”Dunărea de Jos” University of Galați

Scientific Conference of Doctoral Schools

Perspectives and challenges in doctoral Research

14th Edition of SCDS-UDJG

11th and 12th of June 2026

BOOK OF ABSTRACTS

UNIVERSITAS GALATIENSIS

”Dunărea de Jos” University of Galați

DOCTORAL SCHOOL OF MECHANICAL AND INDUSTRIAL ENGINEERING
DOCTORAL SCHOOL OF FUNDAMENTAL SCIENCES AND ENGINEERING
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DOCTORAL SCHOOL OF BIOMEDICAL SCIENCES

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CONFERENCE PROGRAMME

THURSDAY – June 11, 2026

08:00-10:00	Invited plenary lectures
09:00-11:00	Participants registration
10:00-13:00	Invited lectures Oral presentations in concurrent sections
13:00-14:00	Lunch (building D - 1st floor)
14:00-16:00	Oral presentations in concurrent sections
16:00-16:30	Coffee break (building D - 1st floor)
16:00-19:00	Oral presentations in concurrent sections

FRIDAY – June 12, 2026

09:00-10:30	Oral presentations in concurrent sections
10:30-11:00	Coffee break (building D - 1st floor)
11:00-13:00	Posters session
11:00-13:00	Workshop
13:00-14:00	Awarding ceremony. Closing ceremony
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1. ORAL PRESENTATION

OP1

TURBULENT WIND ANALYSES OF EIGHT FLOATING WIND TURBINES

Mohamed Maktabi*, Eugen Victor Cristian Rusu

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ABSTRACT

The objective of this work is to carry out turbulent wind and irregular wave time-domain dynamic analyses on eight floating wind turbines. From this perspective, this paper will study the six degrees of freedom of the eight floating wind turbines. As well as tower-base and tower-top bending moments, and shear forces around the x- and y- axes, etc. First- and second-order wave forces will also be considered. Similar analyses of the drivetrains and mooring lines of the eight floating wind turbines under the same environmental conditions will also be carried out. This research is ongoing, and further related aspects will be added to the paper.

Key words: renewable energy, floating wind, turbulent wind analysis

OP2

ANALYSIS OF WAKE EFFECTS AND YAW MISALIGNMENT IN WIND FARM PERFORMANCE OPTIMIZATION

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ABSTRACT

This paper investigates the influence of wind turbine wake interactions and yaw-based control strategies on the overall performance of wind farms through a computational modeling approach. The wake effect, characterized by a reduction in wind speed and an increase in turbulence downstream of operating turbines, represents a primary source of efficiency loss in multi-turbine configurations. Conventional operation aligns turbines with the incoming wind to maximize individual power output; however, this often leads to significant wake interference affecting downstream units. To address this, the present study explores intentional yaw misalignment as an active wake control strategy. By introducing controlled deviations between the rotor axis and the wind direction for upstream turbines, the resulting wake can be redirected laterally, reducing its impact on downstream turbines and improving overall energy capture. The analysis focuses on the effects of varying yaw angles on wake deflection, recovery rate, and power redistribution within a simplified wind farm layout. The investigation is conducted using a steady-state, physics-based numerical model designed for wind farm flow analysis and control-oriented studies. Simulations are performed for a range of fixed yaw angles to isolate the relationship between yaw misalignment and wake behavior. Key performance indicators include velocity deficit, wake expansion, and turbine power output. Results demonstrate a clear trade-off between the reduced power production of yawed upstream turbines and the increased performance of downstream turbines, with certain yaw configurations yielding a net gain in total farm output. The findings highlight the potential of model-based wake steering strategies to enhance wind farm efficiency and provide a foundation for future implementation of dynamic control systems.

Key words: wind turbine wake, power optimization, renewable energy, farm efficiency

OP3

THE STRATEGIC ROLE OF THE DANUBE RIVER AND THE PORT OF CONSTANȚA IN SUSTAINABLE DEVELOPMENT AND THE ENERGY TRANSITION

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ABSTRACT

The Danube River is essential to the ecological and economic development of the riparian states, having a key role in international transport, energy production, and the sustenance of socio-economic activities. This paper examines the main characteristics of the river and its tributaries, highlighting the importance of navigation and its economic contribution through the facilitation of trade and tourism, as well as through the development of the hydropower sector. At the same time, the study highlights the importance of port areas in the context of the energy transition, with a focus on the Port of Constanța, Romania's main maritime hub on the Black Sea. An analysis of historical climate data and long-term projections indicates significant potential for wind and solar resources, as well as additional opportunities offered by wave energy. Understanding climate variability contributes to the optimization of navigation activities and the development of modern energy infrastructure. Thus, the integration of renewable resources into port systems and the sustainable management of the Danube River represent essential directions for sustainable economic development and the reduction of environmental impact. In addition, these strategic directions can help strengthen infrastructure resilience and adapt to the challenges posed by long-term climate change.

Key words: Danube river, sustainable development, renewable energy, port of Constanța, climate variability

OP4

INNOVATIVE FLOATING STRUCTURES IN EUROPE: HYDRODYNAMIC PERFORMANCE, ENERGY SOLUTIONS, AND SUSTAINABLE DESIGN

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ABSTRACT

In recent years, floating structures have become an important area of development in Europe, offering efficient solutions for the use of maritime areas and the exploitation of available resources. This paper highlights the role of these structures from the perspective of hydrodynamic behavior, the potential for integrating renewable energy sources, and current sustainable design requirements. Aspects related to stability, response to wave action, movements induced by the marine environment, and the influence of mooring systems on operational safety are analyzed. Additionally, solutions are presented for the integration of offshore wind turbines, floating photovoltaic systems, and wave energy conversion technologies. From a structural engineering perspective, the focus is on the use of modern materials, structural weight optimization, modular solutions, and reducing environmental impact. Through examples developed at the European level, the paper highlights the importance of floating structures in the context of the energy transition and the sustainable development of coastal areas.

Key words: floating structures, hydrodynamic behavior, renewable energy, sustainable design, stability, offshore systems, sustainable development, coastal areas

OP5

THE IMPACT OF CLIMATE CHANGE ON MARITIME TRANSPORT AND MARITIME SECURITY

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ABSTRACT

Maritime transport represents a key sector of the Blue Economy of the European Union. Europe positions itself as a global maritime leader, having over 300 major ports on its coasts and controlling approximately a third of the world's merchant fleet. For EU countries, ports constitute vital access points connecting European shipping corridors with the rest of the world. Given that 75% of European external trade transits through EU ports, the shipping sector plays a crucial role in integrating the European market with its trading partners. Current forecasts range between a sea-level rise of 0.5 to 2 meters by 2100 and project a general shift towards meteorological instability, including changes in storm frequency and intensity. A recent study estimates a doubling of the number of category four and five hurricanes in the Atlantic basin by 2100. Other impacts of climate change include: extreme temperatures, which could affect the handling of weather, as well as more intense precipitation, which could cause local flooding and modification of sediment covers, requiring additional dredging operations. In addition, this paper prioritizes maritime security, which refers to the processes and measures instituted to protect a country's territorial claims, assets, maritime lines of communication, and marine resources. This includes the protection of ports, coastal areas, offshore structures, and the marine environment against threats such as piracy, terrorism, poaching, smuggling, and pollution. Maritime media are essential to global trade, energy security, and economic prosperity, and their stability and security are of paramount importance.

