired by passive microwave missions such as NASA SMAP and ESA SMOS offers reliable, all-weather soil moisture observations, yet its coarse native resolution of 9–36 km limits its utility for field-scale decision-making. Downscaling these products to finer spatial grains require the integration of complementary Earth observation data streams, including multispectral optical imagery from Sentinel-2, synthetic aperture radar (SAR) backscatter from Sentinel-1, and terrain attributes derived from spaceborne digital elevation models. Machine learning algorithms — particularly gradient boosting ensembles and deep learning architectures such as convolutional and recurrent neural networks — have demonstrated a strong capacity to capture the nonlinear dependencies between these multi-source satellite inputs and surface soil moisture dynamics. Transfer learning strategies further extend the applicability of such models to data-scarce regions by leveraging knowledge acquired from areas with dense in-situ monitoring networks. Despite these advances, significant challenges persist: cloud contamination degrades optical satellite acquisitions, sub-pixel terrain heterogeneity introduces systematic prediction errors in mountainous landscapes, and the scarcity of ground-truth stations limits robust model validation. A particularly promising research direction lies in the exploitation of Sentinel-1 C-band radar imagery, whose sensitivity to surface dielectric properties and independence from illumination conditions could enable soil moisture retrieval at the scale of individual agricultural parcels. Coupling SAR-derived features with ensemble machine learning pipelines and physics-informed loss functions may provide the foundation for operational, near-real-time soil moisture mapping capable of supporting precision agriculture and climate adaptation strategies in an increasingly volatile environmental context.

Keywords: Satellite imagery, Soil moisture downscaling, Machine learning, Remote sensing

G.5. EXPERIMENTAL STUDY OF THERMAL ENGINE FOR DRIVE OF A CLOSED CIRCUIT WATER PUMP

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Abstract. The study of fluid behavior in various flow regimes is an essential aspect in the understanding and design of hydraulic and thermal systems. In this paper, an experimental stand integrating a thermal engine to drive a closed-circuit water pump is presented. This stand was specifically designed to investigate the flow regimes of liquids through channels equipped with cylindrical perturbators, in order to highlight the changes in flow, parameters caused by their introduction. Cylindrical perturbators introduce local variations in the fluid velocity field, influencing the pressure distribution, power losses and the transition between laminar and turbulent regimes. By observing these phenomena in a controlled environment, we can better understand the fundamental principles of fluid mechanics and their practical applications in engineering. The paper thus contributes to the formation of a solid knowledge base necessary for the analysis and design of fluid transport systems, frequently encountered in fields such as industrial installations, cooling systems, water supply or power engineering.

Keywords: thermal engine, flow regime, cylindrical perturbators

G.6. EXPERIMENTAL SYSTEM FOR WATER EVACUATION FROM THE OPERATING AREA OF A HYDROELECTRIC POWER PLANT

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Abstract. This paper aims to analyze the role, importance and impact of the general services of a hydroelectric power plant on the efficient operation, sustainability and integration into the national energy system. Through this research, it is aimed to highlight how these services contribute to operational safety, environmental protection, energy efficiency and maintenance of equipment in a hydroelectric power plant. The centrifugal pump has a particularly important role in the hydroelectric power plant, ensuring the evacuation of water from the turbine cover. Water escaping through leaks is collected in the turbine cup, from where it is evacuated both during operation and during standstill, using the turbine cover water evacuation installation. The evacuation of water infiltrated into the turbine cover is ensured by the ejector and three pumps (one of which is submersible). Configuring the automation system through a modular structure, based on the functional separation of the detection, control and power circuits, facilitates reliable operation, efficient maintenance and high scalability of the entire electro-hydraulic installation. By implementing the contactors and relays in distinct blocks, a clear separation is achieved between the low-voltage circuits used for logic control and the power circuits that power the pump motors. This separation not only improves the operational safety of the system, but also ensures galvanic isolation between the detection area (sensitive to electromagnetic disturbances or short circuits) and the drive area (involving high currents and voltages). Last but not least, the scheme allows functional expansion (adding new pumps, automatic controls, alarms, etc.) without the need for a complete redesign of the installation, which is a significant advantage in industrial applications where flexibility and adaptability are essential.

Keywords: turbine cover, centrifugal pump, automation system, water evacuation

G.7. LIGHTWEIGHT LANDMARK-BASED GESTURE RECOGNITION SYSTEM FOR ROMANIAN SIGN LANGUAGE

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Abstract. This paper presents a lightweight computer vision system designed for real-time recognition of hand gestures for Romanian Sign Language. The proposed approach focuses on extracting spatial and temporal hand landmarks using MediaPipe framework and converting them into normalized feature vectors suitable for gesture classification. Unlike traditional image-based gesture recognition methods that rely on raw input data, the proposed system operates on a compact representation consisting of twenty-one hand landmarks, lowering computational complexity while preserving gesture information. A custom dataset of gestures was collected using a standard RGB camera under different illumination conditions and signer's variations. Multiple gestures were recorded representing letters and commonly used signs with different hand shapes and motion patterns. Gesture classification stage is implemented using neural

network-based models trained on hand landmark feature vectors. Experimental results demonstrate that the proposed system achieves high recognition accuracy while maintaining real-time performance. The obtained results confirm the feasibility of lightweight landmark-based gesture recognition systems for assistive communication applications.

Keywords: sign language recognition, gesture recognition, MediaPipe, hand landmarks, computer vision, human-computer interaction

G.8. ELECTRICAL AND THERMAL ENERGY PRODUCTION THROUGH A BIOGAS COMBINED HEAT AND POWER PLANT

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Abstract. This paper presents the method of producing electrical and thermal energy with the input of a combined heat and power unit (CHP) consisting of an internal combustion engine driving a 500-kW generator and the thermal installations used for heat recovery through the engine cooling system and the exhaust gas heat exchanger. The engine is powered by biogas produced in the wastewater treatment plant. We gave an overview of the CHP plant and the operation of the water treatment plant, showing the water and sludge path. We showed how a cogeneration unit, consisting of an internal combustion engine and a generator, works, as well as the related thermal installations.

Keywords: biogas, CHP unit, electric generator, heat exchanger

G.9. VIRTUAL REALITY ADOPTION IN ROMANIAN SCHOOLS: THE ROLE OF ATTITUDES, SUBJECTIVE NORMS, AND PERCEIVED BEHAVIORAL CONTROL

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Abstract. Teacher adoption of virtual reality (VR) in education lags behind its demonstrated instructional potential. This cross-sectional survey (N = 408 Romanian teachers, 76.2% female) examined adoption perceptions using an integrated Technology Acceptance Model (TAM) and Theory of Planned Behavior (TPB) framework. Seven constructs measured on five-point Likert scales showed acceptable reliability (Cronbach's $\alpha = .81-.95$). Perceived usefulness was the strongest correlate of attitude toward using VR ($\beta = .71$, $R^2 = .69$). Attitude toward the behavior, attitude toward VR, subjective norm, and perceived behavioral control jointly explained 75.8% of variance in behavioral intention ($R^2_{adj} = .755$). Open-ended responses identified equipment access, cost, and time as primary barriers. Results suggest favorable teacher attitudes and moderate adoption intentions, with perceived usefulness as the most substantial correlate.

Keywords: virtual reality, technology acceptance, Theory of Planned Behavior, teacher perceptions, educational technology

G.10. UAV–LIDAR INTEGRATED APPROACH FOR MONITORING MINERAL RESOURCE EXPLOITATION AND ENVIRONMENTAL IMPACT ASSESSMENT

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Abstract. The exploitation of mineral resources represents an essential sector for infrastructure and industrial development; however, it generates significant environmental impacts such as soil degradation, terrain alteration, and disruption of natural ecosystems. In this context, continuous monitoring of affected areas and the assessment of ecological restoration processes become priorities for implementing sustainable natural resource management. The development of modern remote sensing technologies, particularly systems based on Unmanned Aerial Vehicles (UAVs), provides efficient solutions for collecting and analyzing high-resolution geospatial data. This paper presents an integrated methodology based on the use of UAV platforms equipped with LiDAR sensors and photogrammetric cameras for monitoring mineral resource exploitation and evaluating environmental impact. Experimental data were acquired using modern UAV platforms, enabling rapid collection of topographic data and generation of advanced cartographic products such as orthophotoplans, Digital Terrain Models (DTM), Digital Surface Models (DSM), and Digital Elevation Models (DEM) [1]. Data processing was carried out using specialized software for 3D reconstruction and LiDAR point cloud analysis. The application of filtering algorithms facilitated the separation of ground points from those associated with vegetation or other objects, contributing to the generation of accurate digital models. These models enable detailed analysis of geomorphological parameters, such as elevation differences, slope gradients, and embankment structures, providing essential information for evaluating terrain stability and the evolution of mining activities. The experimental results highlight the capability of UAV–LiDAR technology to deliver high-resolution and high-accuracy data, comparable or superior to traditional topographic measurement methods, but with significantly reduced acquisition time and lower operational costs. By comparing digital models obtained at different time intervals, terrain changes caused by extraction activities can be identified, allowing estimation of excavated material volumes and monitoring of slope stability. Moreover, these technologies can be used to assess ecological restoration processes of degraded lands. The practical applicability of the proposed methodology is demonstrated through case studies of quarry sites, where the generated digital models enabled the identification of terrain morphological changes and the analysis of altitude distribution. These results confirm the usefulness of UAV technologies in environmental monitoring and in optimizing industrial processes in the extractive sector. The integration of UAV systems with LiDAR technologies and advanced geospatial data processing methods represents a modern and efficient solution for monitoring mineral resource exploitation and assessing environmental impact, being highly relevant for the fields of Computer Science and Industrial Power Engineering. The support provided through grant numbers MER 011210 PHYSTECH and the NARD project “Sustainable Environment through Drone Education”, code 25.80012.0807.25TC.

