POLITECHNIKA LUBELSKA
LUBLIN UNIVERSITY OF TECHNOLOGY

POLITECHNIKA LUBELSKA
SZKOŁA DOKTORSKA W POLITECHNICE LUBELSKIEJ

POLITECHNIKA RZESZOWSKA
im. IGNACEGO ŁUKASIEWICZA

Politechnika Białostocka

BOOK OF ABSTRACTS

1st INTERDISCIPLINARY
DOCTORAL CONFERENCE & WORKSHOP

LUBLIN 7-10 XI 2023

PROGRAM STER

NAWA

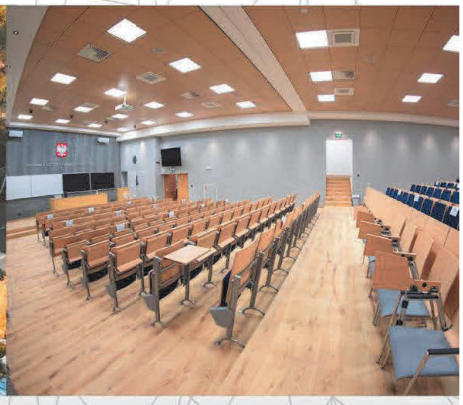
Krajowa Reprezentacja Doktorantów | KRD

PORozumienie Doktorantów Uczelni Technicznych

CONFERENCE PROGRAMME

07.11.2023 (Tuesday)
Faculty of Electrical Engineering and Computer Science
Lublin University of Technology

14:00-15:00	Registration	floor 2
15:00-15:30	**Invited Lecture 1** prof. Kruno MILICEVIC: *Digital Transformation of Metrology*	**Chairman:** T. Kołtunowicz D.Kostyła
15:30-16:00	**Invited Lecture 2** prof. Anton TRNIK: *Non-destructive measurement of Young's modulus*	**Auditorium E201**
16:00-18:00	Visit Laboratory	
18:00-19:00	Steering Commitee Meeting-part 1	
19:00-20:00	Steering Commitee Meeting-part 2	**Auditorium E212**



1st INTERDISCIPLINARY
DOCTORAL CONFERENCE & WORKSHOP

08.11.2023 (Wednesday)
Faculty of Mechanical Engineering, Auditorium A1
Lublin University of Technology

8:00-9:00	Registration	**ground floor**
9:00-9:30	Welcome Speech	**Chairman:** M. Janek, D. Kostyła
9:30-10:00	**Invited Lecture 3** prof. Ivana MILICEVIC: *Application of recycled materials in construction: From Structural Elements to Electromagnetic Shielding*	**Chairman:** A. Trnik M. Kuszneruk
	Session 1 - Mechanical Engineering - A	**Chairman:** A. Trnik M. Kuszneruk
10:00-10:15	P. R. Koczan *Thermal conditions of 3D prints created using the FDM method*	
10:15-10:30	M. Leleń *Analysis of geometric features of double-layer structure after water jet cutting*	
10:30-10:45	K. Ludziak *Application hydrotreated vegetable oils (HVO) in low-temperature combustion systems.*	
10:45-11:00	W. Okuniewski *Effect of shot peening treatment on Ti-6AL-4V: Comparison of additive manufacturing to conventional methods*	
11:00-11:15	P. Podolak *Multiple impact response of titanium-based FMLs in numerical simulations*	
11:15-11:30	M. Rodziewicz *The Effect of Filler Size on the Structure and Selected Functional Properties of Silorane-based Powder Composites*	
11.30-12.00	Coffee Break	

1st INTERDISCIPLINARY
DOCTORAL CONFERENCE & WORKSHOP

08.11.2023 (Wednesday)
Faculty of Mechanical Engineering, Auditorium A1
Lublin University of Technology

	Session 2 - Electrical Engineering	**Chairman:** K. Milicevic M. Janek
12:00-12:15	M. Lech *Analysis of the phenomenon of vacuum, low-voltage electric arc*	
12:15-12:30	A. Zielonka *The impact of renewable energy sources on power grids in Poland*	
12:30-12:45	P. Gałaszkiewicz *Electrical properties of Mo-W-C nanocomposites.*	
12:45-13:00	J. Kowalska *The impact of PV sources on the SAIDI and SAIFI indicators*	
13:00-13:15	D. Kostyła *Fiber optic pressure gauge in medium-voltage vacuum devices*	
13:15-13:30	A. Wilczyńska *The influence of constructional and technological parameters on AC measurements and surface morfology of multilayered NiFe-SiO2 nanocomposites*	
13.30-14.30	**LUNCH - restaurant "Lanczomania"**	
14.30-15.00	**Invited Lecture 4** prof. Igor MEDVED: *Determination of moisture diffusivity in porous materials*	**Chairman:** Z. Suchorab A. Zielonka
	Session 3 - Interdisciplinary	**Chairman:** I. Medved A. Zielonka
15:00-15:15	E. Osmólska *Innovative Strategies to Increase Safety in the Fruit and Vegetable Juice Production Process*	
15:15-15:30	P. Tymińska-Wójcik *Innovative Cheneau brace as an optimised alternative to static orthosis improving idiopathic scoliosis therapy*	
15.30-16.00	Coffee Break	
16.00-18.00	Poster Session - PS	
19.00-22.00	**Gala Dinner - restaurant "Za Kulisami"**	

1st INTERDISCIPLINARY
DOCTORAL CONFERENCE & WORKSHOP

09.11.2023 (Thursday)
Faculty of Civil Engineering and Architecture - Auditorium III
Lublin University of Technology

9:00-9:30	**Invited Lecture 5** Hakim ABDELGADER: *How to choose concrete mix design methods in hot weather climates*	**Chairman**: R. Rusinek, Damian Kostyła
9:30-10:00	**Invited Lecture 6** Andjelka HEDRIH: *Sperm-oocyte interaction as an oscillatory fenomenon*	
	Session 4 - Mechanical Engineering - B	**Chairman:** P. Valvo, Damian Kostyła
10:00-10:15	D. Sałamacha *Impact of measurement conditions and measurement strategy on the accuracy and repeatability of positioning of a milling plotter*	
10:15-10:30	M. Sowa *Effect of the oral environment on the degradation of dimethacrylate resins blends modified with liquid rubber*	
10:30-10:45	A. Świetlicki *Effects of heat treatment and shot peening on 17-4PH steel manufactured using DMLS technology.*	
10:45-11:00	M. Trendak *Oil quality testing as a basis for warranty claims*	
11:00-11:15	K. Vasiukov *Wet vacuum impregnation as a modification of the malting process of barley grains of different varieties*	
11:15-11:30	R. Zablotni *Examining the Effect of Double Excitation in a Lumped Parameter Model for the Implanted Human Middle Ear*	
1.30-12.00	Coffee Break	

1st INTERDISCIPLINARY
DOCTORAL CONFERENCE & WORKSHOP

09.11.2023 (Thursday)
Faculty of Civil Engineering and Architecture - Auditorium III
Lublin University of Technology

	Session 5 - Civil Engineering	Chairman: Z. Suchorab Michał Lech
12:00-12:15	A. Alsharif- ONLIE *The effects of polyethylene and polypropylene fiber additions on the mechanical properties of self-compacting concrete*	
12:15-12:30	M. Budka *Mechanical properties and mechanical erosion resistance of polymer composites with a quartz protective layer*	
12:30-12:45	M. Grzegorczyk-Frańczak *Investigation of the possibility to improve the frost resistance of concrete using polymer microspheres*	
12:45-13:00	M. Janek *Self-healing of cementitious composites by microbial precipitation of carbonates*	
13:00-13:15	A. Szewczak *Adhesion of modified epoxy glue to concrete*	
13:15-13:30	W. Zbyszyński *Evaluation of the interface layer impact on fracture energy of the 3D printed multi-layered mortar composite*	
13.30-14.30	LUNCH - restaurant "Lanczomania"	
14.30-15.00	**Invited Lecture 7** prof. Paolo VALVO: *The Finite Element Method in Solid and Structural Mechanics*	**Chairman:** A. Hedrih Małgorzata Grzegorczyk-Frańczak
15:00-15:30	**Invited Lecture 8** prof. Daniele FANTERIA: *Differences and potential synergies between science, technology and engineering: the perspective of an aeronautical structural engineer*	
16.00-18.00	Visit Lublin	
19.00-22.00	Dinner - restaurant "Trybunalska"	