Key words: climate change, marine structures, marine security

OP6

A MULTI-SITE, LONG-TERM EVALUATION OF OFFSHORE WIND TURBINES IN THE WESTERN BLACK SEA BASIN

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ABSTRACT

In the context of climate change and the increasing rate of global warming, renewable energy sources are becoming the primary alternative to conventional fuels. In the Black Sea, offshore wind energy represents a significant and promising clean energy resource. Therefore, this study aims to assess the offshore wind potential over a quarter of a century, starting from 2026, providing a long-term perspective on resource variability under future climate conditions. Wind speed data, obtained from a regional climate model database, were adjusted to a hub height of 100 m above sea level, representative of offshore wind turbines. The selected sites cover water depths ranging from intermediate to deep conditions and are spatially distributed over a wide and representative area of the western Black Sea basin. The present study focuses on the evaluation of several wind turbine models and tests their performance, highlighting their suitability for each selected location. The results provide a comparative evaluation of turbine efficiency and energy potential within a moderate climate stabilization scenario, which is useful for identifying relevant sites for future offshore wind project development.

Key words: offshore wind potential, offshore wind turbine, Western Black Sea basin, climate change, long-term perspective

OP7

PHYSICS-INFORMED MACHINE LEARNING FOR BEARING HEALTH MONITORING IN ROTATING INDUSTRIAL MACHINERY USING PUBLIC EXPERIMENTAL DATASETS

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ABSTRACT

Predictive maintenance is a major research direction in mechanical and industrial engineering, particularly for rotating machinery where bearing degradation can generate unplanned downtime, safety risks, and significant maintenance costs. This study proposes a physics-informed machine learning framework for bearing health monitoring, fault diagnosis, and remaining useful life estimation using public experimental datasets from rotating machinery test rigs. The methodological design integrates vibration-signal processing, statistical and spectral feature extraction, physically interpretable health indicators, and supervised learning models within a digital-twin-oriented condition monitoring architecture. The proposed framework is structured around publicly available bearing datasets, including run-to-failure and condition-monitoring data suitable for diagnostic and prognostic analysis. Time-domain descriptors, frequency-domain indicators, and degradation-sensitive features are extracted from vibration signals and used to compare conventional machine learning models with physics-informed feature augmentation. The research design includes fault classification, health-index construction, remaining useful life modelling, ablation analysis, confusion-matrix evaluation, feature-importance assessment, and observed-versus-predicted prognostic validation. The expected contribution of this work is a transparent and reproducible computational workflow that links experimental bearing data, machine learning, and engineering-domain knowledge for improved interpretability in predictive maintenance. By combining diagnostic and prognostic tasks within a unified framework, the study supports the development of data-driven digital twins for rotating industrial machinery. The proposed approach is relevant for future industrial deployment because it emphasizes reproducibility, public-data validation, physical interpretability, and maintenance decision support.

Key words: predictive maintenance, machine learning, bearing, health monitoring, data processing

OP8

ARTIFICIAL INTELLIGENCE-BASED MODELLING AND OPTIMIZATION OF MILLING PROCESSES FOR TOOL CONDITION MONITORING AND MANUFACTURING EFFICIENCY

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ABSTRACT

Artificial intelligence is increasingly used in advanced manufacturing to improve process monitoring, tool condition assessment, and operational efficiency in machining systems. Milling operations are particularly relevant because tool wear, cutting conditions, vibration, force, and energy-related indicators can strongly influence productivity, dimensional quality, surface integrity, and production cost. This study proposes an artificial intelligence-based modelling and optimization framework for milling processes using open experimental machining datasets. The proposed methodology combines public machining data, process-parameter analysis, signal-based feature extraction, surrogate modelling, and multi-objective optimization. The framework is designed to support tool wear prediction, process-state assessment, productivity analysis, and energy-aware machining decision support. When direct surface-quality measurements are available in the source datasets, they are incorporated as target variables; otherwise, the analysis is restricted to experimentally available outcomes such as tool wear, cutting signals, productivity-related indicators, and physically justified process-efficiency proxies. This design avoids unsupported assumptions and ensures that the reported results remain directly linked to measured data. The research workflow includes data curation, feature engineering, supervised regression models, performance evaluation, Pareto-based trade-off analysis, and interpretable feature-importance assessment. The expected contribution is a reproducible and transparent AI framework for machining-process optimization that can be extended toward industrial digital manufacturing environments. By connecting open experimental datasets with interpretable machine learning and constrained optimization, the study provides a methodological basis for improving tool life management, process efficiency, and decision-making in modern mechanical manufacturing.

Key words: Artificial intelligence, modelling simulation, milling process, condition monitoring

OP9

ANALYSIS OF GEAR DEFECTS USING IMAGE PROCESSING METHODS

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ABSTRACT

Gear of all types and sizes represent the main components of power transmission systems. Precise development and maintenance of the teeth flanks, based on the fundamental characteristics is crucial in gear manufacturing, assembly, functionality, performance, and evaluation. The primary objective is to reduce as much as possible the noise and vibrations that appear during the meshing of gears, noise that occurs as a result of the existence of transmission error. Profile correction is one of the most prevalent techniques for optimizing transmission error functions. This paper outlines a method for detecting various types of gear defects through the use of different image processing techniques. The process includes steps such as pre-processing, feature extraction, and pattern recognition algorithms, which are presented in order to analyze images of gear surfaces and identify issues such as wear, pitting, cracks, or other forms of damage.

Key words: transmission error, gear meshing, tooth profiles, image processing

OP10

ANALYSIS OF GEAR DEFECTS USING IMAGE PROCESSING METHODS

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ABSTRACT

The integration of renewable energy technologies on inland vessels is becoming increasingly relevant as the maritime sector seeks practical solutions for reducing fuel consumption, auxiliary engine load, and operational emissions. This paper proposes a design and implementation strategy for shipboard wind energy systems installed on inland vessels, using a Danube River case study as the reference application. The study focuses on the technical steps required to assess, select, install, and monitor a small-scale wind turbine intended to support auxiliary power generation under real navigation and operating conditions. The proposed approach considers both the energy potential and the practical constraints associated with onboard installation. Key aspects include the evaluation of local wind availability, the influence of vessel geometry and superstructure on airflow quality, the selection of a suitable mounting location, structural support requirements, vibration and safety considerations, electrical integration, and the interface with batteries or auxiliary consumers. The methodology also includes a monitoring strategy based on the measurement of wind speed, voltage, current, generated power, and accumulated energy, allowing the comparison between expected and actual system performance. The Danube River case study provides a relevant context for assessing the feasibility of small wind energy systems on inland working vessels, where available deck space, variable operating profiles, and low-altitude wind conditions can significantly affect energy yield. Although such systems are not expected to replace conventional onboard power generation, they may contribute to supplying low-power auxiliary loads, charging batteries, and reducing generator operating time when integrated into a hybrid energy architecture. The contribution of this paper consists in defining a practical engineering pathway for the deployment of shipboard wind energy systems on inland vessels. The proposed strategy supports future experimental investigations and provides a technical basis for renewable energy retrofits aimed at improving the environmental performance of river navigation.