Keywords: UAV, LiDAR, photogrammetry, Digital Elevation Models (DEM), remote sensing, environmental monitoring, geospatial analysis, 3D mapping

G.11. STUDIES ON THE DEVELOPMENT OF SOLAR ORIENTATION SYSTEMS FOR PHOTOVOLTAIC PANELS

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Abstract. This article analyzes the general structure of a photovoltaic panel orientation system, highlighting the role of the drive system and the control system. It also presents and classifies photovoltaic panel orientation control algorithms according to the regulation mode (open loop and closed loop), the operating principle (astronomical algorithms, light sensor-based algorithms, hybrid algorithms, and advanced algorithms), and the number of axes controlled. The article mentions established astronomical algorithms, such as the Solar Position Algorithm (SPA) and the methods developed by NOAA, which constitute the current industry standard. In addition, the article discusses the hardware platforms used for implementing control systems, including microcontroller solutions, single-board computers, dedicated controllers, and programmable logic controllers (PLCs). The advantages and application areas of each platform are analyzed based on the complexity of the control algorithms and the application requirements. The findings highlight that the performance of solar tracking systems depends on the seamless integration of mechanical components, drive systems, and control algorithms. A fundamental trade-off exists between improving energy efficiency and the technical and economic complexity of the solution. Single-axis tracking systems offer the most favorable cost-benefit ratio in most applications, while dual-axis solutions are only justified in specific cases. Astronomical algorithms remain the dominant solution in industrial applications, and methods based on power feedback and machine learning are considered complementary, playing a role in both local and higher-level optimization.

Keywords: solar tracking system, photovoltaic panels, orientation control algorithms, hardware platforms

G.12. INDIVIDUAL DIAGNOSIS FOR CURRICULAR AND DIDACTIC ADAPTATION WITH ICT DEVICES. A CASE STUDY WITH A PRELIMINARY EDUCATIONAL PROPOSAL

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Abstract. In the task of introducing children with special educational needs to learning, the educational curriculum must be analyzed to achieve the expected results. It is more difficult to assimilate this fact when a starting point is not established with an evaluation of ICT devices. The problem that was seen when reviewing the history is that the reports have little or no curricular adaptations, the maximum is to do fewer repetitions and achieve the minimum achievements in the subjects, the potential we have in this case is that we work at the occupational therapy level. The pedagogical level, the planning of the didactic units, there is speech therapy, occupational therapy and physical therapy that can be fed to exercise the adaptation of specialized hardware and software, the annual curricular planning with its evaluation criteria and evaluation indicator going down to the micro level where you can already see the planning of the didactic unit and within this it is necessary that through a Individual Diagnosis of Curricular Adaptation planning can be considered from the first year to the fifth. Like results, the proposal of didactic adaptation with ICTs is launched, reviewing the ministerial objectives the minimum achievements of scope

- an initial evaluation must be carried out using the resources that currently have to cope with the teaching in a particular case and with these results propose the use of a preliminary educational proposal and adaptations, if necessary, of hardware and software to strengthen student skills with spastic quadriplegia. The curricular adaptation establishes study scenarios that contemplate the use of software and hardware with the capacity to adapt students with special educational needs and future work will be considered for this particular case study.

Keywords: ICTs, Occupational therapy, Spastic quadriplegia motor disability

G.13. OPTIMIZATION OF A VR TASK TARGETED TO TREATMENT OF NEGATIVE SYMPTOMS IN PEOPLE WITH ATTENTION DEFICIT DISORDERS

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Abstract. This research enjoyed a reversal design on the realization and to examine usability of a VR game to improve attention to activities in children with disabilities. The testing of the prototype developed is intended to evaluate its implementation, look for flaws and collect users' perspectives on the game. It is also intended to test theories speculated during the research and development process of this study. The testing stage took two weeks to complete and due to how long each session was expected to last it had a goal of 20 to 25 participants, which was achieved with a total of 21 participants. Upon completion of two tasks, participants had to answer a questionnaire organized into five sections: Agreement, Personal information, User Experience (UX), Satisfaction, and Suggestions. To evaluate the participant's opinion on the prototype's UX, this section had ten statements to which participants had to evaluate on a Likert scale from 1 to 5 (being 1 completely disagree and 5 completely agree). Data from each of three phases involving children diagnosed with ADHD were charted on: time of visual attention to tasks, time of sitting tolerance, and number of distractions, by observations of the patterns. The data for visual attention, and sitting tolerance respectively, present improvements for all of the participants from the phase they were engaged in VR game-based activities. Treatment mean adjustments beyond participants were -1.91. Wilcoxon matched pairs signed ranks test -3,933; significance 0,0002 level/one-tailed, by 19 freedom degrees). For the treatment phase, mean level of distractions registered were 1.91; in the withdrawal phase, mean level of distraction 5.766. These results denote effectiveness of the use of VR-based on the level of visual attention of children with ADHD. In addition, all children appeared motivated and interested to enroll in the VR-based treatment activities. In conclusion, in our days, the children with or without ADHD preferred the VR-based activities for treatment, but additional research even for a VR concept design for this purpose, it is considered necessary to investigate its sensitivity and clinical meaningfulness.

Keywords: VR environements, cognitive skills, fine motor task, single-subject design

G.14. HOW ARTIFICIAL INTELLIGENCE CAN INFLUENCE ELECTROMAGNETIC COMPATIBILITY

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Abstract. Artificial intelligence is increasingly shaping the field of electromagnetic compatibility, both as a design tool and as an active component within electronic systems. Its influence can be observed across several key areas: Predictive Modeling and Simulation AI algorithms, particularly machine learning models, can analyze vast datasets from previous EMC

tests and simulations to predict electromagnetic behavior early in the design phase. This allows engineers to identify potential interference issues before physical prototypes are built, significantly reducing development costs and time. Automated EMC Testing Traditional EMC testing is time-consuming and requires highly specialized expertise. AI can automate parts of this process by intelligently controlling test equipment, interpreting measurement results, and flagging non-compliant behavior. This not only speeds up testing but also improves consistency and repeatability. Fault Diagnosis and Classification Neural networks and pattern recognition algorithms can be trained to classify types of electromagnetic interference from raw measurement data. This helps engineers quickly pinpoint the source of an EMC problem, whether it originates from conducted emissions, radiated fields, or coupling mechanisms. Adaptive Interference Suppression AI-driven digital signal processing enables devices to dynamically adapt to their electromagnetic environment in real time. By continuously monitoring interference levels, a system can adjust its filtering, shielding strategies, or transmission parameters to maintain compliance and performance. PCB and System Layout Optimization Generative AI and optimization algorithms can assist in designing printed circuit board layouts that inherently minimize electromagnetic emissions and maximize immunity, guided by learned rules from thousands of previous compliant designs. Challenges to Consider Despite these benefits, AI itself introduces EMC concerns. High-performance AI chips generate substantial high-frequency noise, and the wireless connectivity often required for AI systems can be a source of interference. Ensuring that AI hardware meets regulatory standards such as CISPR and IEC 61000 remains a critical engineering responsibility.

Keywords: Electromagnetic compatibility, Artificial Intelligence, Machine learning

G.15. ALGORITHMS FOR COMPLEX ANALYSIS OF ROMANIAN TEXT DOCUMENTS USING MODERN NATURAL LANGUAGE PROCESSING TECHNIQUES

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Abstract. This paper addresses the challenges of complex analysis of Romanian text documents using advanced Natural Language Processing techniques. The study focuses on tasks such as tokenization, lemmatization, named entity recognition, and semantic analysis. Various machine learning and deep learning models are evaluated to determine their effectiveness in processing Romanian language data. The results highlight the importance of linguistic resources and optimized algorithms in achieving high performance. The proposed approach contributes to improving automated text understanding in real-world applications.