1st INTERDISCIPLINARY
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10.11.2023 (Friday)
Faculty of Environmental Engineering, Auditorium
Lublin University of Technology

9:00-9:30	**Invited Lecture 9** prof. Stefano LENCI: *1:1 internal resonance in wind turbines towers*	**Chairman:** R. Rusinek Piotr Gałaszkiewicz
9:30-10:00	**Invited Lecture 10** prof. Tamas KALMAR-NAGY: *A mechanistic model for turbulence*	
	Session 6 - Mechanical Engineering - C	**Chairman:** T. Kalmar-Nagy Piotr Gałaszkiewicz
10:00-10:15	M. Drożdziel-Jurkiewicz *Interlaminar fracture toughness analysis of carbon-fiber titanium laminates – effect of surface modification*	
10:15-10:30	S. Kapyś *Selected properties of PHB modified by nigella oil cake*	
10:30-10:45	J. Brzozowska *Problems of forecasting the length of the assembly cycle of complex products realized in the mto (make-to-order) model*	
10:45-11:00	K. Cybul *Improving relative measurement uncertainty by developing and implementing a new force reference standard up to 100 kN into the national metrology infrastructure*	
11:00-11:15	B. Czajka *Compressed composite columns - experimental and numerical research*	
11:15-11:30	F. Longwic *Highly filled polymers as a method of plant waste management*	
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1st INTERDISCIPLINARY
DOCTORAL CONFERENCE & WORKSHOP

10.11.2023 (Friday)
Faculty of Environmental Engineering
Lublin University of Technology

	Session 7 - Environmental Engineering	**Chairman:** Z. Suchorab Aleksandra Wilczyńska
12:00-12:15	G. Sadowska *Development of a method for short-term forecasting of energy yield in solar-powered systems*	
12:15-12:30	K. Wrzesińska *Application of HPLC-ICP-MS Coupled Technique for Direct Determination of Iodinated Contrast Media (ICM) in Hospital Wastewater*	
12:30-12:45	M. Staniszewski *Application of machine learning to identify activated sludge organisms*	
12:45-13:00	N. Marchelina *Non-ureolytic pathway of MICP for improvement of loose sandy soil*	
13:00-13:15	D. Mikušová *Monitoring of water transport using reflectometric technique*	
13:15-13:45	Closing Ceremony	

1st INTERDISCIPLINARY
DOCTORAL CONFERENCE & WORKSHOP

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Contents

ABSTRACTS

The effects of polyethylene and polypropylene fiber additions on the mechanical properties of self-compacting concrete

Alsharif Abdualhamid
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Scientific discipline: Civil Engineering, Surveying and Transportation

Self-compacting concrete (SCC) has become the global focus of attention among researchers due to its distinctive properties that allow it to be easily used to produce narrow, densely reinforced concrete sections and sections with irregular shapes. The interest in the use of different types of fibers in concrete production has also increased due to the ability that materials provide to produce concrete sections with high performance and durability. The objective of the study is to study the possibility of producing self-compacting concrete with enhanced mechanical properties using different fibers of polyethylene and polypropylene. The different categories of mixtures were produced using a fixed ratio of water to cement of 0.4 and with the addition of a plasticizer of 2% of the weight of cement. Fibers were added in four different volume ratios: 0.05%, 0.075%, 0.1%, and 0.125% for both types of fibers, while a reference mixture was used for comparison purposes. Slump tests and J-ring tests were conducted to study the fresh properties of the resulting concrete, while compressive strength and flexural strength tests were also conducted to study the properties of hardened concrete. The results of the study showed an improvement in the mechanical properties of concrete when adding fibers, especially when used at a rate of 0.075%. Polypropylene fibers achieved an increase in compressive strength of 16.11% and an increase in flexural strength of 16.83%. Polyethylene fibers show an increase of 12.35% and 6.15% in compressive and flexural strength, respectively, without disturbing the properties of fresh concrete.

Keywords: self-compacting concrete; polyethylene; polypropylene; compressive strength; flexural strength.

Problems of forecasting the length of the assembly cycle of complex products realized in the MTO (Make-To-Order) model

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One of the key stages in the manufacturing process of customized products is the assembly cycle. An accurate analysis of the assembly time of a particular product that a customer wants to order affects the actual completion of the order within the agreed time, and consequently the shipment of the finished product within the time specified in the contract. Nevertheless, determining this time in a traditional way is in many cases impossible, which prompts the search for methods using the latest scientific and technological advances. This article presents the problem of forecasting the length of machine assembly cycles in make-to-order production (Make-to-Order). The model of Make-to-Order production and the technological process of manufacturing the finished product are presented. The possibility of developing a novel method, using artificial intelligence solutions, to estimate machine assembly times based on historical company data on manufacturing times for structurally similar components, is described. It is assumed that the result of the developed method will be an intelligent system supporting efficient and accurate estimation of machine assembly time, ready for implementation in production conditions. Such data as part availability, human resource availability and novelty factor will be used as input data for learning the neural network, while the output variable during learning the neural network will be the actual machine assembly time.

Keywords: assembly cycle; machine assembly; forecasting; Make-to-Order; artificial neural networks.

Mechanical properties and mechanical erosion resistance of polymer composites with a quartz protective layer

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Fiber-reinforced composites with a polymer matrix, thanks to their low weight and high strength parameters, have found applications in various engineering fields such as civil engineering, automotive, and aviation. However, their susceptibility to environmental factors poses a challenge for long-term use [1]. In this study, we propose an innovative strategy to enhance the mechanical durability of polymer composites by adding a protective quartz layer [2]. The inclusion of the quartz process was developed under laboratory conditions in to achieve an even distribution of quartz and was carried out using vacuum infusion.

The results revealed that the inclusion of a protective sand layer have altered the mechanical erosion resistance of the composite. The results showed approximately 33% reduction of the failure force of after the mechanical erosion test compared to unprotected reference samples. Microstructural analysis showed the even distribution of sand in the composite matrix. By using digital image correlation, the results of the deformation map of the samples were obtained. The presented findings represent a significant step towards the development of more durable and resilient polymer composites. The results of the research will help in the development and design of new protection systems.

Keywords: polymer composites; protective layer; quartz; infusion; mechnical erosion.

Acknowledgements
This research was funded by the National Centre for Research and Development of Poland grant number LIDER XIII 0135/L-13/2022.

References

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2 P. Golewski, T. Sadowski: Technological and Strength Aspects of Layers Made of Different Powders Laminated on a Polymer Matrix Composite Substrate Molecules 2022, 27(4), 1168; https://doi.org/10.3390/molecules27041168.

Improving relative measurement uncertainty by developing and implementing a new force reference standard up to 100 kN into the national metrology infrastructure

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Scientific discipline: Mechanical Engineering

The subject of the thesis will be the study of the measurement system and the analysis of issues related to the development of a new force reference standard up to 100 kN in the national metrological infrastructure. Force measurements have very broad applications in the national economy. To quarantee the correctness of the measurement results, appropriate measuring instruments are required to ensure high measurement accuracy. To accomplish this task, it is necessary to provide in the national metrological institute (Central Office of Measures, GUM) appropriate reference standards of the highest accuracy.

The force reference standard will be dead load measuring devices allowing measurements in the measurement range up to 100 N, realizing compressive and tension force measurements. The application of the method of primary realization of the unit of force will increase the measurement accuracy and reduce the measurement uncertainty, thus improving the measurement capability of national laboratories. The aim of this work will be the development and validation of measuring stand of force reference standard up to 100 kN. One of the tasks will be to build a completely new measuring stand based on the assumptions prepared in the implementation of the GUM Kampus in Kielce. The obtained results performed at the force reference standard stand in Kielce and in the Central Office of Measures in Warsaw will significantly improve the quality of tests and calibrations of measuring instruments used for force measurement.