Key words: shipboard wind energy, inland vessels, Danube River, renewable energy integration, auxiliary power generation, maritime decarbonization

2.POSTERS

SECTION I: ADVANCED RESEARCH IN MECHANICAL AND INDUSTRIAL ENGINEERING

PP1

RECENT DEVELOPMENT IN CO_2 REFRIGERATION TECHNOLOGIES

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ABSTRACT

CO_2 is widely used today in all kinds of applications, from refrigeration plants serving supermarkets to heat pumps for various industrial applications, being considered the best option in commercial refrigeration since its GWP is equal to 1 and having zero ODP. It has been analyzed all kinds of theoretical models and practical examples, from traditional installations known as standard, or basic, CO_2 transcritical systems, to heat pumps with double evaporators equipped with EJ technology, to find out how the efficiency can be improved and the energy consumption reduced, with the main goal of widespread use in both commercial and industrial applications.

Key words: energy consumption, commercial refrigeration, carbon dioxide, ejector

PP2

OFFSHORE PLATFORM ADAPTATION TO CLIMATE CHANGE THROUGH TECHNOLOGICAL OPTIMIZATION AND ADVANCED MONITORING: LITERATURE REVIEW

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ABSTRACT

Climate change is one of the major challenges of the 21st century for the offshore oil industry, generating fundamental changes in operating conditions and requiring complex technological adaptations. This paper investigates the vulnerability of offshore oil infrastructures to the effects of climate change, analysing the impact of temperature increases, sea level changes and the intensification of extreme weather events on offshore platforms. By analysing the specialized literature and evaluating the data, the study identifies the main risks to which these infrastructures are exposed and proposes integrated optimization and adaptation strategies. The results highlight the need to implement advanced structural monitoring technologies, develop multi-criteria optimization methods and integrate renewable energy solutions to increase the resilience of offshore platforms. The analysis shows that infrastructure in Arctic regions is exposed to risks caused by permafrost instability, and many major European terminals are vulnerable to sea level rise. Our paper proposes a unified conceptual model that integrates structural optimization technologies, continuous monitoring solutions, and modern risk management approaches to maintain the safety and sustainability of offshore operations under conditions of intensifying climate change.

Key words: offshore platforms, structural optimization, risk management, oil infrastructure

PP3

TENSILE BEHAVIOR OF BIAXIAL (±45°) NON-CRIMP GLASS FIBER COMPOSITES: INFLUENCE OF TEST RATE AND LAMINATE THICKNESS

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ABSTRACT

The reinforcement used in this study was a biaxial (±45°) E-glass non-crimp fabric (NCF) with an areal density of approximately 620 g/m² and a nominal width of 127 cm. The fabric layers were held together by polyester stitching (Z-binding). Following a literature review on resins for glass fiber composites, the resin Enydyne H 68372 TA, together with the Metox - 50W accelerator was selected. There were tested two composites, one with 4 layers of biaxial prepreg and the other one with 8 layers. The test rate was in the range 10-1000 mm/min. At test rate of 10 mm/min, tensile strength is slightly increasing when number of layers increase from 4 layers to 8 layers (from 112.8 MPa to 126.8 MPa), but for the higher test rates (200-1000 mm/min) the composite thickness has no noticeable influence on the strength values. Even if the number of layers is double, the values for the thicker composite, F_{max} is almost three-times greater than for the thinner composite and no clear sensitivity to test rate was noticed. The tensile response of the composite with biaxial glass fibers is governed by in-plane shear deformation, a nonlinear behavior and larger strain. The increased deformability of biaxial (±45°) laminates makes them suitable for applications involving complex geometries or curved structures, where enhanced formability and shear compliance are required.

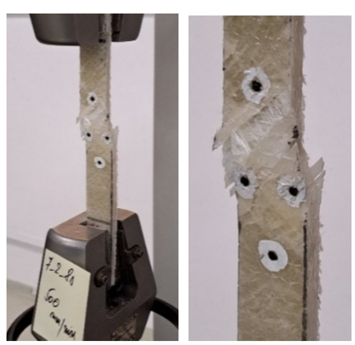

Figure 1. Sample with 8 layers of biaxial prepreg, tested in traction at 500 mm/min

Key words: composites, biaxial (±45°) fabric, tensile tests, test rate, non-saturated polyester resin

PP4

METHANOL AS A SUSTAINABLE ALTERNATIVE TO HFO IN MARINE BOILERS

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ABSTRACT

Methanol is increasingly utilized in marine boiler applications as an alternative to conventional fuels such as heavy fuel oil (HFO), and is widely recognized as a superior option due to its favorable emissions profile, clean combustion characteristics, and economic potential. Compared to HFO, methanol virtually eliminates SO_x emissions and significantly reduces NO_x, particulate matter, and CO_2 emissions, thereby ensuring compliance with stringent regulations imposed by the International Maritime Organization and supporting global decarbonization objectives in the maritime sector. A wide range of theoretical and experimental investigations has been conducted, covering conventional HFO-based boiler systems as well as advanced methanol-fired configurations, with the aim of evaluating performance improvements and emission reductions. These studies demonstrate enhanced energy efficiency, more stable combustion processes, and reduced specific fuel consumption under optimized operating conditions. From an economic perspective, methanol presents several advantages, including lower maintenance requirements due to cleaner combustion, reduced need for exhaust gas after-treatment systems, and decreased exposure to emission-related taxes and penalties. Although its lower energy density leads to higher volumetric fuel consumption, these drawbacks are often offset by operational savings and regulatory compliance benefits. Consequently, methanol represents a technically feasible and economically viable solution for large-scale implementation in commercial and industrial maritime boiler applications.