Keywords: text analysis, Romanian language, natural language processing, machine learning, deep learning, semantic analysis, document processing

G.16. OFFLINE ARTIFICIAL INTELLIGENCE MODELS FOR EDUCATIONAL SUPPORT IN PRE-UNIVERSITY ENVIRONMENTS

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Abstract. This paper explores the use of offline artificial intelligence models to support teaching and learning processes in pre-university education. The research focuses on developing AI

systems that operate locally, without internet connectivity, ensuring data privacy and accessibility in resource-constrained environments. The proposed approach integrates natural language processing and machine learning techniques to assist students in tasks such as content understanding, question answering, and personalized feedback. The results demonstrate that offline AI models can provide reliable educational support while maintaining data security and reducing dependency on external services.

Keywords: artificial intelligence, offline models, education, natural language processing, personalized learning, data privacy, educational technology

G.17. CURRENT TRENDS AND OPEN CHALLENGES IN HUMAN ACTIVITY RECOGNITION: MULTIMODALITY, GENERALIZATION, AND DEPLOYMENT

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Abstract. Human Activity Recognition (HAR) is moving from benchmark-centric classification toward representation learning that is robust to sensor heterogeneity, label scarcity, and deployment constraints. In current practice, accelerometers, gyroscopes, and magnetometers remain the most practical sensing core for smartphone- and smartwatch-based HAR, while physiological, ambient, and video streams are increasingly fused when context, robustness, or clinical relevance matter. Canonical datasets still anchor evaluation especially WISDM, UCI-HAR, PAMAP2, Opportunity, and MHealth but broader smart-device corpora and more inclusive resources now play a larger role, including HHAR, RealWorld, Extrasensory, CAPTURE-24, and a recently released mobility-disability dataset. Methodologically, classical machine learning remains a necessary low-data baseline, deep CNN/RNN/LSTM systems still dominate many standard wearable benchmarks, transformers matter most when adapted through hybrid or multimodal design, and self-supervised pretraining is emerging as the most consistent route to improved transfer and label efficiency. The hardest unresolved problems are cross-user and cross-device generalization, sensor-position variability, class imbalance, missing data, privacy, and realistic edge deployment. The most plausible near-term research direction is therefore not a single best architecture, but a pipeline that combines large-scale pretraining, modality-aware fusion, standardized cross-dataset evaluation, and explicit reporting of latency, memory, and quantization robustness.

Keywords: wearable sensing, multimodal HAR, self-supervised learning, transformers, dataset generalization, edge inference, privacy

G.18. SELF-SUPERVISED PRETRAINING IN HUMAN ACTIVITY RECOGNITION: METHODS, TRANSFERABILITY, AND OPEN CHALLENGES

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Abstract. This abstract focuses on self-supervised pretraining for HAR, which has become a leading strategy for reducing annotation cost while improving generalization across datasets, users, and sensor configurations. Recent work shows that pretraining on large volumes of unlabeled wearable time series can yield representations that outperform both training-from-scratch deep models and strong classical baselines after transfer learning. A landmark study pretrains on 700,000 person-days from UK Biobank [8] and then transfers to eight HAR

benchmarks, reporting consistent gains and demonstrating that scale and diversity in pretraining data matter as much as architecture choice. Complementary results from DCTCSS show that a BYOL-style contrastive framework with a deep convolutional transformer backbone can achieve strong F1 scores while using only a small labeled fraction of UCI-HAR, Skoda, and MHealth. CrossHAR extends the picture by explicitly targeting cross-dataset generalization through hierarchical self-supervised pretraining, while RobustHAR emphasizes masked, multi-scale spatiotemporal pretraining for missing-data regimes and shows strong results on Opportunity, RealWorld, and CZU-MHAD. Taken together, these studies suggest that self-supervision in HAR is valuable not simply because it reduces labeling effort, but because it stabilizes representations under domain shift, sensor dropout, and heterogeneous activity distributions. The remaining open questions concern pretraining corpus bias, modality extension beyond accelerometry, and the lack of standardized few-shot and cross-dataset transfer protocols.

Keywords: UK Biobank, CrossHAR, DCTCSS, BYOL, UCI-HAR, RobustHAR, transfer learning

G.19. INDOOR AIR QUALITY MONITORING SYSTEM

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Abstract. This paper presents the development and implementation of an air quality monitoring and assessment system for indoor spaces that integrate pollutant detection sensors with IoT systems to develop an easy-to-use mobile application, through which the air quality being breathed can be easily monitored in real time. Four sensors are used (for detecting carbon dioxide, PM2.5 particles in the air, toxic gases, temperature, and humidity) that transmit the data recorded by them via an internet connection to a local server from which the application will process and display the data on the user's phone. The implementation of the system was based on the use of the ESP32-WROOM-32 microcontroller, which easily provided Wi-Fi connectivity to the local server where the data was stored. The sensors used (CCS811, DSM501A, BME280, and MQ-4) allowed coverage of a wide range of pollutants, providing a complete picture of the environmental conditions in indoor spaces. Also, if the air in the room becomes harmful, the user will receive alerts to notify them of this. Thus, the project presents a solution for monitoring and improving the quality of the air we breathe and can reduce the health risks posed by prolonged exposure to polluted air. The results obtained demonstrated that the implemented system is a reliable system for monitoring air quality in various environments, from residential spaces to industrial areas. The collected data highlighted correlations between pollutant levels and elements such as the indoor ventilation of buildings or human activities, which emphasizes the usefulness of the system in identifying pollution sources and optimizing energy consumption.

Keywords: air quality, IoT, sensors, indoor, real-time, energy consumption

G.20. HIDDEN ECHO - ANDROID APPLICATION THAT HIDES AND SECURES MESSAGES IN MULTIMEDIA FILES THROUGH COMBINED TECHNIQUES OF STEGANOGRAPHY AND CRYPTOGRAPHY

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Abstract. The desire to communicate confidential information in a secure and discreet manner has significantly increased in recent years. In today's digital context, HiddenEcho addresses these needs, as an Android application dedicated to hide and protect messages within multimedia files,

using a combination of advanced cryptographic and steganographic techniques. The application encrypts messages into a code that cannot be read without a password and then conceals them within images or audio files using steganography, so that no one else can detect the presence of a hidden message. HiddenEcho targets both individual users concerned with privacy and professionals working in sensitive domains, such as journalists, activists, military personnel, intelligence agencies, or cybersecurity companies. The application provides an intuitive interface, adaptable to the user's experience level, and integrates steganographic algorithms (LSB, Advanced LSB for images, Direct Sequence Spread Spectrum), symmetric encryption (AES, ChaCha20), as well as secure password generation options. The application interface was developed using the Kotlin language together with the Jetpack Compose framework, which allowed a flexible and modern construction of the user screen. The control logic architecture was implemented in Java, facilitating interoperability with the Android SDK and clear management of services and processes. For the steganography algorithms, a performant native layer written in C++ was chosen, which allowed direct and efficient processing of media files, reducing resource consumption and increasing execution speed. The results confirm the feasibility of reliably hiding messages without significantly affecting the host file and with increased resistance to automated detection. HiddenEcho is a complete, stable, and efficient solution for secure communication scenarios, with a solid technical design and a high potential for use and expansion in fields such as journalism, civic activity, security, or even in the educational environment for demonstrating the principles of cryptography and steganography.

Keywords: Android, steganography, cryptography, symmetric encryption, object-oriented programming, robustness, scalability

G.21. IOT-BASED SMART ENERGY MONITORING AND COST ANALYSIS SYSTEM FOR LABORATORY ENVIRONMENTS

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Abstract. Directive (EU) 2023/1791 on energy efficiency, as well as the revisions of the Energy Performance of Buildings Directive (EPBD), set ambitious objectives at European level, namely reducing final energy consumption by at least 11.7% by 2030 and decarbonizing the built stock by 2050. These strategic directions require the development and implementation of technological solutions that allow for the monitoring, analysis and optimization of energy consumption in real time. In Romania, there is a trend towards the implementation of smart meters installed by electricity suppliers at the consumption point level. However, end-user access to their own consumption data is, in many cases, limited, unintuitive or available only with a delay. As a rule, the consumer becomes aware of the level of consumption only upon receipt of the monthly bill, at which point the possibilities for intervention to reduce or optimize consumption are considerably diminished. In this context, technologies based on the Internet of Things (IoT) offer a viable, flexible and scalable alternative for real-time monitoring of electricity consumption. By integrating measurement sensors, data communications and processing and analysis platforms, an IoT system allows the user continuous access to relevant information on consumption and associated costs, facilitating the adoption of proactive energy efficiency measures. In addition, the proposed solution can integrate additional electrical protection functions, contributing to increasing the safety of users and laboratory equipment. The device can detect and react to dangerous voltage fluctuations generated by improper network maneuvers, atmospheric discharges or interruption of the neutral conductor, situations that can lead to damage to electrical equipment. By implementing mechanisms for continuous monitoring of electrical parameters, the system can signal or even interrupt the power supply in abnormal conditions, thus preventing costly breakdowns.