Keywords: force; measurement uncertainty; force standard; comparison; calibration.

Compressed composite columns – experimental and numerical research

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The conducted research consists of an interdisciplinary study of the stability and load-carrying capacity of thin-walled composite structures using advanced experimental studies and numerical analysis based on the finite element method. Thin-walled composite columns made of CFRP material in two different lay-ups [0/-45/45/90]s and [90/0/90/0]s were used for stability and failure tests. The test specimens consisted of 8 laminate layers. In the experimental research, the specimens were subjected to axial compression on a universal testing machine. Experimental tests were divided into two stages. In the first phase, the buckling was examined. In the second, the loss of load-carrying capacity study was conducted. During tests laser sensor measurement and acoustic emission method were used. Numerical research was carried out using commercial Abaqus software. Only stability simulations have been performed yet. The results obtained by the two research methods show significant correlation. Post-buckling numerical investigation is planned in the further research.

Keywords: buckling; post-buckling equilibrium paths; critical loads; thin-walled composite structures; finite element method.

The influence of fabric reinforcement type on impact energy absorption properties

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The aim of this study was to investigate the influence of weave type, amount, and orientation (the arrangement of layers relative to each other) of aramid fabrics on the impact energy absorption properties of polymer composites. Four groups of polymer composites based on epoxy resin were manufactured using the infusion method. The first and second groups consisted of composites reinforced with aramid fabric with a plain (P) and twill (T) weave, respectively, in which no orientation of the reinforcement layers was applied (orientation type: [0,0,0,0]). The third (PO) and fourth (TO) groups consisted of composites in which the reinforcement was oriented with the type: [22.5,45,67.5,90]. Each group is represented by 4, 8, and 12-layer composites. Samples were cut from the manufactured composites and subjected to impact resistance testing using a drop weight tower. From the obtained data, the values of maximum energy (Em), puncture energy (Ep), and absorption energy (Ea) were determined. Based on the results obtained, it was found that the weave type, the amount of layers, and their orientation significantly impact the improvement of absorption properties. Composites reinforced with twill-weave aramid fabric exhibited better impact properties compared to composites containing plain-weave fabric. For the majority of composites with oriented reinforcement, the values of the various energies were higher compared to composites where no orientation was applied.

Keywords: polymer composites; types of fabric reinforcements; impact drop test; energy absorption capability.

Alloy coatings as catalysts for electrolytic hydrogen evolution

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Hydrogen Evolution Reaction (HER) is one of the most studied electrochemical reactions. The growing interest in hydrogen is due to the introduction of cleaner energy sources than the fossil fuels currently in use. The use of hydrogen as an energy medium is challenging, primarily for reasons of transport and storage. While there are several methods for producing hydrogen, only the electrolysis process of water produces green, i.e. environmentally friendly, hydrogen. In order to increase the share of electrolytic hydrogen production in global production, its cost must be reduced. By replacing precious metals with electrocatalysts of transition metals such as nickel and cobalt, the cost of water electrolysis can be reduced.

The research conducted concerns the electrodeposition of nickel, cobalt and Co-Ni alloy coatings on a chromonickel substrate. The prepared electrodes were then used as hydrogen evolution cathodes. Current and overpotential analysis enabled the selection of the coating that performed best as an electrocatalyst for hydrogen evolution in acidic and alkaline environments. In order to determine the energy yield of the coatings used, electrolysis was carried out in a set-up that allowed the measurement of the volume of hydrogen produced. Using an optical and digital microscope, the structures of the coatings were determined before and after electrolysis. Comparison of these results, allowed the strength properties of the deposited coatings to be determined.

Keywords: hydrogen evolution; alloy coatings; electrochemistry.

The influence of titanium compounds on the flammability and smoke density of plastics

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Flame retardants containing titanium, or titanium compounds used as synergists for intumescent flame retardants, improve fire resistance and thermal properties of materials. They are widely applied as additives to plastic matrix or their coatings.

The aim of the study is to review the recent research findings on the application of titanium compounds in order to achieve greater fire resistance or lower smoke emission of selected plastics during fire. In addition, the research on the influence of the titanium nitride on the flammability and smoke density parameters of glass/polyester laminate coated with gelcoat had been conducted. The laminates were prepared via the hand lay-up method.

Flammability was estimated by limiting oxygen index (LOI) test conducted according to ISO 4589-2:2017, and smoke density was determined by single-chamber test conducted according to ISO 5659-2:2017.

Although the addition of titanium nitride only slightly improved LOI value, the smoke density had been reduced.

Keywords: titanium; flammability; smoke density; thermal stability; glass/polyester laminates.

Acknowledgements
Research has been funded by the Ministry of Science and Higher Education, grant number WI/WB-IIŚ/8/2022.

Interlaminar fracture toughness analysis of carbon-fiber titanium laminates – effect of surface modification

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Hybrid laminates, consisting of alternating metal and composite layers, are currently an interesting group of materials, particularly for the aerospace industry. They are characterised by favourable properties such as low density, fatigue strength, impact resistance and corrosion resistance. One of the most important issues in fibre-metal laminates is the metal surface treatment, which has an important influence on the adhesion strength between the metal sheet and the composite layer. The influence of metal surface treatment on the interfacial delamination behaviour of carbon-epoxy composites and aluminium sheet has been determined. The effect of titanium surface treatment including mechanical and chemical methods on the surface morphology, topography and physicochemical properties in relation to interlaminar fracture toughness using the End Notched Flexure method was analysed in the study. The influence of intermediate layers application to achieve adequate adhesion at the metal-composite interface in fibre metal laminates has also been investigated. Failure analysis and failure mode in relation to the modified surfaces have been investigated using scanning electron microscopy.

Keywords: fibre metal laminates; adhesion; surface treatment; aluminium and alloy.

Magnetic Systems for Autonomous MegaSumo Robots

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Presenting research on magnetic systems used in MegaSumo robots, this study delves into a comparative analysis of two configurations of neodymium magnet arrangements. The research revolves around evaluating the attraction of these magnet sets. The two configurations under scrutiny are as follows: the first involves an alternating polarization arrangement of magnets, while the second employs a Halbach array configuration. The investigation encompasses both computer simulations carried out in the COMSOL program and practical testing conducted on the MTS 858 TABLE TOP SYSTEM machine.

Taking the research a step further, the study explores a hybrid magnetic system that combines neodymium magnets arranged in a Halbach array with electromagnets. This hybrid system is subsequently implemented in an autonomous MegaSumo robot, with the goal of enabling precise control over the robot's adhesion to the surface it competes on. As part of the electromagnet selection process, extensive simulation tests were executed to scrutinize the impact of varying the number of coils and core radius on the attraction force.

Following the electromagnet selection phase, a hybrid magnetic system was developed, featuring 60 neodymium magnets and two electromagnets. Rigorous testing of this system was conducted using the MTS 858 Table Top System machine. The experimental results clearly demonstrate that the adoption of this hybrid solution brings about numerous advantages, and in certain scenarios, it significantly outperforms conventional solutions. Furthermore, the testing process facilitated the determination of the optimal number of turns for the electromagnet coil through a series of optimization tests.

Keywords: MegaSumo robots; magnetism; Halbach array; neodymium magnets; electromagnets.

Acknowledgements
Participation in the conference was funded by the Faculty of Mechanical Engineering at Bialystok University of Technology.