Key words: methanol, marine boilers, emissions reduction, energy efficiency, decarbonization, economic viability

PP5

GEOSPATIAL ASSESSMENT OF OFFSHORE WIND ENERGY POTENTIAL IN ROMANIA’S EXCLUSIVE ECONOMIC ZONE

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ABSTRACT

Rapid expansion of the European offshore wind sector is driven by increasing energy security concerns and ambitious decarbonization targets. As mature basins such as the North Sea approach saturation, the Black Sea is emerging as a strategic area for large scale renewable energy development. This study evaluates offshore wind energy potential within the Romanian Exclusive Economic Zone using ERA5 reanalysis datasets for the 2022 to 2025 period. Wind conditions at 100 m hub height are assessed through percentile distribution, directional analysis, and estimates of annual energy production and capacity factor based on a contemporary offshore wind turbine. Results indicate a consistent offshore wind gradient, with median wind speeds exceeding 7 m/s in central and northeastern sectors, while capacity factors exceed 40 percent in the most favorable locations. Compared to established onshore wind projects in Romania, offshore sites demonstrate higher production stability and improved overall performance. In the context of ongoing regulatory developments and the completion of maritime spatial planning, findings support the technical feasibility of offshore wind projects exceeding 1 GW per development phase. Integration of next generation turbines above 15 MW, together with the potential deployment of floating foundations in deeper waters, supports the positioning of the Romanian Black Sea as a relevant offshore energy hub contributing to national decarbonization objectives and regional power system stability.

Key words: Romania, EEZ, ERA5, wind turbines, marine areas

PP6

A MAZE ROUTING ALGORITHM FOR SAFE AND SUSTAINABLE BLACK SEA VOYAGES

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ABSTRACT

The Black Sea is a challenging area for navigation due to unreliable weather, local hazards, restricted zones, and growing demands for fuel efficiency and lower emissions. In these conditions, choosing the shortest route is not always the safest or most cost-effective option for commercial ships. This study describes a straightforward maze-routing algorithm as an easy-to-use tool for planning safer, more efficient voyages between Constanța and Batumi. In this study, the sea is represented as a grid, with dangerous weather, restricted or risky areas, and less favorable regions marked as obstacles or penalty points. The routing method finds paths between Constanța and Batumi that avoid hazards and minimize detours, helping keep fuel use and travel time reasonable. A case study was used to test how well the method adapts to shifting Black Sea conditions, how simple it is to use, and how useful it is in practice. The results show that this approach can find practical alternative routes that make navigation safer, while keeping the sailing distance and fuel use close to those of direct routing. The study shows that good route planning does not always need advanced optimization software. Even when quick decisions are needed, a simple routing method can be helpful. For the Black Sea, this approach could support merchant and naval operations, especially in route selection, training, and early risk assessment.

Key words: routing, navigation safety, Black Sea, maze, algorithm

PP7

PERSPECTIVES ON THE INTEGRATION OF HYDROGEN INTO THE COMBINED BLOWING PROCESSES OF THE LD CONVERTER

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ABSTRACT

The steel industry is one of the largest consumers of energy worldwide, with steelmaking processes being associated with high consumption of fossil fuels and significant emissions of carbon dioxide and other greenhouse gases. In the current context of energy transition and international objectives regarding the reduction of polluting emissions, the development of more efficient and less polluting technologies in metallurgy has become a strategic necessity. The LD (Linz–Donawitz) converter, widely used in steelmaking, is based on blowing oxygen into the molten bath in order to oxidize impurities and obtain the desired chemical composition of steel. During this process, intense oxidation reactions occur, accompanied by significant heat release and the formation of large volumes of process gases rich in carbon monoxide and carbon dioxide. In order to improve the efficiency of the metallurgical process, many modern steel plants use combined blowing technology, which involves the combination of top oxygen blowing and bottom blowing through nozzles placed at the base of the converter. This method contributes to the intensification of molten bath mixing, improvement of heat and mass transfer, as well as increased efficiency of metallurgical reactions.

Key words: Linz-Donawitz converter, perspectives, hydrogen, siderurgy

PP8

HYDRATION EFFECT ON THE MECHANICAL PROPERTIES OF FLOUR-MODIFIED EPOXY

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ABSTRACT

In the context of the global transition to a circular economy and sustainable use of resources, the development of environmentally friendly composite materials has become a priority. The work addresses the issue of sustainability of traditional epoxy composites by integrating by-products from the food industry as natural additives, thus reducing the dependence on petrochemical resources. The present work also investigates the influence of water absorption on the mechanical properties of innovative composite materials, developed within CCDCOMT, by modifying an epoxy matrix with sustainable plant additives: grape seed flour and milk thistle seed flour. The study comparatively analyzes the impact of the type of flour (characterized by the presence of fats in the case of grapes and silymarin in the case of milk thistle), of the mass concentration (2.5% and 5%) and of the granulation (with and without prior grinding) on the structural performance. The methodology involved preparing the samples at ambient temperature and exposing them to a regime of continuous immersion in water for 5 weeks to evaluate the hydration rate. From a mechanical point of view, while the pure epoxy matrix remained stable under the action of water, the modified composites showed a decrease in tensile strength proportional to the degree of hydration, the increase in the additive concentration and the reduction in particle size. The comparative analysis demonstrated that the use of grape flour ensures a mechanical strength superior to that of milk thistle, regardless of the processing conditions, providing essential data for the optimization of biocomposites intended for use in humid environments.

Key words: epoxy resin, grapes seeds flour, milk thistle seeds flour, mechanical properties variability

PP9

ANALYSIS OF MECHANICAL PROPERTIES OF EPOXY RESIN MODIFIED WITH ORGANIC AGENTS

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ABSTRACT

This study focuses on the development and testing of new composite materials made by modifying an epoxy resin with chitosan and aspartic acid. The main goal of the research was to see how these organic additives influence the mechanical strength and durability of the final material. To create these materials, specific amounts of chitosan and aspartic acid (in both L and D forms) were mixed into the resin, followed by a controlled hardening process. The performance of the resulting composites was then evaluated through various tests, including stretching and bending tests, as well as checking how much water the material absorbs over time. The results show that adding chitosan and aspartic acid allows for better control over the material's stiffness and strength, while also making it more eco-friendly. This study highlights the potential of these modified composites for advanced use in fields like bioengineering or lightweight industrial manufacturing, where both biocompatibility and reliable mechanical properties are essential.

Key words: epoxy composites, chitosan, aspartic acid, mechanical properties, biomaterials

PP10

$nTiO_2$ - EPOXY COMPOSITES

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ABSTRACT

Titanium dioxide (TiO_2) is one of the most studied and used oxide materials worldwide, being present in a wide range of industrial and technological applications – from pigments and coatings to photocatalysts, biosensors, optoelectronic devices and renewable energy solutions. Overall, the experimental results highlighted the fact that the physical and mechanical properties of the composites are strongly dependent on the proportion and homogeneity of the $nTiO_2$ dispersion, but also on the way in which they affect the internal structure of the polymer matrix. The control sample served as a constant reference, confirming that the presence of $nTiO_2$ must be carefully optimized in order not to compromise the mechanical integrity of the material. Also, the tests revealed the importance of the dimensions of nano-particles of TiO_2 used (on same amounts) to modify the epoxy-based material's properties.