Keywords: IoT, smart meter, protection

G.22. ENERGY STORAGE SOLUTIONS FOR RENEWABLE ENERGY SYSTEMS

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Abstract. This paper presents some creative technological solutions for energy storage of renewable energy systems like solar and wind power to increase the electrical power grid resilience under variable and intermittent environment conditions on sunny and windy days compared with low production days. Key technologies explored include lithium-ion and lithium iron phosphate batteries, along with thermal storage using molten salts tanks. The paper concludes that integrating diverse energy storage solutions is essential for transitioning to a sustainable and resilient electrical power system.

Keywords: renewable energy systems, solar power, wind power, energy storage, lithium-ion batteries, lithium iron phosphate batteries, molten salts tanks

G.23. OPTIMIZING ENERGY CONSUMPTION IN SMART BUILDINGS THROUGH PV–BMS INTEGRATION: A STANDARD-BASED AND CASE STUDY APPROACH

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Abstract. The building sector is responsible for a significant share of global energy consumption and greenhouse gas emissions, accounting for approximately 40% of total energy use. In this context, the integration of renewable energy systems and intelligent energy management solutions represents a critical pathway toward sustainable development. This paper investigates the integration of photovoltaic (PV) systems with Building Management Systems (BMS) to optimize energy consumption in smart buildings. The study combines theoretical modeling, system integration strategies, and a case study analysis to evaluate the performance of PV–BMS systems. The proposed architecture enables real-time data acquisition, monitoring, and control of building subsystems, including HVAC, lighting, and electrical loads. Through advanced control algorithms and optimization strategies, the system dynamically adjusts energy flows based on user demand, environmental conditions, and PV generation profiles. The methodology is aligned with the European standard EN 15232 (Energy Performance of Buildings — Impact of Building Automation Control and Building Management), which provides structured approaches for assessing the influence of automation and control functions on building energy performance. According to the standard, building automation systems are classified into efficiency classes (A–D), where Class A systems correspond to high energy performance through advanced automation and integrated management functions. The integration of PV systems with high-level BMS functionalities enables buildings to achieve superior energy efficiency levels by reducing unnecessary energy use and improving operational control. A case study conducted on a real building infrastructure demonstrates the effectiveness of the proposed system. The results indicate significant improvements in energy efficiency, reduction in operational costs, and enhanced user comfort. The integration of IoT-based data acquisition and intelligent control contributes to predictive energy management and supports decision-making processes. Furthermore, the system enables continuous monitoring of performance indicators and facilitates

cost-benefit analysis. The findings confirm that PV–BMS integration is a viable solution for achieving near-zero energy buildings (nZEB) and meeting European regulatory requirements such as the Energy Performance of Buildings Directive (EPBD). The study highlights the importance of combining renewable energy generation with advanced automation systems to maximize energy efficiency and sustainability in modern buildings.

Keywords: Photovoltaic systems, BMS, Smart buildings, Energy efficiency, EN 15232, Building automation, Renewable energy, IoT

G.24. STUDY CONCERNING THE CONSTRUCTION OF A MEDIUM FREQUENCY INDUCTION HEATING OVEN WITH PWM FREQUENCY ADJUSTMENT

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Abstract. The study presents the design and development of a medium frequency induction heating furnace using Pulse Width Modulation (PWM) for frequency control. The paper emphasizes the importance of operating at medium frequencies, which offers a balanced compromise between penetration depth and heating efficiency, making the system suitable for various industrial processes, such as metal treatment or melting. A key contribution of the study is the implementation of PWM control to regulate the output frequency of the inverter. This approach allows for precise control over the heating process by regulating both the supplied power and the operating frequency, leading to improved system stability and performance. The overall system architecture includes a power supply, a frequency inverter, a resonant circuit composed of an induction coil and capacitors, and a control unit responsible for managing the PWM signals. The integration of these components ensures efficient energy transfer and reliable operation. The study demonstrates that using PWM-based frequency adjustment in a medium-frequency induction heating furnace improves efficiency, enables precise temperature control, reduces energy losses, and increases system flexibility for various industrial applications.

Keywords: PWM, medium frequency, induction, heating

G.25. USING BDD TO PREDICT FAULTS IN AUTOMOTIVE: A CASE STUDY

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Abstract. Fault prediction and reliability assessment are critical in modern automotive systems, particularly in safety-critical subsystems such as braking. This paper investigates the use of Binary Decision Diagrams (BDDs) as a formal method for modeling, analyzing, and predicting faults within automotive control systems. BDDs provide a compact and canonical representation of Boolean functions, enabling efficient analysis of complex system logic and failure conditions. A case study focusing on brake system failure is presented, where the logical relationships between sensor inputs, control signals, and actuator responses are modeled using BDDs. Various fault scenarios—including delayed braking response, partial braking effectiveness, and total brake failure—are encoded as Boolean expressions and transformed into BDD structures. These models allow systematic exploration of all possible input combinations, facilitating the identification of critical fault paths and minimal failure conditions. The results demonstrate that BDD-based analysis enables early detection of fault-prone configurations and supports precise

reasoning about system behavior under both normal and degraded conditions. Compared to traditional testing and simulation approaches, this method provides improved scalability and exhaustive coverage of logical states.

Keywords: BDD, Automotive, Fault prediction

G.26. PREDICTIVE MAINTENANCE SYSTEM FOR WATER PUMPS

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Abstract. In recent years, water pumping systems have become essential components of industrial, agricultural, and urban infrastructure, playing a critical role in the efficient distribution of hydraulic resources. The continuous and reliable operation of water pumps is essential for reducing operational costs and preventing unplanned downtime. To ensure optimal performance and minimize maintenance costs, the implementation of predictive maintenance strategies has become a necessity. This paper presents the architecture of a predictive maintenance system for water pumps based on monitoring essential parameters such as vibrations, pressure, temperature, flow rate, and energy consumption. Data collected through IoT sensors are transmitted to a server for analysis using machine learning algorithms, enabling the estimation of Remaining Useful Life (RUL) and early fault detection in order to reduce costs and increase system reliability.

Keywords: predictive maintenance, water pumps, IoT, machine learning, RUL

G.27. SMART SOLAR PANELS: AUTONOMOUS CLEANING AND SELF-DIAGNOSIS FOR ENHANCED ENERGY EFFICIENCY

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Abstract. The efficiency of photovoltaic (PV) systems is significantly affected by dust accumulation (soiling), which can reduce energy output by 5% to over 30% depending on environmental conditions. Addressing these losses requires advanced maintenance solutions beyond conventional manual methods. This paper explores smart solar panels equipped with autonomous self-cleaning and self-diagnosis capabilities to enhance energy efficiency. The proposed approach integrates environmental sensors, automated cleaning mechanisms, and AI-based diagnostic models to monitor panel performance and detect anomalies such as efficiency degradation, shading, and surface defects in real time. Simulation results indicate that autonomous maintenance systems can significantly reduce soiling-related losses, improve energy yield, and minimize operational costs. These findings highlight the potential of smart photovoltaic systems to support more efficient, reliable, and sustainable energy production.

Keywords: photovoltaic systems, smart solar panels, self-cleaning, soiling losses

G.28. TECHNOLOGICAL EVOLUTION AND DECARBONIZATION PATHWAYS IN ELECTRO-THERMAL POWER PLANTS

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Abstract. The evolution of electro-thermal power plants reflects the continuous advancement of technology aimed at improving energy efficiency, reliability, and environmental performance. This paper provides an overview of the historical development of electro-thermal plants, from early steam-based systems to modern combined-cycle and cogeneration technologies. It highlights key milestones in the transition from simple thermal generation to more complex and efficient systems that integrate electricity and heat production. The study examines the role of fuel diversification, including the shift from coal to natural gas and the growing incorporation of renewable energy sources. It also addresses major technological innovations such as advanced turbines, heat recovery systems, and digital control through SCADA and automation platforms. Furthermore, the paper discusses current challenges, including emissions reduction, resource optimization, and integration into smart energy systems. By analyzing past developments and current trends, the paper outlines future directions for electro-thermal power plants, emphasizing sustainability, decarbonization, and the increasing importance of hybrid and flexible energy solutions.