Electrical properties of Mo-W-C nanocomposites

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Transition metal carbides due to their excellent electrical, mechanical, and thermal properties, and the possibility of manipulating them through changes in the chemical composition, are of great interest nowadays [1,2]. This paper presents the results of a study of the alternating electrical properties of Mo-W-C composition layers. The layers were prepared using a two-source magnetron sputtering method. Structural studies showed that the obtained layers are nanocomposites consisting of metal carbide nanoparticles incorporated into an amorphous carbon matrix with a thickness of approximately 950 nm. The alternating-current electrical properties of the films were measured in the temperature range from 20 K to 375 K in the frequency range from 50 Hz to 2 MHz. Two nanocomposite layers S1 and S4 were selected for conductivity and dielectric permeability studies. Layer S1 contained 100% of (Mo2+W2)C nanoparticles, while layer S4 contained 28 % of (Mo2+W2)C and 72 % of a MoWC nanoparticles. Nano-grained structure of the layers supports the occurrence of hopping conductivity [3]. To analyse the results obtained, a model of DC and AC step conductivity based on the quantum mechanical phenomenon of electron tunneling between nanometer-sized potential wells was used [4].

The temperature-frequency characteristics of the conductivity and the frequency factor α(f) were determined for both layers. For both samples, there were two mechanisms observed to influence the conductivity and α(f) factor values, high-frequency and low-frequency. From the maxima on the α(f) factor characteristics, the values of relaxation time were calculated, and in terms of the occurrence of the low-frequency stage, the temperature dependence of the relaxation time was determined, and from this, the activation energy of the relaxation time was determined to be $\Delta E1 \approx 0.333$ eV for layer S1 and $\Delta E4 \approx 0.263$ eV for layer S4. Based on the dielectric permeability of the layers, the potential energy of the dipoles was determined to be (0.07±0.004) eV. On this basis, the average distance between carbide nanoparticles (distance over which electrons tunnel) was calculated, which was (3.4±0.2) nm.

Keywords: carbides; nanocomposites.

References

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What stem cells can add to liver cancer treatment? The effect of adipose tissue-derived stem cells and sorafenib on the viability and proliferation of hepatocellular carcinoma cells

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Hepatocellular carcinoma (HCC) is a global health challenge due to its rising incidence and mortality as well as its resistance to chemo- and radiotherapy. The current standard of care includes surgical resection of tumor for early and intermediate stages of the disease. In advanced HCC, patients receive oral kinase inhibitors, such as sorafenib. New treatment opportunities are investigated to address the problem of limited therapeutic options in disseminated hepatocellular carcinoma. One such idea is the use of adipose tissue-derived stem cells (ADSC), whose anti-proliferative effect was shown e.g. in colorectal and ovarian cancer.

To investigate the synergistic effect of ADSC with sorafenib on HepG2 hepatocellular carcinoma cells. ADSC-derived conditioned medium (CM ADSC) was derived from passage 3 ADSC (Lonza, Switzerland). HepG2 cells were cultured with CM ADSC (diluted 1:1 with standard medium) alone (H+CM) or with 7.5 μM sorafenib (H+CM+S) for 48 hours. Control groups consisted of HepG2 cultured alone (H) or with 7.5 μM sorafenib (H+S) for 48 hours. To evaluate the effect of co-culture on HepG2, the viability of HepG2 cells was assessed with an MTT assay. Flow cytometry was used to evaluate the presence of CD133 cancer stem cell marker, apoptotic activity (annexin V stain), and changes in HepG2 cell cycle (propidium iodide stain). The expression of RAS/RAF/MEK/ERK signaling and HCC marker, alpha-fetoprotein, and cyclin D protein was assessed by immunofluorescence, and HRAS, KRAS, RAF1 and CCNE1 gene expression was evaluated by RT-qPCR.

The viability of H+CM was 1.59 times higher than H ($p<0.001$), but sorafenib reduced the viability in H+S and H+CM+S groups by 38.62% and 35.23%, respectively ($p<0.001$). The percentage of viable, apoptotic, dead or necrotic HepG2 cells did not statistically differ between the studied and control groups. Moreover, CD133 cancer stem marker expression did not change after the co-culture. In the cell cycle assessment, sorafenib reduced the percentage of S-phase cells in H+S and H+CM+S groups ($p=0.01$ and $p=0.003$). Moreover, sorafenib increased the percentage of M-phase cells in H+S group compared to untreated HepG2 cells ($p=0.03$). Immunofluorescence stains of alpha-fetoprotein and cyclin D did not result in significant differences between the groups. In this study, the conditioned medium derived from ADSC did not show an anti-proliferative effect on HepG2 hepatocellular carcinoma cells. Moreover, CM ADSC did not show any synergistic effect with sorafenib on viability, cell cycle and apoptotic activity of HepG2.

Keywords: hepatocellular carcinoma; stem cells; adipose tissue; adipose-derived mesenchymal stem cells; apoptosis.

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Numerical evaluation of scaffolds as a method to restore continuity of a long bone

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In case of necessity of removing a bone fragment, the process of restoring bone continuity relies on the use of bone grafts or bone plates as osteosynthesis methods. These approaches are characterised by several disadvantages, such as significant changes in load transfer method through the bone. Recently, scaffolds emerged as potentially more efficient method in restoring bone continuity. In this paper, an attempt was made to validate the correctness of this statement.

Three lengths of bone defects were selected for the analysis: 35, 45 and 55 mm, located in the lower, middle and upper section of femur diaphysis. The following methods of restoring bone continuity were evaluated: 1 plate, 2 parallel plates, 1 plate and scaffold, 2 parallel plates and scaffold. Simulations of the forces generated during human gait cycle were performed. The evaluated parameters obtained were: maximal and average stresses, strain energy density as well as percentage changes in values of these parameters in relation to the values obtained for intact bone in its selected zones.

Studies have shown that the best method of restoring bone continuity is to use a single plate with a scaffold. The stress distribution obtained by this method had the highest similarities to the one obtained for intact bone model in terms of load transfer as well as maximal stresses values obtained.

The study validated the statement that the use of a scaffold to restore bone continuity is potentially more efficient method than conventional approaches.

Keywords: scaffold; bone; continuity; FEA.

Investigation of the possibility to improve the frost resistance of concrete using polymer microspheres

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The study investigated the possibility of using an alternative technology to improve the frost resistance of concrete, by replacing the traditional aerating admixture with polymer microspheres. To achieve the frost resistance of concrete, aeration is used, i.e. the introduction of small, evenly distributed A300 air bubbles (micropores) at the concrete mixture preparation stage. These bubbles should be evenly distributed over the entire volume and spaced sufficiently close to each other (distribution index \overline{L}) that the overall air volume (A) is not too high. However, in concrete aeration technology, the problem is to achieve a repeatable and stable air pore structure, including both air volume and bubble size. This problem is particularly important when mineral additives (fly ash, microsilica, blast furnace slag) and different chemical admixtures, i.e. superplasticiser, aerating agent, are used in concretes at the same time. This leads to an unstable pore structure and fluctuations in the overall air content (formation of large air pores, agglomeration of smaller pores into larger clusters, escape of air bubbles from the mixture).

An alternative method of aerating the concrete mixture is to introduce solid particles of sufficient, unchanging size, known as microspheres. As opposed to air bubbles created by a chemical admixture, microspheres do not change their dimensions and are stable over time. The innovation of this solution is the elimination of the fundamental problems related to the merging and dimensional change of air bubbles.

The paper presents the results of a research study to determine the possibility of using polymer microspheres to aerate concrete mixtures.

For this purpose, 3 types of concrete were made and compared to each other: MSFC - concrete aerated with a polymer microsphere admixture, AEAC - concrete aerated with a traditional admixture, REFC - reference concrete, not aerated.

The scope of the study included tests on the concrete mix (consistency, air content) and the hardened concrete, i.e. compressive and flexural strength, specific and bulk density, water absorption. Frost durability was determined by the decrease in compressive strength after 150 freeze-thaw cycles. Finally, microstructure analyses using a scanning electron microscope.

The tests showed a high water absorption rate of about 6% in all the concretes tested and a slight decrease in density under aeration of the mix. The concretes with polymer microspheres showed an 18% higher compressive strength compared to concrete aerated with a traditional admixture. The effectiveness of using polymer microspheres as an alternative anti-frost admixture was confirmed by frost resistance tests, which showed improved frost durability in the concretes.

Keywords: frost resistance; polymer microsphers; air-entraining admixtures.