Key words: epoxy resin, $nTiO_2$, mechanical properties

PP11

EXPERIMENTAL INVESTIGATION OF STRESS STATES IN ROAD INFRASTRUCTURE USING ELECTRICAL RESISTANCE STRAIN GAUGE TECHNIQUES

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ABSTRACT

This paper presents an experimental study on the stress state in road infrastructure elements using electrical resistance strain gauge techniques. The research focuses on the structural behavior of a steel bridge located over the Siret River (DN 2B, km 125+340, Șendreni, Galați County), subjected to real traffic loads. The methodology is based on the application of resistive strain gauges mounted on critical structural elements of the bridge. The measurement system includes Wheatstone bridge configurations and a multi-channel data acquisition unit (Quantum X), enabling high-frequency recording of strain variations during vehicle crossings. Three sets of measurements were performed under normal traffic conditions, each covering a 90-second acquisition interval. Experimental results highlight the distribution of normal stresses in the monitored elements, with maximum recorded values of approximately 6.51 MPa. These values are significantly lower than the allowable stress limits of the structural material, confirming the structural safety under current loading conditions. However, the study emphasizes the presence of significant dynamic effects, particularly vibrations induced by traffic, which may influence long-term structural performance. The research demonstrates the effectiveness of electrical resistance strain gauge techniques for in-situ structural monitoring and provides valuable insights for infrastructure assessment, maintenance strategies, and traffic regulation measures.

Key words: strain gauges, road infrastructure, experimental analysis, stress distribution, bridge monitoring, structural health monitoring

PP12

BALLISTIC DAMAGE MECHANISMS IN ULTRA-HIGH-MOLECULAR-WEIGHT POLYETHYLENE ENDUMAX PLATES: COMPARATIVE TESTS ON 65- AND 165-LAYER LAMINATES

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ABSTRACT

Hard plates made of Endumax XF33 (Teijin, Netherlands, 2022) – a UHMWPE ultra high molecular weight polyethylene and they were tested against different ammunitions (9×19 mm FMJ, .44 Magnum SJSP, 7.62×39 mm FMJ, and 7.62×51 mm FMJ). Two plates were fabricated (with 68 layers and 135 layers, respectively). Test conditions were: firing distance: 5 and 15 m, backing material: Roma Plasteline no. 1 and measured parameters were: projectile velocity and backface deformation. The results are only indicative, not certifying, but providing relevant results for continuing the research study. High resolution photographs reveal particular failure mechanisms: shear breakage generating an orifice of about ¼ of the plate thickness, local deformation caused by projectile flattening process, layer delamination (more severe at almost mid-plane of the cavity), fibre stretching and fibrillation, local compaction: This indicates a progressive energy dissipation through the laminate and larger lateral cavitation at higher velocities. The cross-sectional images reveal a progressive, layer-by-layer damage process. Higher impact velocity produced more localized and severe damage. The 135-layer plate showed a larger capacity for energy dissipation. Further tests are required for statistical validation.

a)

Projectile	Plate	V_0 [m/s]	BFD [mm]
9×19 mm FMJ	68 layers	415-431	10-16
.44 Magnum JSP		411-448	17-22
7.69x39 FMJ	135 layers	693-722	10-28
7.62x51 FMJ		831-838	30-43

b)

Figure 1. a) Cross section in Endumax XF33 135-layer plate, after being hit with a projectile 7.62x51 mm, v_0=833 m/s, BFD=28 mm; b) ranges for involved parameters: V_0 – impact velocity, BDF – backface deformation

Keywords: Endumax XF33, hard plate, ballistic test, 9×19 mm FMJ, .44 Magnum SJSP, 7.62×39 mm FMJ, 7.62×51 mm FMJ, failure mechanisms, BFD (backface deformation)

PP13

MECHANICAL PROPERTIES OF NONLINEAR ACTIVE ELECTRICAL RESISTIVE MATERIALS FOR OVERVOLTAGE PROTECTION

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ABSTRACT

Nonlinear active resistance represents the specific behavior of certain electrical materials and devices (such as varistors, hybrid composites, or insulators with special properties), characterized by a nonlinear dependence between voltage and current. In this case, the electrical resistance does not remain constant but varies with the applied voltage, enabling energy dissipation under overvoltage conditions, being adequate for equipment protection, and increases reliability of power systems. This phenomenon is essential for designing advanced materials used in impulse protection and overvoltage applications. In the field of power engineering, the development of advanced composite materials is crucial for creating reliable and durable protective equipment. Epoxy composites reinforced with ceramic fillers and nanostructured additives such as SiC and metal oxides (Tm_2O_3, MgO, $Al_2O_3 \cdot TiO_2$, SiO_2, Al_2O_3, Sm_2O_3, TiO_2) exhibit superior mechanical and electrical properties. The aim of this research is to evaluate the mechanical and physicochemical behavior of these composites for potential applications. Experimental tests included current–voltage (VAC) analysis, bending and tensile strength measurements, and water absorption determination. The results highlight the influence of nano-additives on material performance and support the identification of optimal combinations for protecting electroenergetic installations.

Key words: nonlinear active resistance, nano-additives, mechanical properties, water absorption

PP14

COMPARATIVE NUMERICAL ANALYSIS OF LAMINATED COMPOSITE AND HYBRID METAL–COMPOSITE PLATES FOR SMALL CRAFT APPLICATIONS

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ABSTRACT

This paper proposes a comparative numerical study of the mechanical behavior of laminated composite plates and hybrid metal–composite plates, with a focus on lightweight structures for small craft applications. The main objective of the research is to analyze how the material configuration influences structural stiffness, stress distribution, and maximum displacement under similar loading conditions. The numerical models are developed in ANSYS using identical geometries and equivalent boundary conditions, so that the results obtained for the analyzed solutions can be directly compared. The study considers both laminated composite plates with different fiber orientations and hybrid variants consisting of composite layers and metallic components. Based on the results, the paper aims to highlight the advantages and limitations of each analyzed configuration, especially regarding the relationship between mechanical performance and structural weight. The research may contribute to the identification of efficient design solutions for lightweight marine structures and serve as a preliminary step toward the development of optimized hybrid materials for small craft applications.