Keywords: electro-thermal power plants, energy efficiency, cogeneration, decarbonization

G.29. HYBRID PHOTOVOLTAIC–THERMAL (PV/T) SYSTEMS FOR INDUSTRIAL APPLICATIONS: MODELING, ENERGY ANALYSIS, AND TECHNO-ECONOMIC OPTIMIZATION

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Abstract. In the context of the ongoing energy transition and European decarbonization targets, the integration of renewable energy sources into the industrial sector has become a strategic priority. This paper proposes the analysis and development of hybrid photovoltaic–thermal (PV/T) systems for industrial applications, aiming to improve energy efficiency and reduce CO₂ emissions. PV/T systems enable the simultaneous conversion of solar energy into electrical and thermal energy, enhancing overall system performance through photovoltaic cell cooling. The thermal energy can be utilized for industrial heating processes, while the electrical energy supports auxiliary equipment, contributing to reduced dependence on conventional energy sources. The study is based on the development and application of mathematical models for evaluating the energy and economic performance of PV/T systems, considering key variables such as solar irradiance, ambient temperature, and working fluid temperature. Previous research demonstrates that such systems can be economically viable under Romanian climatic conditions, with payback periods shorter than their operational lifetime. Furthermore, the integration of PV/T systems with heat pumps is investigated, highlighting their impact on energy and exergy performance. Comparative studies indicate that increasing the supplied hot water temperature leads to a decrease in energy, exergy, and economic efficiency, while certain hybrid configurations—such as those incorporating steam ejector heat pumps—may offer superior performance in continuous industrial applications. Based on a case study and climatic data specific to Romania, the research highlights the significant potential of PV/T systems in industrial

applications, particularly for processes requiring low- to medium-temperature heat. The economic (LCOE, payback period) and environmental (CO₂ emission reduction) assessments confirm that these solutions contribute to improved sustainability and energy independence. The results confirm that hybrid PV/T systems represent a viable solution for integrating renewable energy into industrial systems, offering a balanced trade-off between energy performance, implementation costs, and environmental impact.

Keywords: PV/T systems, solar energy, energy efficiency, industrial applications, heat pump, exergy analysis, sustainability

G.30. DEVELOPMENT OF A MODULAR WEB PLATFORM FOR CONTENT MANAGEMENT

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Abstract. This paper introduces a scalable and modular web platform designed to streamline the creation, management, and delivery of digital content across multiple projects. Unlike traditional content management systems, the proposed solution empowers non-technical users to build fully functional websites and mobile applications without writing code, by intuitively defining custom content structures tailored to their specific business needs. The platform addresses a critical challenge faced by digital agencies and organizations managing multiple clients: the need for rapid deployment, centralized control, and consistent configuration across projects. By consolidating content management into a single, extensible system, the solution significantly reduces development overhead, operational complexity, and time-to-market. Technically, the platform leverages a modern JavaScript/TypeScript stack. The backend, implemented with NestJS and MongoDB, provides a robust, type-safe API capable of runtime validation based on dynamically defined content schemas. Key features include secure API key authentication, fine-grained role-based access control, automated versioning, soft deletion with recovery mechanisms, scheduled publishing, and an event-driven architecture supporting extensibility through webhooks. On the frontend, an administrative interface built with Next.js offers a highly interactive and user-friendly environment for configuring content models, managing data entities, and customizing presentation logic per project. Complementing this, a mobile application prototype developed with Expo demonstrates the platform's Server-Driven UI paradigm, where interface structures are centrally defined and dynamically rendered on the client side. This approach eliminates the need for application redeployment when modifying content or layout, thereby enhancing flexibility and maintainability. The main contributions of this work include: (1) a runtime-configurable content modeling system with strong type safety guarantees, (2) the introduction of a flexible BlockLayout mechanism enabling context-aware content rendering across different platforms, and (3) the implementation of a Server-Driven UI architecture that decouples frontend presentation from deployment cycles. In conclusion, the proposed platform offers a self-hosted, open-source, and cost-effective alternative to existing CMS solutions, particularly suited for multi-project environments. It enhances productivity, reduces configuration effort, and provides a future-proof foundation for managing structured content in modern digital ecosystems.

Keywords: Headless CMS, NestJS, Next.js, Expo, MongoDB, Server-Driven UI, Monorepo

G.31. DEVELOPMENT OF A SECURE DATA CONTAINER MANAGEMENT APPLICATION

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Abstract. This paper presents the design and implementation of a robust software solution for the secure management of encrypted data containers, addressing the growing need for advanced data protection mechanisms in modern organizational environments. As the volume and sensitivity of digital information continue to increase, ensuring confidentiality, integrity, and controlled access has become a critical requirement for both enterprises and individual users. The proposed application enables users to create, extract, and manage encrypted containers through an intuitive interface, while also supporting version tracking to enhance transparency and data lifecycle control. To further improve data safety, the system incorporates a “Trash” mechanism that allows recovery of deleted containers or their permanent removal, thereby reducing the risk of accidental data loss and supporting secure data disposal practices. Security is enforced through the integration of a reliable and consistent encryption algorithm, ensuring stable protection of stored data. The application introduces a flexible credential management approach, allowing either the use of a centralized, organization-wide default password or the definition of user-specific passwords, in accordance with varying security policies and operational requirements. A key innovation of the system lies in its hybrid authentication model, which enables user identification either through device-level association or integration with Windows-based accounts. This dual approach facilitates seamless deployment within enterprise infrastructures, enhances compatibility with existing identity management systems, and improves the overall user experience by simplifying authentication workflows while maintaining strong security guarantees. Experimental results and functional validation demonstrate that the application achieves a high level of security, reliability, and usability. The main contributions of this work include the design of a modular and secure system architecture, the implementation of comprehensive data protection and recovery mechanisms, and the development of an efficient and user-friendly graphical interface. In conclusion, the proposed solution offers a practical and scalable approach to secure data container management, providing organizations with a reliable tool for safeguarding sensitive information while maintaining operational flexibility and ease of use.

Keywords: Data encryption, Secure containers, Access control, Hybrid authentication, Data recovery, Enterprise security

G.32. SOLUTIONS REGARDING THE OPTIMIZATION OF THE PARALLEL OPERATION OF GDTM TYPE ELECTRIC TRACTION MOTORS ON DIESEL-ELECTRIC LOCOMOTIVES

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Abstract. This paper aims to study the optimal parallel operation of GDTM 533 traction motors, which are used on diesel-electric locomotives in Romania. The study was conducted on a 2100 C-class 060 EGM diesel-electric locomotive and involved the installation of GDTM 533 F and GDTM 533 H DC traction motors. The aim was to determine certain characteristics of the traction motors and analyze them under actual operating conditions. More specifically, the parallel

operation of the GDTM 533F and GDTM 533H traction motors was studied.

Keywords: electric motor, wear, locomotive, wheel

G.33. BIOGAS PRODUCTION FROM SUGAR INDUSTRY RESIDUES: APPLIED ANALYSIS IN A SUGAR FACTORY

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Abstract. The increasing demand for energy and the environmental impact of fossil fuels have driven the development of renewable energy solutions. This paper analyzes biogas production through anaerobic digestion, focusing on sugar industry residues, especially sugar beet pulp. The study presents the main stages of the process and the key operating conditions required for efficient biogas generation. A case study examines the integration of a biogas plant within a sugar factory, including digestion, biogas treatment, and energy recovery through cogeneration. Results show that biogas utilization reduces energy costs, improves process efficiency, and supports waste valorization. Additionally, it contributes to lowering greenhouse gas emissions, making it a sustainable solution for the sugar industry.

Keywords: biogas, cogeneration, anaerobic digestion, biomethane, energy efficiency, automation, Python, Matplotlib, digital monitoring, decarbonization, greenhouse effect, digestate, digester, manure, beet pulp

G.34. EFFECTS OF REDUCING THE NUMBER OF TRANSFORMERS WITH THE NEUTRAL DIRECTLY CONNECTED TO THE GROUND IN HIGH VOLTAGE ELECTRICAL SUBSTATIONS

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Abstract. In high and very high voltage electrical networks, the neutral is directly connected to the ground. The level of overvoltage due to single-phase faults is lowest in this operating mode. This solution is also justified by the cost of insulation which takes on an increasing share of the total cost of the network because of the increase in the service voltage. However, in certain cases, depending on the network configuration, the single-phase short-circuit current may be higher than the value of the three-phase short-circuit current for which the primary switching devices are checked. The paper examines the impact of reducing the neutral earthing points of transformers in high voltage substations. A case study is provided for a network area with a voltage level of 110 kV. Using modeling and simulation in MATLAB/Simulink, this study evaluates the correlation between the reduction of fault currents and the increase in overvoltage levels in various fault scenarios. The results highlight the effects of reducing the number of transformers with a neutral directly connected to earth in high voltage electrical networks to limit the single-phase fault current below the value of the three-phase fault current or below the breaking capacity of the existing circuit breakers.

Keywords: Transmission and distribution networks, fault current, temporary overvoltage, methods of neutral grounding, direct grounding system

G.35. PRINCIPLE-BASED AI SECURITY : NON-PATTERN DETECTION OF INTENT AND INCOHERENCE

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Abstract. This theoretical paper presents a principle-based security framework for artificial intelligence interactions. The framework reduces the combinatorial complexity of attack detection from approximately 10^{12} distinct methods to 18 fundamental intention types and 4 dimensions of incoherence. An uncertainty relation between intent and context is formalized as $\Delta I \times \Delta C \geq 0.5$. The 4D incoherence model covers semantic, contextual, behavioral and strategic dimensions. A complete risk formula integrates weighted intent uncertainties, informational completeness, perturbation factors, psychological manipulation measures, and incoherence amplification. The framework includes management strategies for the fundamental uncertainty region between 0.4 and 0.6. A detailed example illustrates the framework's operation. All contributions are theoretical. Experimental validation remains to be implemented in future work.