This work was financially supported by the Ministry of Education and Science (Poland), within the Grant Szkoła Doktorska-Grant-Małgorzata Grzegorczyk-Frańczak.

Self-healing of cementitious composites by microbial precipitation of carbonates

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The formation of cracks in cementitious composites is one of the major problems occurring in building structures. One of the mechanisms for self-healing, which is an alternative to standard structural repair methods, is microbial carbonates precipitation (MICP). The concept involves the use of selected strains of bacteria that, in the presence of appropriate chemicals, can seal cracks that have formed in the composite structure. In this work, a multiple-step evaluation of the carbonate precipitation ability of the Bacillus Subtilis bacterial strain was carried out for the healing of cementitious composites. Firstly, the amount of carbonates precipitated by the applied bacterial strain was studied in the presence of medium solution (urea, calcium and magnesium compounds) of different compositions. The masses of carbonate precipitates in the simulated MICP process were compared, and their phase and morphological composition were studied (XRD, SEM). Then, cement mortar samples were subjected to the procedure of producing artificial cracks. The cracked samples were placed in medium solutions analogous to the first stage of the study. In order to determine the effectiveness of crack surface reduction, the specimens were scanned cyclically, after 0, 3, 7, 14 and 28 days of curing. Analysis of the change in scratch area of the treated specimens was performed by computer image analysis using ImageJ software. The crack area was defined as the area covered by the crack in relation to the area of the analyzed image. The crack area reduction rate was calculated based on its percentage reduction over the analyzed time. The study showed that the application of Bacillus subtilis strain and selected nutrients allowed the sealing of cracks in more than 90%, confirming the potential of microbial repair of cement mortar cracks.

Keywords: MICP; self-healing concrete; image analyzis.

A refined beam model for free vibrations and bifurcation bucking of FGM porous nanostructures with electro-elastic couping effect

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In present study, a model for free vibration and bifurcation buckling analysis of simply-supported three-layered functionally graded smart nanobeam is presented. The displacement field of the beam-like nanostructure satisfies assumptions of the Reddy third-order shear deformation. The constitutive relations are determined based on a higher-order nonlocal elasticity and strain gradient theory and expressed by nonlocal and length scale parameters affecting softening and hardening effects. It is assumed, that sandwich nanobeam consist of symmetric, with respect to the midplane, functionally graded porous core and outer piezoelectric layers. The core material properties are nonlinearly distributed across its thickness via modified Voigt's rule of mixtures coupled with porosity distribution functions. However, the properties of the upper and lower piezoelectric layer are the same and constant with respect to their thickness. Ideal mechanical contact between layers and core is assumed. Hamilton's variational principle is applied to derive coupled equations of motion for beams subjected to in-plane mechanical as well as electric forces. The final nonlocal equations of motion are expressed by the displacements. The poster presents key results of impact of nonlocal parameters, variation of material properties including distribution of porosity and external mechanical and electrical loads on stability and dynamic response of the nanostructure.

Keywords: higher-order shear deformation beam theory; free vibration; bifurcation buckling; functionally graded material; piezoelectric effect.

Selected properties of PHB modified by nigella oil cake

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Environmental pollution by plastics has become one of the world's major problems. It not only poses a risk to animals, but also to human life. Biopolymers modified with organic fillers may be a promising alternative to environmentally unfriendly polymer composites based on fossil fuels. Polyhydroxybutyrate (PHB) is a polyester that is sentisized in-vivo by a variety of microorganisms. Its main advantage is its ability to decompose in the environment - in soil and in water. Composting is also possible. PHB can replace polypropylene (PP) or polyethylene (PE) due to smiliar properties, but its use is limited by high cost and brittleness. Nigella oil cake is a by-product of the manufacture of oil from nigella oilseeds. After extraction oil cake still contains oil, that can be used as a plasticizers to reduce brittleness and improve processability of PHB. In research selected mechanical properties of Biomer® P304P filled with nargella oil cake were determined. Samples were prepared in two steps: biocomposite grain was produced in extrusion process and then it was used to form samples in injection modling process. The comparative analysis of the properties of PHB and PHB biocomposite with 10, 20 ,30 % filler content was carried out.

Keywords: PHB; biocomposites; biopolymers; biodegradation; nigella oil cake.

Cycloaddition of carbon dioxide to epichlorohydrin catalyzed by bifunctional salphen-type Schiff bases

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The aim of this study was to investigate the catalytic activity of previously synthesized salphen-type Schiff bases, containing additional functions of pyridinium, 4-(dimethylamine)pyridinium and 2,6-lutidinium salts (chlorides, bromides or iodides), in the model cycloaddition reaction of carbon dioxide to epichlorohydrin. Catalytic tests were carried out in a pressure glass reactor for 2 hours under a constant supply of CO2. The reactions were carried out at temperatures in the range of 80°C to 140°C. The catalyst concentration was 0.5 mol% relative to the epoxide. The catalytic activity was assessed based on the analysis of 1H-NMR spectra of post-reaction mixtures using biphenyl as an internal standard. The catalytic tests showed that under applied reaction conditions (2 bar, 2h, 120°C, 0.5% mol cat.), an organocatalyst that contained two 4-(dimethylamine)pyridine-derived units in its structure exhibited the highest level of activity within the Schiff bases containing chloride ions (TOF = 64 h-1). Both asymmetrically substituted organocatalysts were also characterized by high catalytic activity (TOF = 60 and 64 h 1). However, salphens with pyridine- and 2,6-lutidine-derived functions in their structure displayed clearly lower activity (TOF = 51 and 40 h-1, respectively). The replacement of chloride ions with bromide ions improved the catalytic activity (TOF = 68 h-1) of an appropriate organocatalyst, while the presence of iodide ions was most likely a steric hindrance preventing the effective course of the reaction. For the most active organocatalyst, the influence of carbon dioxide pressure and time on the cycloaddition reaction was also examined. Both the extension of the reaction time from 2 to 6 hours and elevating CO2 pressure from 2 to 6 bar increased the epoxide conversion (from 77 to 90%) and the yield of cyclic carbonate formation (from 64 to 78%).

Keywords: organocatalysis; cyclic carbonates; Schiff bases; salphen.

The effect of temperature and humidity on thermal conductivity of various insulation materials

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My purpose is to introduce the issues related to the influence of air humidity and test temperature on the value of heat conduction coefficient of various thermal insulation materials. The thermal conductivity coefficient is the basic parameter characterizing the properties of thermal insulation materials, denoted by the symbol λ [W/mK]. The lower the value of the thermal conductivity coefficient of a material, the better insulator it is.

I analyzed the results of laboratory tests of insulating materials accumulated over the past few years. The group of materials tested included wood-based materials, perlite plasters, climate panels, cellular concrete and rock wools. The tests were carried out using a Laser Comp FOX 314 device, and the steady-state heat flux method was used during the test. The steady-state heat flux method, used during the test, consists of passing a heat flux through a material sample. The flux is characterized by a constant value, and the sample is characterized by a fixed temperature at each point. The thermal conductivity coefficient of the tested material is determined by measuring the heat flux density and the temperature difference on both sides of the sample. I compared the obtained results with the data declared by manufacturers of insulation materials.

Keywords: thermal insulation materials; thermal conductivity coefficient; thermal insulation performance.

The Solny Market – its historical and contemporary role in forging the identity of Zamość

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The Solny Market (Rynek Solny) is one of the most important public spaces of the historic Zamość. The historical urban layout of that space has undergone substantial changes owing to a growing demand of parking places around the Town centre. The Solny Market has got qualities of a transition space leading to the heart of Zamość – The Great Market (Rynek Wielki). Is it the only perspective with which to perceive and use that space? The paper presents functional and formal qualities of the Solny Market together with the Zamość residents' expectations and needs in connection with the Market contemporary usage and aesthetics. The contextual, theoretical background knowledge on transition spaces is provided.