Key words: laminated composite plates, hybrid metal–composite plates, ANSYS, structural stiffness, lightweight marine structures, small craft

PP15

GLOBAL MARINE ENERGY UNDER CLIMATE CHANGE. A REVIEW WITH FOCUS ON THE BLACK SEA

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ABSTRACT

Decarbonization continues to be a topic that require ongoing research. It brings together multiple organizations that aim to offset the climate change consequences and implement targets to reduce emissions, particularly IPCC, IEA and IMO. The objectives to reduce the global warming until 2°C and to achieve net-zero emissions by 2050 may seem ambitious, however it reflects a global perspective and is heavily dependent on the ongoing scientific and technological progress. Considering this context, marine renewable energy has become significant in the transition toward sustainable resources. The present review provides a synthesis of existing studies concerning marine energy potential under climate change, with particular emphasis on the Black Sea region. This study highlights the importance of integrating the current knowledge altogether to understand the marine energy environment and contribute to the global objective of emission reduction. It explores the climate variability of wind and wave resources and the methodologies widely used to simulate the sea state under past and future conditions. Among the various datasets and modelling approaches, the relevant ones for this paper are the simulation results provided by SWAN model, ERA5 reanalysis for hindcast assessment, and simulation carried out under climate scenario frameworks including Representative Concentration Pathways (RCPs) and Shared Socioeconomic Pathways (SSPs) for forecasting. On the whole, the paper aims to support the sustainable path of global energy transition through an approach that considers both the global context and scientific methodology.

Key words: decarbonization, renewable energy, Black Sea, wave energy, wind energy

PP16

ASSESSMENT OF THE BENEFITS OF FLOATING DOCKS REPOSITIONING IN "NAVROM" SHIPYARD

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ABSTRACT

This paper analyses the operational, energy-efficiency, and safety improvements due to the realignment of the docks of the "NAVROM" Shipyard. The study focuses on how the rearrangement of the docks affects material handling, workforce mobility, electricity consumption, and ship maneuvering operations. Based on a comparative analysis of the dock layout before and after the relocation of the infrastructure, a comprehensive case study was conducted. The results show that repositioning the docks closer to the shore through a different orientation relative to the shoreline significantly reduces the distance between the cranes located on each platform and the dock platforms, thus eliminating the need for intermediate transfers. The study highlights the following key aspects: The first aspect is the improvement of workplace safety, due to the strategic placement of the docks, which minimizes worker movement between different units, reducing access routes by up to 50%. The second issue is about energy efficiency by minimizing energy losses through shortening the distances for electricity supply. The final aspect is the significant reduction in the time required for ship docking and undocking operations, which contributes to lower transportation costs and increased overall productivity. The findings highlight the importance of strategic arrangement of dock orientation as a key element in optimizing the operational performance of modern shipyards.

Key words: energy-efficiency, safety improvements, costs

PP17

ENERGY CONSERVATION IN MUNICIPAL BUS SYSTEMS: A REVIEW

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ABSTRACT

Municipal bus systems are central to sustainable urban mobility, providing high passenger capacity with lower energy consumption per capita than private road transport. However, increasing urbanization, rising service demand, and stringent climate policies necessitate further reductions in operational and life-cycle energy use. This review synthesizes recent research on energy conservation in municipal bus systems, focusing on vehicle technologies, operational strategies, digital energy management, and system-level planning approaches. Particular attention is given to hybrid and battery electric buses, regenerative braking, eco-driving, route optimization, and intelligent charging infrastructure. Results from empirical studies and real-world deployments indicate that integrated energy conservation strategies can reduce operational energy consumption by 30–60% compared with conventional diesel fleets, depending on route characteristics, climate conditions, and electricity generation mix. Remaining challenges and future research directions are identified to support the large-scale deployment of energy-efficient municipal bus systems.

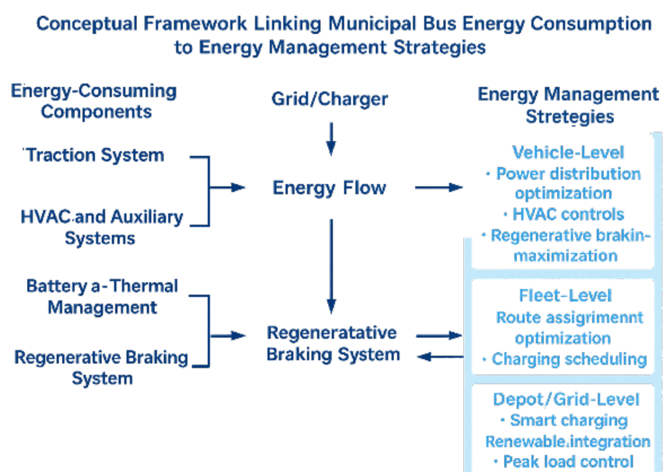

Figure 1. Conceptual Framework Linking Municipal Bus Energy Consumption to Energy Management Strategies

Key words: municipal buses, energy conservation, hybrid and electric buses, regenerative braking, eco-driving, urban transport

PP18

FLOW RATE ANALYSIS OF NONCIRCULAR GEAR PUMPS BASED ON CENTRODES GENERATED BY THE GIELIS SUPERFORMULA

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ABSTRACT

This paper presents the use of the Gielis superformula for the generation of noncircular gears intended for application in positive displacement pumps. Due to its high parametric flexibility, the Gielis equation enables the definition of a wide range of smooth, closed centrodes with controllable geometric features, making it a suitable tool for noncircular gear design. A set of geometric conditions is established to ensure the generation of centrodes with a prescribed number of lobes, while maintaining the continuity and smoothness required for proper gear meshing. These centrodes are further employed in the construction of noncircular gear pairs, allowing the evaluation of their functional behavior in pumping applications. The analysis focuses on the relationship between gear geometry and the resulting flow rate of the pump. By systematically varying the shape of the centrodes, the parametric influence on volumetric performance is highlighted. The study emphasizes the potential of the Gielis superformula as a versatile approach for extending the design space of noncircular gear pumps.

Key words: noncircular gear pumps, flow rate, Gielis

PP19

PRELIMINARY STUDY ON THE ELECTRICAL BEHAVIOR OF 3D PRINTED PLA-BASED COMPOSITES

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ABSTRACT

Fused deposition modelling (FDM) is widely used to manufacture components from polymer composites filled with nano-conductive particles, providing versatility in the orientation and arrangement of the printed conductive lines. This study addresses the electrical behavior of FDM 3D printed polylactic acid (PLA)-based composites filled with different nano-conductive particles. The effects of 3D printing parameters on the DC resistance and AC impedance, including its frequency response, are evaluated. The orientation of the printed lines is controlled during 3D printing by changing the printing direction: longitudinal (0°), oblique (+45°/−45°), and alternative (0°/90°). The investigation aims to quantify how the filler type and the printing direction govern current transport along and across the printed lines, and to identify the printing strategy that yields the most stable and reproducible conductivity. The results will support the design of FDM printed conductive components for electronics, sensors, and printed interconnects.