Keywords: AI security, principle-based detection, 4D incoherence, uncertainty relation

G.36. AGENTIC PARETO OPTIMIZATION FOR NLP-GUIDED DYNAMIC ROUTING

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Abstract. The formulation of the multi-criteria Traveling Salesman Problem with Time Windows (TSPTW) in dynamic environments requires bridging rigorous combinatorial optimization with complex, unstructured real-world constraints. In applied logistics, vehicle route sequencing frequently relies on the empirical heuristics of human transport coordinators. While these dispatchers utilize years of accumulated spatial memory regarding regional topographies, traffic patterns, and client needs to construct trajectories, this manual paradigm is fundamentally bounded by human cognitive limitations, yielding mathematically suboptimal solutions and consuming substantial operational time. This paper introduces a novel agentic computational framework designed to systematically transcend these human limitations. The methodology establishes an initial mathematical baseline utilizing the Google OR-Tools exact solver. Subsequently, an integrated Natural Language Processing (NLP) agent processes unstructured customer data, applying entity recognition and sentiment scoring to mathematically quantify qualitative time-window constraints. A dynamic routing heuristic then adjusts the baseline to approximate a Pareto-optimal frontier across a strict multi-criteria matrix: (1) premium-tier service prioritization, (2) order value maximization, and (3) adherence to NLP-extracted temporal preferences. To rigorously validate the algorithmic performance, we propose the Composite Routing Efficiency Index (CREI)—an aggregated metric encompassing total distance, travel time, and average monetary yield. Benchmarking the framework against empirical, human-generated routing sets demonstrates that the agentic system consistently achieves superior CREI scores. Ultimately, this research provides a robust, scalable mathematical model that effectively replaces time-intensive human spatial heuristics with an optimized, cognitively-driven combinatorial approach.

Keywords: Agentic Routing, Natural Language Processing (NLP), Pareto Optimization,

TSPTW, Composite Routing Efficiency Index (CREI)

G.37. ENERGY TRANSITION IN ROMANIA: THE CONTRIBUTION OF DISTRIBUTION SYSTEM OPERATORS TO RENEWABLE ENERGY INTEGRATION

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Abstract. The energy transition represents a strategic process at both European and national levels, aimed at reducing greenhouse gas emissions, increasing energy efficiency, and integrating renewable energy sources into power systems. In Romania, the accelerated development of prosumers and distributed generation creates significant challenges for distribution system operators, which must adapt the existing infrastructure to new operating conditions characterized by bidirectional power flows, voltage variations, and increasing requirements regarding power quality. This paper analyzes the role of distribution system operators in the integration of renewable energy sources, with a focus on the activity of Delgaz Grid S.A. and the impact of the rapid increase in the number of prosumers in the Moldavian region. The study highlights that, during the 2010–2025 period, the number of prosumer connection requests experienced exponential growth, exceeding 22,000 applications in 2025, thus confirming the necessity of modernizing and digitalizing distribution networks. The applied part of the study is represented by the modernization of PTAB 2 Bogdan Vodă transformer substation, located in Bacău County, within the CARMEN project (Carpathian Modernization of Energy Network). The technical analysis revealed that the existing infrastructure, commissioned in 1973, presented a high degree of wear and limited performance in the context of renewable energy integration. Therefore, the proposed technical solution consisted of replacing the existing transformer with a modern 400 kVA transformer equipped with an automatic voltage regulator, possible SCADA integration, and modernization of protection and metering systems. The results demonstrate that modernization leads to the reduction of technical losses, improvement of SAIDI and SAIFI continuity indicators, increased network reliability, and enhanced integration capacity for prosumers. Furthermore, the economic analysis highlights the viability of the investment, with an estimated payback period of approximately 7.4 years and significant reductions in operational and maintenance costs. In conclusion, investments in digitalization, automation, and distribution infrastructure modernization represent essential conditions for the development of smart grids and for supporting the energy transition process in Romania. Keywords: Photovoltaic systems; BMS; energy transition; renewable energy sources; prosumers; smart grids; Delgaz Grid; electricity distribution; grid modernization; SAIDI; SAIFI.

Keywords: energy transition, renewable energy, distribution system operators, prosumers, smart grids, grid modernization

G.38. MODEL PREDICTIVE CONTROL OF AN OFF-GRID PV WATER PUMPING SYSTEM UNDER DESERT CLIMATE CONDITIONS: GHARDAÏA, ALGERIA AS AN APPLICATION CASE

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Abstract. This paper proposes a model predictive control (MPC)–based supervisory strategy for an off grid photovoltaic (PV) water pumping system supplying rural demand in an arid region. The case study is inspired by existing PV pumping installations in the Ghardaïa area in southern

Algeria and uses 10 minute measured solar irradiance and ambient temperature data from a desert meteorological station as external inputs to the model. The system under study consists of a PV array feeding a DC–DC boost converter with perturb and observe maximum power point tracking, a DC motor–pump set, and an elevated storage tank that buffers the mismatch between variable solar production and time varying water consumption. The proposed MPC formulation adjusts the pump operating signal based on short term predictions of irradiance and water demand, while explicitly enforcing hydraulic constraints on minimum and maximum tank levels and electrical constraints on the PV–converter operating range. The controller objective is to reduce unmet water demand and avoid critical tank depletion or overflow, thereby improving both service reliability and the utilization of available solar energy. The complete model and control strategy are implemented in MATLAB/Simulink using real meteorological data for Ghardaïa, and the full paper evaluates the performance of the proposed MPC supervisor through comparative simulations against a conventional rule-based control scheme.

Keywords: Photovoltaic water pumping, model predictive control (MPC), solar energy, water storage tank, off grid rural water supply, desert climate, Ghardaïa Algeria, maximum power point tracking (MPPT), MATLAB/Simulink

G.39. GLUCOGUARD: DESIGN AND FEASIBILITY ANALYSIS OF A NON-INVASIVE NIR-BASED GLUCOSE MONITORING WEARABLE

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Abstract. This paper presents GlucoGuard, a student-designed wearable prototype aimed at non-invasive blood glucose estimation using near-infrared (NIR) spectroscopy, skin temperature, and humidity sensing, combined with machine learning regression. The device integrates an MLX90614 contactless temperature sensor, an SHT35 humidity sensor, and a custom-built NIR sensor operating at 1550 nm, all connected to an Arduino Nano ESP32. A Random Forest Regressor trained on data correlated with a commercial Dexcom G7 CGM reference achieved a mean absolute error of approximately ± 9 mg/dL and an R^2 above 0.85 under laboratory conditions. However, during experimental validation, the prototype experienced a critical hardware failure: the IR LED circuit was destroyed due to improper biasing of the driving stage. Subsequent analysis also revealed fundamental feasibility challenges, including insufficient signal-to-noise ratio at the tissue interface, the confounding absorption of water and lipids near 1550 nm, and regulatory constraints on IR irradiance for wearable devices. This paper documents the design process, the experimental findings, and an honest assessment of the technical and regulatory barriers to practical non-invasive glucose monitoring at the pre-professional student level. The work was recognised for its conceptual ingenuity at a national student competition.

Keywords: non-invasive glucose monitoring, NIR spectroscopy, wearable biosensor, machine learning, random forest regression, feasibility study, student engineering project

G.40. LEVERAGING LTE NETWORK INFRASTRUCTURE FOR UNMANNED AERIAL VEHICLE DETECTION: A DEEP DIVE INTO BBU-RRU ARCHITECTURE, S1-AP PROTOCOL IMPLEMENTATION, AND RF SIGNATURE ANALYSIS

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Abstract. The proliferation of Unmanned Aerial Vehicles (UAVs) in civilian airspace has necessitated the development of robust detection and monitoring systems. This paper presents a

comprehensive methodology for UAV detection utilizing existing Long-Term Evolution (LTE) network infrastructure, specifically leveraging the distributed architecture of Baseband Units (BBU), Remote Radio Heads (RRU), and the S1 Application Protocol (S1-AP) interface. We detail the complete signal path from antenna arrays through fronthaul networks (CPRI over fiber optic or microwave radio links) to the Evolved Packet Core (EPC), demonstrating how each component can be instrumented for passive RF signature collection. Our approach exploits the RF fingerprinting characteristics of commercial drones operating in the 2.4 GHz and 5 GHz ISM bands, captured through spectrum sensing extensions to existing RRU hardware. The system architecture includes modifications to the BBU pool for real-time signal processing, integration with S1-AP signaling for coordination, and aggregation through Mobile Switching Centers (MSC) and concentrator nodes. Field trials across urban, suburban, and rural deployment scenarios demonstrate detection accuracy of 96.3% with end-to-end latency under 180ms through optimized transport network configurations.