The Solny Market is situated along one of the two main axis of the historical centre of Zamość. The prior, mercantile function, among other, is still present in the space, however, its primary usage is slowly leaning towards communicational function. In consequence, its concrete urban interior becomes blurred. The Solny Market, the Jaroszewicza Square, The Stefanidesa Square, The Wolności Square are key parking spaces in the historical centre of Zamość. The area around The Solny Market performs the parkingspace the Town Hall municipal office. Zamość has been undergoing intensive revitilisation works for a fair amount of time. What place does the Solny Market have in that process?

Keywords: Zamość; public space; Rynek Solny.

Thermal conditions of 3D prints created using the FDM method

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The presentation will outline a research plan regarding the impact of thermal conditions on samples produced using the FDM 3D printing method. I will discuss the research results obtained through a survey conducted this year among individuals who are actively interested in this technology and effectively utilize it in their daily lives. This survey also influenced the planning of an experiment concerning the studied parameters, which were determined for further analysis. Current work will be discussed, involving the examination of all elements involved in the study of this issue, including the workstation. Observations from personal monitoring of the heated machine table using a thermal imaging camera will be presented, including temperature distribution on the table's surface. The materials used in the construction of worktables will be summarized, with a particular focus on controlled thermal conditions within the printer's closed working chamber. I will pay special attention to temperature control solutions, such as heaters or hot air blowers, and compare and evaluate existing designs. The final result of these efforts is the assessment of the measurement setup for conducting experiments and the elimination of sources of measurement errors. The next step is to test measurement paths, select emissivity, eliminate disturbances, and achieve measurement repeatability.

Keywords: 3D printing; rapid prototyping; FDM; Slicer; G-Code; filament.

Fiber optic pressure gauge in medium-voltage vacuum devices

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The quality and continuity of electricity supply is one of the key elements enabling the increasingly demanding tasks associated with the development of the modern world. Outdated grid infrastructure hinders the implementation of advanced development work through frequent failures and inadequate parameters of supplied energy, these in turn lead to an increase in the reliability coefficients SAIDI and SAIFI. In order to meet the requirements, the utility power industry has focused on the use of equipment of closed design, whose insulating medium is vacuum. Vacuum technology devices, despite a number of advantages, have two significant disadvantages – the lack of a real-time apparatus diagnostic system and the generation of switching surges. In order to meet the expectations of the utility power industry, a measuring head was developed to enable diagnostics of vacuum equipment. The head uses pressure-sensitive mechanical elements combined with a fiber-optic measuring system. This combination of elements made it possible to develop a measuring head capable of detecting pressure in vacuum devices in the range of 2×10^{1} Pa to 1×10^{5} Pa

Keywords: fiber Bragg granting; fiber optics sensor; pressure measurement; vacuum technology; electrical devices.

The impact of PV sources on the SAIDI and SAIFI indicators

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The aim of the presentation is to demonstrate that connecting a large number of PV installations to the grid generates growth indicators of the duration of a power outage. This increase is due to the need for maintenance proper voltage parameters of the supplied energy. The presentation analyzed the dynamics of the number growth PV sources connected to the grid in 2019-2022 in relation to shutdowns made in the grid for the purposes of tap changer regulation in transformers. The values of the SAIDI and SAIFI indicators in the area were calculated Lublin Voivodeship resulting from this type of exclusions. The analysis confirms that the problem is significant and shutdowns for lowering the voltage in the summer and increasing the voltage in the winter have impact on the increase in SAIDI and SAIFI indicators. Considering the rate of increase in indicators observed in the study, the data are alarming. In 2023, it is assumed that the incremental trend in the construction of prosumer installations will continue. Therefore, a dramatic improvement in the condition of the LV network should be assumed, as the investment process is long-lasting. It should be assumed that the electricity outage duration indicators SAIDI and SAIFI will continue to grow significantly. Distribution System Operators seeing diagnosed problems must be looked for other than tap regulation of MV/LV transformers,ways to maintain the proper voltage level in the network.

Keywords: PV; SAIDI; SAIFI; renewable energy sources.

ESG reporting by the property development industry

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In the context of escalating challenges related to climate change, social tensions, and the increasing pressure on sustainable business practices, property development companies remain pivotal participants in the economy, demonstrating responsibility for Environmental, Social, and Governance (ESG) reporting strategies. This study conducts an analysis of ESG reporting concepts within the real estate development sector and highlights its role in shaping cities and societies from an environmental, social, and economic perspective. In the course of this research, a review of literature and ESG reports prepared by major property development firms was carried out. The focus was placed on comprehending the fundamental aspects of ESG reporting and its impact on property development companies and the formation of multifamily housing. Various ESG reporting concepts and standards were analyzed, including the Global Reporting Initiative (GRI), the Sustainability Accounting Standards Board (SASB), and the Task Force on Climate-related Financial Disclosures (TCFD), identifying their significance and influence on the real estate industry, and by extension, on the development of cities.

Keywords: ESG reporting; climate change; housing; property development companies; residential developments; real estate market.

Polylactide-based compositecs with hydroxyapatite with potential for medical applications

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Bone loss is a major problem for an increasing number of patients. Some of the many reasons for this include trauma, cancer, infection (osteitis or osteomyelitis), osteoporosis or congenital defects [1]. However, the ability to regenerate bone tissue is limited. Large bone defects, most often resulting from tumor resection, surgical excision of tissue or severe trauma, are unable to reconstruct themselves, mainly due to the lack of a platform for the growth and differentiation of cells associated with bone repair [2,3]. Such a situation not only leads to poorer wound healing efficiency, but also definitely worsens the patient's quality of life, and in the worst cases is capable of causing life-threatening situations [3]. Current treatment methods include autologous or allogeneic bone grafting and bone tissue engineering scaffolds [2,4]. The problems associated with grafts are well known. Not only is there the problem of poor sizing, but they can also lead to secondary hazards, or induce an immune response in the patient's body, which can result in graft rejection. Finding a suitable donor is also often a problem [2,5]. Bone regeneration scaffolds provide properties that can solve most of these problems. Among their main advantages is that they require a donor. In addition, thanks to the use of modern computer techniques, their shape is perfectly matched to the patient's defect, and their structure is properly designed to promote bone growth. The ability to use increasingly improved 3D printing techniques combined with computer imaging of cavities is an excellent example of personalized medicine [6]. The biggest challenge posed to scaffolds is the choice of materials used in their manufacture. They must be biocompatible and stimulate tissue growth, while not having toxic properties or causing adverse effects on the body. Composite materials based on polymers and minerals are the best group for this task. Compared to other known solutions, they allow to achieve significantly better results [2,6]. An unquestionable advantage over the used implants or meshes made of metal is that there is no need to remove the scaffold after the bone restoration process is completed. Properly selected material allows the scaffold to biodegrade during bone reconstruction [7]. In addition, the use of appropriate materials allows not only to supplement the tumor-forming bone with appropriate minerals, but also in some cases to be a drug carrier, which allows during the whole process to protect the tissues and reduce the risk of inflammation or infection, among other things [8]. Among the many available materials used to make scaffolds, one of the best is a composite made on the basis of polylactide with hydroxyapatite. Both components are biocompatible and their combination provides many additional advantages. Thanks to the matrix of polylactide, the material is biodegradable, and also importantly, by using appropriate methods, the degradation time can be controlled, which makes it possible to provide adequate time for tissue growth [6]. Hydroxyapatite is a natural component of human bones, so that as the material degrades, it is resorbed by the resulting tissue, thus supplementing it [9]. The combination of these two materials makes it possible not only to ensure biocompatibility or control the degradation time of the material. The properties of such a composite are similar to those of human bones, and the possibility of using 3D printing techniques in combination with CAD/CAM methods makes it possible to perfectly tailor scaffolds or implants to the needs of patients [6]. The poster will present the results of the author's blends of polylactide-hydroxyapatite composite. Tests of mechanical and rheological properties carried out so far will be presented.

Keywords: composites; polylactide; hydroxyapatite; scaffolds.