Key words: fused deposition modelling, conductive PLA, line orientation, electrical impedance, 3D printing

PP20

RECENT ADVANCES IN RHEOLOGICAL MODELLING OF GRANULAR MATERIALS STABILIZED WITH ENZYMES, NANOMATERIALS, AND ECO-FRIENDLY BINDERS

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ABSTRACT

Rheological modeling of eco-stabilized granular materials has emerged as a growing research direction in mechanical engineering, particularly in the context of developing sustainable materials with controlled mechanical performance and optimizing dynamic densification processes. Recent studies highlight the potential of enzymes, nanomaterials, bio-based additives, industrial by-products, and other sustainable binders to modify the mechanical, rheological, and microstructural behavior of these complex systems. The aim of this paper is to synthesize recent contributions on the constitutive and rheological modeling of materials stabilized with enzymes, nanomaterials, and eco-friendly binders, with a focus on their response to dynamic loading and the mechanisms involved in vibratory compaction and energy dissipation processes. The analysis focuses on several key directions: rheological modification through enzyme-based stabilization, the influence of nanomaterials on stiffness and apparent viscosity, the use of sustainable binders for controlling mechanical behavior, the development of constitutive models for treated materials, and the characterization of dynamic response under cyclic loading conditions. This work contributes by correlating material composition, type of stabilizer, microstructural transformations, and processing conditions with the overall rheological and mechanical response. The results indicate that eco-stabilized materials exhibit significant potential for engineering applications requiring adaptable mechanical properties and sustainable performance. However, their behavior strongly depends on parameters such as particle size distribution, binder dosage, moisture content, curing time, and dynamic loading regime, highlighting the need for integrated rheological models validated experimentally and applicable in advanced mechanical simulations.

Key words: rheological modeling, eco-stabilized soils, enzyme-based stabilization, nanomaterials, eco-friendly binders, vibro-compaction, geotechnical composites

PP21

REDESIGNING INDUSTRIAL DOLLIES FOR AUTOMATED LOGISTICS: VIBRATION CONTROL, COMPACT ROUTES AND AGV COMPATIBILITY

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ABSTRACT

Industrial dollies and trailers are increasingly used in automated intralogistics systems, where compact factory layouts, longer transport routes and the integration of AGV or autonomous towing vehicles generate new design constraints. Unlike conventional manually operated or tractor-towed trailers, modern industrial dollies must ensure stable tracking, reduced vibration transmission, safe load retention and reliable operation under repetitive dynamic loading. This study focuses on the redesign requirements of industrial dollies operating in automated logistics environments. Particular attention is given to vibration control, frame stiffness, wheel–ground interaction, coupling systems and load stability. The research also considers the development of an anti-vibration system intended to improve operational safety, reduce structural fatigue and protect transported components. The proposed design approach supports the transition from traditional industrial trailers to smart, automation-compatible dolly systems.

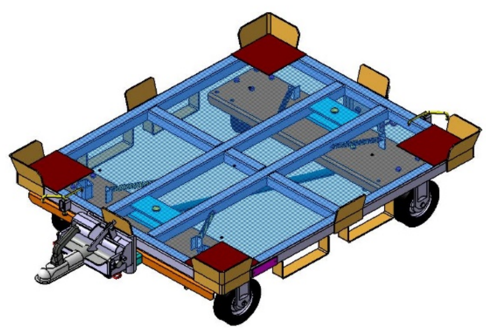

Figure 1. A design solution for the trailer vehicle

Key words: transfer system, airport trailer, components, design solution

PP22

PRELIMINARY DISTRIBUTION OF CHEMICAL ELEMENTS IN SUSPENDED PARTICLES RETAINED ON FILTERS FROM PRUT RIVER WATER SAMPLED IN THE CAHUL LOCATION

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ABSTRACT

This study presents an initial assessment of the distribution of selected chemical elements in suspended particulate matter retained on water filters from the Prut River, in the Cahul area. The investigation was carried out on a limited number of samples collected during two seasonal periods: summer 2025 and winter 2026. The winter dataset includes two consecutive sampling/analysis intervals in February 2026, while the summer dataset corresponds to samples collected in June 2025. Suspended particles were separated according to filter-size fractions, including approximately 10 µm, 300 µm and 600 µm, in order to obtain a first indication of how chemical elements are associated with different particulate-size ranges. The analytical results indicate the presence of several major and trace elements, including K, Ca, Ti, Cr, Mn, Fe, Ni, Cu, Zn, As, Br, Rb, Sr and Pb. Among the quantified elements, Ca and Fe showed the highest concentrations in most particle fractions, suggesting a dominant contribution of mineral and lithogenic material in the suspended load. Elements such as Ti, Mn, Sr and K were also consistently detected, while trace metals including Cr, Ni, Cu, Zn and Pb were observed at lower but measurable levels in several fractions. As was generally close to or below the limit of quantification in the winter samples, indicating that its interpretation should be treated with caution. Although the number of samples is limited, the results suggest differences between particle-size fractions and between the summer and winter sampling periods. In several cases, the finest fraction retained on the 10 µm filter showed increased concentrations of trace metals, especially during the February 2026 analyses, while coarser fractions were characterized by variable enrichment in Ca, Fe and other mineral-associated elements. These observations may reflect seasonal changes in river flow, suspended sediment composition, runoff input, and local geochemical background. The present work should be regarded as a pilot investigation rather than a complete environmental assessment. Its main value lies in establishing a first dataset for the chemical characterization of suspended particulate matter in the Prut River near Cahul, an area for which such fraction-based analyses have not been systematically reported so far. The results provide a methodological and interpretative basis for future monitoring within the doctoral research program, where weekly sampling is planned in order to obtain a more representative dataset, evaluate temporal variability, and better distinguish natural geochemical signatures from possible anthropogenic contributions.

Key words: chemical elements, Prut River, water, Cahul location, analysis, suspended particulate matter, size fractions

PP23

IMPACT TESTS ON COMPOSITES MADE OF NON-CRIMP GLASS FIBER PREPREGS WITH COREMAT XI3 MIDDLE LAYER

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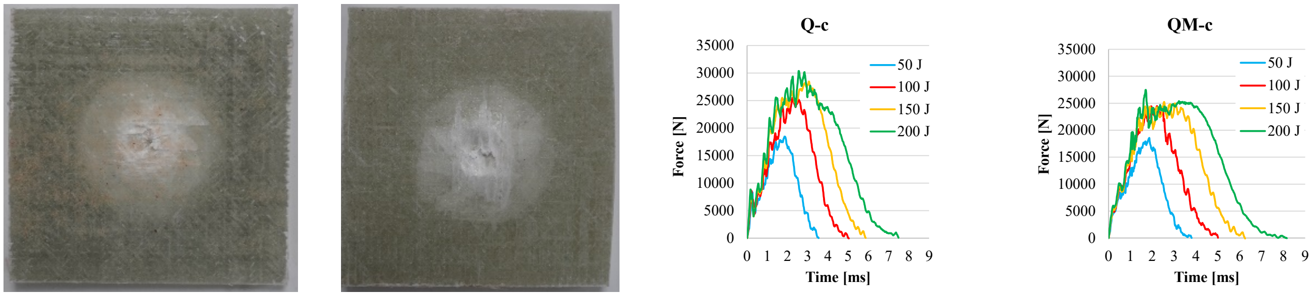
ABSTRACT