Keywords: UAV detection, LTE infrastructure, BBU-RRU architecture, S1-AP protocol, CPRI fronthaul, RF fingerprinting, spectrum sensing, machine learning

G.41. EXPERIMENTAL INVESTIGATION ON THE CALCULATION OF THE RESULTANT OF CUTTING FORCES AND MOMENTS USING A C++ PROGRAM

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Abstract. This paper presents aspects of the processing of hard mineral materials with superabrasive discs in the finishing grinding process on the RPO 200-AKS surface grinding machine. According to the cutting force criterion, aspects of the machinability of mineral materials as well as aspects of the cutting capacity of diamond discs are presented. The cutting forces and moments in the experimental factorial designs are determined by the Kistler dynamometer which is solidly located on the grinding machine platform connected to a computer. The C++ programs proposed for calculating the resultant of the cutting forces and moments are of real use in determining their variations, the machinability of mineral materials, the global cutting capacity of the tools used, all of which are presented in the conclusions of the paper.

Keywords: Finishing grinding, superabrasive discs, Kistler dynamometer, resultant of cutting forces, resultant of cutting moments, resultant calculation program in C++

G.42. COMPARATIVE EXPERIMENTAL ANALYSIS OF MONOFACIAL AND BIFACIAL OFF-GRID PHOTOVOLTAIC SYSTEMS UNDER REAL OPERATING CONDITIONS

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Abstract. This paper presents a comparative experimental analysis of two off-grid photovoltaic (PV) systems equipped with monofacial and bifacial solar panels, respectively. The experimental study was carried out in the Renewable Energy Laboratory of the Faculty of Engineering, “Vasile Alecsandri” University of Bacău, with the objective of evaluating the electrical and energetic performance of both technologies under identical operating conditions. The investigated systems were designed using equivalent components for energy conversion, storage, and protection, ensuring that the photovoltaic module type represented the only major variable influencing

system performance. The experimental setup included a 430 W LONGi monofacial photovoltaic panel and a 430 W JA Solar bifacial photovoltaic panel mounted on the same support structure. Measurements were performed on 06 May 2026 over multiple time intervals between 09:00 and 17:30. The monitored parameters included panel voltage and current, front and rear irradiance, ambient temperature, panel temperature, wind speed, humidity, and generated electrical power. Additional measurements were obtained from the inverter displays and smart monitoring systems integrated into the experimental stand. To quantify the energetic advantage of bifacial technology, several performance indicators were calculated, including bifaciality coefficient, bifacial gain coefficient, conversion efficiency, produced energy, and relative energy gain. The bifaciality coefficient of the tested module was considered $\gamma = 0.6$, while the active area of the panel was approximately 1.953 m². The calculations demonstrated that the bifacial module benefited significantly from rear-side irradiance, particularly during periods of increased solar reflection and higher global irradiance levels. The experimental results highlighted a consistent energetic advantage of the bifacial photovoltaic system compared with the monofacial configuration. At 09:00, the bifacial energy gain reached approximately 14.9%, while at 09:30 the gain was 10.75%. During higher irradiance conditions around midday, the energetic improvement increased considerably, reaching 21.27% at 10:00 and approximately 22.25% at 10:30. The bifacial module also exhibited slightly higher conversion efficiencies due to the contribution of rear-side irradiance captured from reflected solar radiation. The study confirms that bifacial photovoltaic technology can significantly improve the overall energy yield of off-grid solar systems, especially when installed under conditions that maximize rear-side light reflection. Although bifacial modules involve slightly higher installation costs and more complex mounting requirements, their superior energy production and long-term performance make them a promising solution for sustainable photovoltaic applications. These findings support the increasing adoption of bifacial photovoltaic systems as an efficient alternative to conventional monofacial panels in modern renewable energy installations.

Keywords: Bifacial photovoltaic panel, monofacial photovoltaic panel, renewable energy, off-grid photovoltaic system, solar energy, photovoltaic efficiency, energy gain, experimental analysis, bifaciality coefficient, sustainable energy systems

G.43. ANALYSIS OF ACTIVE ISLANDING DETECTION METHODS FOR PHOTOVOLTAIC POWER PLANTS

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Abstract. This paper analyzes the islanding phenomenon in photovoltaic (PV) systems, a major technical challenge arising in the context of the accelerated growth of distributed generation in Romania, where the installed capacity exceeded the 3 GW threshold in the second half of 2025, bringing the national total to over 7 GW. The primary objective of the study is to analyze active methods for detecting unintentional islanding, a phenomenon that can jeopardize the safety of maintenance personnel and the integrity of electrical equipment. The paper explores the mechanisms of islanding occurrence at the point of common coupling (PCC) and evaluates their impact on grid voltage and frequency stability. Special emphasis is placed on the concept of the Non-Detection Zone (NDZ), standing for the interval in which conventional protection methods may not find autonomous operation. The advantages of active control methods integrated into inverters are analyzed, which allow for the reduction of the non-detection zone and ensure rapid disconnection in case of a loss of power from the main electrical grid. The results of the study underscore the necessity of modernizing anti-islanding (AI) protection systems in the context of the transition towards smart grids and the high density of grid-connected prosumers.

Keywords: photovoltaic (PV) systems, islanding, active detection methods, prosumers, smart grids

G.44. ANALYSIS OF WIND POWER PLANTS UNDER ELECTRICAL GRID FAULT CONDITIONS

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Abstract. This paper addresses a highly topical subject within the context of the energy transition: the analysis of the dynamic behavior of wind power plants (WPPs) during electrical grid faults. The primary aim consists in evaluating the Fault Ride Through (FRT) capability of wind turbines (WTs) equipped with Doubly-Fed Induction Generators (DFIG), in compliance with the technical requirements imposed by modern grid codes. The theoretical section analyzes the legislative and technical framework, highlighting the importance of voltage and frequency stability at the point of common coupling (PCC). It details the mathematical modeling of a WT equipped with a DFIG in the dq reference frame, including the two-mass mechanical model, the aerodynamic model, and the vector control of the power converters within the WT generator system (WTGS). The work to simulate various types of grid faults in the MATLAB/Simulink environment. The study investigates variations in electrical parameters (voltage, current, active power, and reactive power) and the efficiency of control strategies in reducing the non-detection zone and protecting the equipment. The results confirm the critical importance of rapid reactive power regulation for voltage support during transient regimes, thereby ensuring the operational stability of the electrical power system (EPS) under conditions of high renewable energy sources (RESs) penetration.

Keywords: wind energy, wind turbines (WTs), electrical grids, fault conditions, fault ride through (FRT) capability

G.45. ENERGY PERFORMANCE ANALYSIS OF COGENERATION SYSTEMS IN A CHP PLANT

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Abstract. Cogeneration involves coupling two different energy processes within the same installation: the simultaneous production of electrical and thermal energy. This leads to fuel savings. In this study, various operating parameters of two different installations belonging to a district heating power plant, in this case Thermoenergy, were monitored and centralized over a one-year period. The sources used for the production of electrical and thermal energy were as follows: a cogeneration unit with a gas turbine and heat recovery boiler rated at 14 MWe and 22 MWt, a combined-cycle gas-steam cogeneration unit rated at 10.95 MWe and 14 MWt with supplementary firing, and two auxiliary steam boilers with a capacity of 10 t/h each. The data recorded over the course of one year were centralized in tables including gas consumption, produced electrical and thermal energy, temperatures, pressures, and losses in the district heating network. Based on the collected data from the two installations, various graphs and diagrams were developed, including: the influence of air temperature on electrical power output in the cogeneration installation, the annual energy balance and seasonal comparison of the two installations, efficiency as a function of electrical load, the contribution of the installations to annual production, electrical energy production compared to thermal energy production, and the correlation between energy production and gas consumption. By comparing the graphs and diagrams of the two installations, it was observed that the power plant is slightly more oriented toward heat production than electricity generation; air temperature is a critical limiting factor for production capacity in cogeneration; the maximum efficiency of the cogeneration installation is

achieved at high load during winter, while the combined-cycle installation operates optimally at medium load; maximum gas consumption occurs during the winter months when the demand for heat and electricity increases, and minimum consumption occurs during the summer period.

Keywords: Cogeneration, Combined Heat and Power (CHP), Energy Efficiency, Gas Consumption

G.46. INTELLIGENT SYSTEM FOR SPEED REGULATION OF A THREE-PHASE ASYNCHRONOUS MOTOR MADE WITH THE ARDUINO MEGA 2560 DEVELOPMENT BOARD

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Abstract. This paper presents an intelligent system for speed regulation of asynchronous motor made with the Arduino Mega 2560 development board. The speed regulation of the three-phase asynchronous motor is done by means of a static frequency converter controlled by a speed regulator made with the help of a program developed in the Arduino IDE programming environment. The speed regulator is of the proportional-integrative (PI) type and was implemented with the help of the Arduino Mega 2560 development board on the experimental stand made in the Electrical Machines and Actuators laboratory within the Faculty of Engineering in Bacău. The PWM type control signal generated by the Arduino Mega 2560 development board is converted into an analog signal using a PWM converter module powered separately at 12 V.d.c. By using this intelligent three-phase asynchronous motor speed control system, the amount of electrical energy consumed by the three-phase asynchronous motor during transient starting or braking regimes will be reduced. This three-phase asynchronous motor speed control algorithm can also be implemented for other electric drive systems in various industrial applications.