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Flight performance analysis of STOL class aircraft equipped with hybrid propulsion

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There is a growing number of research work and projects aimed at introducing more environmentally friendly propulsion systems into aviation. One possibility is the use of SAF fuels, mixtures of traditional hydrocarbon fuels with hydrogen. Currently, hybridisation and electrification of aircraft propulsion systems seems to be the most promising. The paper presented here shows an energy analysis of a proposed hybrid propulsion unit solution for the STOL PZL M28 aircraft. This aircraft is equipped with two Pratt & Whitney Canada PT6A-65B turbine engines with a power of 820 kW each. The proposed solution is based on the basic turbine engine cooperating in a series hybrid system with a package of two EMRAX 268 electric motors with a total continuous power of 214 kW and instantaneous power of 400 kW. The electric motors, together with the turbine engine, drive the propeller through a reduction gearbox. The additional power generated by the electric motors would be used during take-off, climb and emergency flight situations of the aircraft. In the range of steady flight, where the combustion engines have some excess energy, the electric motors would operate in generator mode, storing the energy in batteries. An energy analysis of the use of such propulsion has been carried out and a proposed energy management scenario presented. The work is part of a study for PZL Mielec.

Keywords: hybrid; combustion engines; hybrid propulsion; aviation.

Analysis of the phenomenon of vacuum, low-voltage electric arc

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The results of the research presented by the author are related to the parameters of the vacuum electric arc. They are divided into two parts. The first presents the results from the study of the effect of delaying the arc ignition time on its parameters, including energy and burning time. It was found that the use of high vacuum significantly reduces the burning time of the electric arc and its energy. The second part of the results concerns the analysis of the phenomenon of vacuum electric arc by photographic method. A series of time-lapse photography was carried out, based on which it was found that in selected cases the process of vacuum arc burning can be divided into several phases: stable and unstable, in which there was an increase in its voltage. In turn, the movement of microparticles between the contacts of the chamber can be divided primarily into reflection between the electrodes and absorption of the microparticle by one of them. Moreover, with the use of an ultrafast camera, the motion of a selected microparticle can be precisely imaged, as shown in a selected example. The author's method of photographically determining the burning time of an electric arc using an ultrafast camera is also presented. The developed results were compared with arc burning time values determined using an oscilloscope. Comparing the data obtained, it was found that the differences in the results obtained using the described methods for determining the burning time of the electric arc in the discharge chamber are very close. Therefore, it can be concluded that the developed method makes it possible to determine the burning time of a vacuum electric arc in a very accurate way.

Keywords: vacuum arc; vacuum switchgear; vacuum interrupters; photographic analysis.

Analysis of geometric features of double-layer structure after water jet cutting

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The paper presents the results of experimental work on the assessment of 3D geometry of surface stereometry obtained as a result of Water Jet (AWJ) water-abrasive beam cutting using an Eckert hydro-abrasive cutter. Studies of geometric structures were conducted using the Alicona microscope. 3D spatial roughness parameters such as Sa, Sq, Ssk, and Sku were analysed. The roughness parameters has been determined for 3 macro-areas of the multilayer structure surfaces combined as a result of the vulcanization process with an aluminium alloy surface (for representative surface of the aluminium alloy (B) and silicone (A), as well as the interphase surface (A/B)). The obtained experimental results were described by means of a 2nd degree regression function and the relevant determination coefficients were determined. All recorded characteristics of roughness changes showed an upward trend. The progressive nature of the changes concerned the entire range of input values as a function of the feed rate vf for both analysed mass expenditures of the Water Jet cut. The results of the research work are summarized in the technological function of the AWJ cutting conditions, such as the cutting speed and the mass flow of the abrasive material.

Keywords: aluminium alloy; silicone; water jet cutting; surface roughness; surface morphology.

Highly filled polymers as a method of plant waste management

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Reducing the consumption of a polymeric material with maintaining the best mechanical properties of the product is one of the leading trends in the modern materials market. The addition of inorganic and organic fillers to the polymer matrix becomes increasingly important issue during development of new materials with desired properties dedicated to specific applications [1]. Fillers extracted from plant waste, which are commonly used as alternative energy sources in combustion processes, can be applied again to the process of new material development. After properly processing, which includes grinding to a specific fraction and reducing humidity, they can be a source of raw material with interesting properties that will greatly impact the final properties of the products made of them [2]. These types of fillers can be obtained from any part of the plant and the main advantage of using them are locally available resources. Relatively low cost of obtaining this type of raw material can cover the current demand of manufacturers, lowering the production costs of fillers and making plastic products more ecological, which corresponds to the general trends of the closed loop economy and the principles of sustainable development [3]. The presentation includes literature analysis and results of own research on the production and use of highly filled polymer compositions with plant waste.

Keywords: polymers; fillers; plant waste.

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Application hydrotreated vegetable oils (HVO) in low-temperature combustion systems

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Increasingly stringent limits on CO2 emissions and toxic exhaust components are a challenge for the automotive industry as well as for research centres working in this area. A number of measures are in place to reduce the above-mentioned compounds in internal combustion engines, e.g. optimisation of the combustion process to achieve lower emissions, use of external exhaust aftertreatment systems, application of advanced combustion systems and use of biofuels with a low carbon footprint.

Hydrotreated oils (HVO) are one such type of biofuel, produced mainly by hydrotreating vegetable oils. HVO can be produced from waste raw materials from the food industry, so that we can then classify it as a 2nd generation renewable fuel. The use of HVO produced from 100% renewable raw materials can result in up to 90% fewer greenhouse gas emissions (GHG or CO2e) over the entire life cycle of the fuel compared to fossil diesel. Similar properties to diesel allow the use of hydrotreated oils in compression-ignition (SI) engines. The absence of aromatic hydrocarbons, the low sulphur content, or the lower ratio of carbon atoms to hydrogen atoms can favourably influence the emissions performance of engines fuelled with HVO. The high cetane number of HVO requires an appropriate approach to combustion control for proper engine operation.

The study showed that it is possible to use renewable HVO fuel in low-temperature combustion systems. Combustion characteristics and exhaust emissions were analysed and compared for conventional fuel, for renewable HVO fuel and their 1:1 mixture. Low-temperature combustion of HVO fuel shows great potential in reducing emissions of toxic exhaust components, while maintaining high efficiency.

Keywords: low-temperature combustion; renewable fuels; exhaust emissions.

Non-ureolytic pathway of MICP for improvement of loose sandy soil

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The application of non-ureolytic pathways in the MICP process had been the subject of significant research in geotechnical engineering. The process involves the use of certain microorganisms capable of facilitating the precipitation of calcium carbonate in soil, without requiring the consumption of urea as a substrate. This pathway uses the bacteria metabolism that involves the carbon cycle through the oxidation of organic salts, particularly heterotrophic sources, such as calcium lactate (CaL) (Froncyzk et al.2023). Study conducted by (Hemayati et al. 2023), showed a promising result in order to stabilized sand dune against wind erosion using non-ureolytic MICP pathway. This method has great potential to increase soil stability, reduce erosion, and improve the mechanical properties of soil materials. Hence, the purpose of this study was the optimization of composition and concentration of non-ureolytic bio-cementation solution for its application in loose sandy soil stabilization using MICP technique. This study investigated the chemical and physical properties of soil before and after treatment with solutions containing different bacteria strains, different concentrations and ratios of chemical concentration. A series of laboratory experiments were conducted, including pH and electrical conductivity measurement, compressive strength and calcium carbonate content test, and XRD analysis. The results indicated the optimum solution of cementation substances which ensure the higher rate of calcium/magnesium carbonate precipitation.