The composite reinforcement was a quadriaxial prepreg (0°/45°/90°/-45°) E-glass non-crimp fabric (NCF) with an areal density of 620 g/m². The fabric layers were held together by polyester stitching (Z-binding). Following a literature review on resins for glass fiber composites, the resin Enydyne H 68372 TA, together with the Metox–50W accelerator was selected. There were tested two composites, one with 8 layers of quadriaxial prepreg (coded Q-c) and the other one with 8 layers + one middle layer of Coremat Xi3 (coded QM-c). The impact energy is in the range of 50-200 J. The parameters recorded during the test were: time (resolution 0.01 ms), force (45 kN load cell), displacement, strain, and velocity, all integrated into the data acquisition system of the Instron 9350 impact testing machine. F_{max} (Figure 1c and d) increases with impact energy; however, this increase also depends on the composite type: composite without mat (Q-c) exhibits higher F_{max} values compared to composite with mat (QM-c). The dependence on impact energy is more pronounced for composites without mat, while for composites with mat the slope of this dependence is lower. For these two composites, the time to the end of impact (defined as the first zero value of force after F_{max}) increases similarly and shows approximately identical values. The maximum displacement, d_{max}, shows very similar mean values at 50 J; however, as the impact energy increases, this parameter increases while maintaining the same hierarchy at each energy level: $d_{max\ (Q\text{-}c)} < d_{max\ (QM\text{-}c)}$. The displacement at impact end, when $F_f = 0$ after reaching the maximum value, noted $d_{(Ff=0)}$, is ordered for all impact energy levels as: $d_{(Ff=0)(Q\text{-}c)} < d_{(Ff=0)(QM\text{-}c)}$. Regarding energy absorption, the behavior of these composites is clearly divided: the composites without mat exhibits lower values, while that including a mat layer in the mid-plane presents higher values; however, the differences remain sufficiently small such that this parameter – the presence of mat middle layer, cannot be considered a well-defined influencing factor.

Key words: composites, glass fiber quadriaxial (0°/45°/90°/-45°) prepreg, impact test, low velocity impact, mat layer, unsaturated polyester resin



a) Q-c b) QM-c c) Q-c d) QM-c

Figure 1. a) and b) Impact-tested specimens at nominal energies of 200 J; c) force – time curves at different impact energies: c) for the composite Q-c, d) for the composite QM-c

PP24

A COMPARATIVE ANALYSIS OF MECHANICAL PROPERTIES OF TWO DENTAL COMPOSITE MATERIALS USING THE NANOINDENTATION TECHNIQUE

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ABSTRACT

Restorative dental materials are of great importance in dentistry for restoring and replacing injured or missed teeth with the purpose of simulating natural teeth functions. During the mastication process, the restorative materials are exposed to both static and dynamic loading as tooth cusps and hard foods indent these materials. Therefore, successful restoration of teeth mainly depends on the mechanical properties of dental restorative composites. The aim of this study is to assess the mechanical performance of two dental composite materials, namely Amaris (VOCO) and Te-Econom Plus (Ivoclar Vivadent), using the nanoindentation technique. Both materials are commonly used in direct restoration, yet they differ significantly in composition and structure, which influence their mechanical behaviour. Therefore, static and multi-cycle indentation tests were performed to assess the nanoscale mechanical properties. With the mechanical response of load-displacement curves at different applied loads (50, 100 and 200 mN) and holding times (0, 10 and 30s) and indentation of cycles (6, 12, 18, 24 and 30 indentation cycles), the elastic modulus and hardness of the two dental composites were assessed and compared.

Key words: nanoindentation, dental composite, Amaris, Te-econom Plus

PP25

EXPERIMENTAL ASSESSMENT OF A SMALL WIND TURBINE INSTALLED ON A DANUBE RIVER DREDGER FOR AUXILIARY POWER GENERATION

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ABSTRACT

The integration of renewable energy systems on inland vessels represents a practical direction for reducing auxiliary fuel consumption and supporting the decarbonisation of river transport operations. This study presents the experimental assessment of a small wind turbine installed on a Danube River dredger, with the aim of evaluating its suitability for auxiliary power generation under real operating conditions. The research focuses on the onboard integration of the turbine, the monitoring architecture, and the relationship between local wind availability and electrical energy output. The experimental setup includes the wind turbine, its mounting structure, electrical conversion components, battery interface, and monitoring instruments for recording wind speed, voltage, current, power, and energy production. Particular attention is given to the influence of the vessel environment, including superstructure-induced turbulence, variable wind direction, vibration, and operational constraints specific to dredging activities. The collected data are intended to support a comparison between theoretical turbine performance and measured onboard energy yield. The expected contribution of this work is a practical evaluation framework for small-scale wind energy harvesting on inland working vessels. By linking measured electrical output with auxiliary energy demand, the study provides insight into the feasibility of using compact wind turbines to support low-power consumers, battery charging, and partial reduction of generator operating time. Although the installed system is not intended to replace conventional power generation, it can contribute to improved energy efficiency and lower emissions when integrated within a hybrid onboard energy strategy. The results are expected to inform future decisions regarding renewable energy retrofits on river vessels and to support the development of experimental methodologies for evaluating shipboard renewable energy systems in inland navigation conditions.

Key words: small wind turbine, river dredger, auxiliary power generation, onboard renewable energy, Danube navigation, experimental assessment

PP26

STATE OF THE ART IN SHIP HYDRODYNAMICS IN SHALLOW WATER: A REVIEW OF NUMERICAL AND EXPERIMENTAL APPROACHES

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ABSTRACT

The hydrodynamic performance of ships operating in shallow water has been the subject of extensive research due to its direct impact on fuel consumption, operational efficiency, and environmental footprint. Given the increasing pressure to reduce emissions under frameworks established by the International Maritime Organization, a comprehensive understanding of ship behavior in depth-restricted waters is essential. This paper presents a structured review of the current state of research concerning ship hydrodynamics in shallow water conditions. The analysis covers both experimental investigations and numerical approaches, with particular emphasis on computational fluid dynamics (CFD). Key aspects addressed in the literature include resistance variation, squat and sinkage effects, wave pattern development, and the influence of depth-based Froude number and blockage ratio. The study synthesizes findings from a wide range of published works, highlighting consistent trends as well as discrepancies between experimental data and numerical predictions. Special attention is given to the limitations of existing models, including scale effects, turbulence modeling uncertainties, and challenges in accurately capturing free-surface interactions in shallow water regimes. Furthermore, the paper identifies gaps in the current body of knowledge, such as the limited availability of full-scale validation data, the need for improved modeling of ship–waterbed interaction, and the integration of shallow water effects into performance prediction tools used in ship design and operation. The results of this review provide a consolidated reference for researchers and practitioners, supporting the development of more accurate predictive methods and contributing to the optimization of ship performance in restricted waterways.

Key words: shallow water, hydrodynamics, CFD, review, resistance