Keywords: asynchronous motor, Arduino Mega 2560, signal PWM

G.47. ADAPTIVE GEO-SPATIAL NAVIGATION AND POSITIONING ARCHITECTURE EXPLOITING SPIRAL WAVE INTERACTIONS WITHIN NATURALLY OCCURRING IONIC FIELDS

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Abstract. This paper presents a conceptual autonomous navigation system based on the hypothesis that naturally occurring spiral ionic waves exist within oceanic environments. The proposed model assumes that the interaction of major seawater ions under the influence of the Earth's geomagnetic field and vertical CO₂ gradients generates stable spiral-wave patterns that can serve as natural geo-spatial references for positioning and navigation. The study describes a non-linear self-sustaining mechanism composed of four stages: ionic accumulation, resonance amplification, fragmentation, and wave recombination. A multidimensional environmental reference model integrating spatial coordinates, salinity, temperature, and dissolved CO₂ concentration is proposed for signal interpretation and localisation. The navigation architecture employs a circular multi-electrode sensing array combined with polar correlation algorithms and AI-assisted signal analysis to detect and reconstruct spiral-wave structures in real time. Unlike conventional GNSS technologies, the proposed system operates passively, requires no external infrastructure, and remains functional in underwater or electromagnetically restricted environments. The research combines concepts from oceanography, non-linear dynamics, artificial intelligence, and autonomous navigation engineering, providing a potential foundation

for future resilient underwater positioning systems and intelligent maritime cyber-physical platforms.

Keywords: autonomous navigation; spiral ionic waves; underwater positioning; geomagnetic interactions; oceanic sensing; nonlinear dynamics; AI-assisted navigation; marine cyber-physical systems; intelligent localization; adaptive navigation architectures

G.48. COMPUTATIONAL ARCHITECTURE FOR ADAPTIVE DIGITAL BEHAVIORAL FINGERPRINTING, IDENTITY MODELING, AND PATTERN RECOGNITION IN HUMAN–ARTIFICIAL INTELLIGENCE INTERACTION ECOSYSTEMS

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Abstract. This work investigates how recurrent interactions between humans and artificial intelligence systems can lead to the emergence of stable yet evolving digital behavioral signatures. Unlike static user profiles, these signatures are treated as dynamic constructs shaped by context, intent variability, interaction history, and cognitive response patterns. The proposed framework models human–AI communication as a continuous data stream from which behaviour regularities can be extracted using temporal learning techniques, sequence modelling, and probabilistic inference. Rather than relying solely on explicit user inputs, the system analysis indirect interaction cues such as response latency, linguistic structuring, correction patterns, and decision consistency to construct a multi-dimensional behavioral representation. A core aspect of the approach is the transformation of raw interaction data into abstract behaviour embeddings that evolve over time. These embeddings enable the system to adapt its responses without storing identifiable raw content, supporting a balance between personalisation and data minimisation. The model further incorporates a contextual adaptation layer that adjusts behaviour interpretation depending on task type and interaction environment. The study highlights the potential of digital behaviour fingerprinting as a mechanism for improving adaptive intelligence in human–AI systems, while also emphasising the importance of interpretability, privacy preservation, and ethical constraints in behavioral modelling.

Keywords: digital behaviour fingerprinting; human–AI interaction; behavioural pattern recognition; adaptive user modelling; machine learning; temporal behaviour analysis; identity modelling; artificial intelligence systems; interaction profiling; privacy-aware AI; sequential data modelling; predictive behaviour analytics; human-computer interaction; neural representation learning; adaptive personalization

G.49. A THERMODYNAMICALLY CONSTRAINED CRYPTOGRAPHIC PARADIGM BASED ON PHYSICAL IRREVERSIBILITY, LANDAUER’S PRINCIPLE, AND THE Λ -PATH STATE TRANSITION MECHANISM

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Abstract. This paper introduces a conceptual cryptographic framework grounded in physical irreversibility, combining Landauer’s principle with a proposed computational construct termed the Λ -path mechanism. The central idea is to explore encryption not solely as an algorithmic

transformation, but as a process constrained by thermodynamic limits, where information erasure and logical irreversibility impose fundamental bounds on computational security. Landauer's principle establishes that the erasure of one bit of information is associated with a minimum energy dissipation, linking information theory with physical entropy. Building on this foundation, the Λ -path model is introduced as an abstract representation of constrained state transitions in computational systems, where encryption processes are interpreted as energetically directed trajectories in a physically grounded state space. Within this formulation, security emerges from the irreversibility of transformations rather than computational complexity alone. The proposed framework examines how irreversible state evolution can be exploited to design cryptographic primitives that are resistant to inversion, even under idealised computational assumptions. By embedding cryptographic operations within thermodynamically constrained processes, the system aims to shift the security paradigm from mathematical hardness to physical non-reversibility. The Λ -path mechanism further formalises this behaviour by modelling encryption as a path-dependent process in which reconstruction of the initial state becomes infeasible without violating physical constraints. The study also discusses potential implications for post-quantum security, low-energy computation, and physically uncloseable information systems. Although largely theoretical, the framework suggests a new direction in which cryptographic strength is derived from fundamental physical laws rather than purely algorithmic assumptions.

Keywords: physical cryptography; Landauer principle; thermodynamic irreversibility; information theory; entropy and computation; Λ -path model; irreversible computation; post-quantum security; physical-layer encryption; computational thermodynamics; information erasure; hardware-based security; physical uncloseable systems; energy-aware cryptography; state-space encryption

G.50. AUTONOMOUS ROBOTIC ARCHITECTURE BASED ON ARTIFICIAL INTELLIGENCE FOR REAL-TIME MULTIMODAL VISUAL PERCEPTION AND VOCAL INTERACTION IN DYNAMIC ENVIRONMENTS

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Abstract. This work addresses the design and implementation of an autonomous intelligent robotic navigation system that integrates modern computer vision techniques, proximity sensing, and deep learning algorithms. In the context of the rapid advancement of autonomous vehicles and mobile robotics, this topic is highly relevant, supported by recent progress in convolutional neural networks used for real-time environmental understanding. The main motivation of this project lies in exploring the deployment of deep learning algorithms on resource-constrained embedded systems, aiming to enhance autonomy and safety in mobile platforms. The proposed system enables a robot to perceive its environment, detect obstacles, and make real-time navigation decisions through a hybrid approach combining classical sensors with artificial vision. The primary objective is the development of an autonomous vehicle capable of intelligent navigation. Specific objectives include the integration of a mobile hardware platform equipped with motors and distance sensors, the implementation of a vision-based detection module using MobileNet SSD for real-time object recognition, the development of a decision-making algorithm for obstacle avoidance and target tracking, and the integration of a vocal interaction system to provide feedback regarding detected objects and navigation actions.

Keywords: autonom robotics; multimodal perception; computer vision; speech recognition; human-robot interaction; deep learning; sensor fusion; real-time systems; natural language understanding; AI-driven robotics; visual-linguistic integration; adaptive decision-making; interactive autonomous agents; embodied artificial intelligence

G.51. AI-DRIVEN FUZZY SEMANTIC FRAMEWORK FOR CONTEXTUAL MODELING AND INTELLIGENT ANALYSIS OF ACADEMIC CONFERENCE ECOSYSTEMS

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Abstract. This paper presents an intelligent framework for contextual analysis of academic conferences, integrating artificial intelligence techniques with fuzzy semantic modeling to enhance the interpretation of complex conversational environments. In the context of rapidly increasing volumes of information generated during meetings and scientific events, the automatic identification and structuring of relevant knowledge become essential for improving decision-making and knowledge management processes. The proposed system employs natural language processing methods to transcribe and analyze spoken content, combined with fuzzy logic mechanisms to represent the inherent uncertainty and ambiguity of human language. This hybrid approach enables the extraction of semantically meaningful elements such as dominant topics, contextual dependencies, and relational structures between concepts discussed during conferences. By combining probabilistic language modelling with fuzzy semantic representation, the system achieves a more flexible and adaptive interpretation of discourse compared to traditional rule-based or purely statistical approaches. Preliminary results indicate improved contextual understanding and more coherent semantic structuring of conference content. The developed framework is implemented as a software application (MeetingBrainAI) capable of processing audio recordings of meetings and generating structured, context-aware semantic representations. The system demonstrates potential applicability in knowledge management, collaborative analysis, and decision-support environments within organisational and academic contexts.

Keywords: contextual analysis; fuzzy semantic modelling; artificial intelligence; natural language processing; speech-to-text processing; knowledge representation; uncertainty modelling; semantic extraction; conference analysis; decision support systems; machine learning; discourse analysis; information retrieval; MeetingBrainAI; intelligent meeting systems



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