The experimental work performed in this research was conducted using loose sandy soil classified as poorly graded fine sand with the grainsize in the range of 0 – 0.25 mm. In this study, a solution consisting of nutrient broth (peptone, yeast extract and sodium chloride as well as vegetative cells of Bacillus subtilis, Arthrobacter sp, or Sporosarcina Pasteurii) was used as a source of bacteria. There were prepared 27 combination bio-cementation solutions with different bacteria strains and concentrations of CaCl2 (from 0.1 to 0.25 mol/L), calcium lactate (from 0.1 to 0.25 mol/L), MgCl2 (from 0.1 to 0.5 mol/L). The highest content of precipitates (up to 3.8% of carbonate) was observed for samples treated with Bacillus subtilis, and cementation solutions containing CaCl2 0.25M, MgCl2 0.5 M and calcium lactate of 0.2 M. The highest compressive strength (441.27 kPa) was also observed for this combination. Moreover, higher concentration of organic carbon (CaL) resulted in fungi contamination, thus the lower concentration of organic carbon was more desirable to eliminate the contamination. This research showed that using the non-ureolytic pathway results in a slower process comparing to the ureolytic pathway. An important consideration in this regard is the demand for increased bacterial concentration to achieve comparable results. This phenomenon requires a comprehensive evaluation of resource allocation and feasibility in real-world applications.

Keywords: microbially induced calcite precipitation; soil improvement; non-ureolytic pathway.

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Monitoring of water transport using reflectometric technique

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The phenomenon of heat and water transport through a porous medium plays an important role in several scientific disciplines. The porous medium presupposes a complex system in which three phases (solid, liquid, gas) coexist. Porous media is characterized by various state variables that change depending on the investigated medium. It is important to know the behaviour of the system in the future as a response to changing excitations. The tool for this investigation is the modelling. A mathematical model of a system can be defined as a set of equations that approximately simulate the relationship between excitation and response. In general, a mathematical model combines physical and/or experimental rules with system peculiarities. Experiment observing capillary uptake using the TDR technique is investigated. TDR technique is an indirect technique for determining the moisture content in porous materials. The TDR is suitable for validating the capillary uptake model in porous materials. The formulation of the model for the calculation of mass moisture for autoclaved aerated concrete with a density of 400 kg/m3 and the uncertainty of measurement using the TDR technique is presented.

Keywords: capillary uptake; model; TDR; porous medium; water transport.

Modern protein purification methods

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Protein purification is a cornerstone in the realm of biochemistry and biotechnology, indispensable for various scientific and industrial applications. The main transformation techniques are discussed, including chromatography and electrophoresis, which have redefined the landscape of protein purification. Chromatography, a versatile set of methods, empowers precise separation of proteins predicated on diverse attributes, including size, charge, and specificity. The principles underlying various chromatographic methodologies are presented, highlighting their key role in the isolation and purification of target proteins. Electrophoresis, a linchpin in protein analysis, harnesses the migration of charged molecules in an electric field. Basic electrophoretic approaches such as SDS-PAGE, 2D-PAGE and capillary electrophoresis were analyzed, discovering their importance in protein separation and characterization. The poster provided insight into the effectiveness of these methods, highlighting practical insights and their profound impact on modern protein purification. New improvements that are constantly being introduced to the described techniques are also indicated. There is huge potential for the development of this research and the application of selected protein purification and separation methods.

Keywords: protein purification; chromatography; electrophoresis; biochemistry.

Architectural design of the therapy centers for war victims

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The topic concerns architectural issues related to the operation of rehabilitation centers for veterans and those injured in warfare. Currently, we are seeing an increase in armed conflicts, resulting in the need for places where the injured could undergo various types of therapy (treatment of post-traumatic stress and physical injuries). The latest results of scientific research conducted according to Evidence Based Design methodology demonstrate the therapeutic role of architecture in the process of both physical and mental recovery. The purpose of the research is to identify directions and design guidelines for the architectural design of rehabilitation centers and facilities for people injured in armed conflicts and for veterans. The research topic is based on an attempt to determine this impact for a specific group of users, and this topic has not yet been developed. The implementation of the research will be based on a review of the available literature and an analysis of previous realizations in the European field, but with an expansion of the research background to selected global realizations. The research will achieve a scientific goal: typological study, identification of the resource and determination of development directions, and a practical goal: development of design guidelines for newly constructed facilities. An important component of the research will be the development of a survey targeting facility users and patients to determine the real needs of users. In subsequent stages, simulations and prototyping of selected spaces and facilities will be carried out. It is planned to use Eye-tracker research on the basis of previously performed simulations of architectural solutions.

Keywords: architecture; rehabilitation center; war victims and veterans treatment.

Mechanical properties of polylactide-based composites with iron powder additions

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Biodegradable polymers based on polylactide (PLA) are one of the most popular biodegradable materials. Unique features and the possibility of modifying them are becoming important mostly in medicine. For this reason, scientists increasingly carry out tests related to the properties of polylactide-based composites.

Six different compositions of composites based on polylactide with different iron powder and nanopowder additions were made. Materials were mixed by hand and then extruded using an EHP 25Eline laboratory extruder (Zamak Mercator, Skawina, Poland). After extrusion, flat samples were obtained, from which shapes suitable for tensile tests were then cut out. A Shore durometer (type D) was used to measure the hardness of the composites. Tensile tests were carried out with the MTS 858 Mini Bionix testing machine.

When comparing the tensile strength values for a sample made of pure PLA and samples with the addition of iron powder and nanopowder, a decrease in this parameter can be seen. As for the Young's modulus value for the composites made, these values are slightly higher for materials with the addition of iron nanopowder. These values are comparable to the young modulus of pure PLA. The hardness of the materials is 62-73°Sh. Composites with the addition of iron powder seem harder than those to which nanopowder was added. The hardness decreases as the percentage of powder decreases.

In the case of composites with the addition of iron nanopowders, comparable strength properties to pure PLA can be observed. The addition of iron powder reduced the strength of the polylactide.

Keywords: polylactide; iron powder; mechanical properties.

Effect of shot peening treatment on Ti-6AL-4V: Comparison of additive manufacturing to conventional methods

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Literature review indicates that the basic microstructure of Ti-6Al-4V is bimodal which consist of two phases: α + β and occurs after fabrication in conventional methods such as casting, plastic forming or machining processes. After additive manufacturing methods there could be significant changes in microstructure. Due to rapid heat exchange during heat-treatment process bimodal microstructure transforms into lamellar microstructure which consist of two phases α' + β. Despite applying optimum printing parameters, 3D-printed products exhibit typical surface defects and discontinuities. One of the primary technologies for the improvement of surface layer properties of titanium alloys is shot peening. Our research team did extensive research in this matter. Previously the surfaces of prepared samples have been subjected to shot peening process at three different values of working pressure (0.2, 0.3 and 0.4 MPa) by means of three different working media i.e. CrNi steel shot, crushed nut shells and ceramic balls. The overall results after shot peening process indicated to favourable influence on the corrosion behaviour, mechanical properties and condition of the surface layer of titanium alloy. The next step for our research is to combine shot peening and electropolishing processes to verify the recent reports that suggest that it can improve the surface layer properties.

Keywords: shot peening; titanium alloys; additive manufacturing; surface treatment.

Innovative Strategies to Increase Safety in the Fruit and Vegetable Juice Production Process

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Safety in the production process of fruit and vegetable juices is a key element for consumers, producers and the food sector as a whole. One of the most important production control systems is Hazard Analysis and Critical Control Points. By identifying, assessing and controlling critical points in the juice production process, the risk of product contamination can be effectively minimised and food safety ensured. There are a number of modern methods of preserving fruit and vegetable juices. For example, high-pressure or low-temperature plasma technology can be used to preserve product quality. However, the raw material itself is also important. Reliable supplies of semi-finished products from trusted suppliers are crucial. Systems for monitoring and controlling the quality of raw materials at an early stage of production avoid contamination problems. What's more, modern automation and production management systems reduce process times while minimising the risk of product contamination or simply human error. Attention should also be paid to employee training and maintaining high hygiene standards. This is key to ensuring food safety. Increasingly, innovative packaging is also appearing on the market, which, with the right design, can help to reduce the emergence of product infections. In addition, they can help to increase product shelf life. Interestingly, an increasing number of companies are opting for advanced IT systems and blockchain technology to track every stage of production and delivery, which promotes rapid response in case of food safety issues. Innovative strategies to enhance safety in fruit and vegetable juice production are not only a guarantee of product quality, but also to build consumer trust and meet their growing expectations for healthy and safe food. Implementing modern strategies is essential for long-term success in the food industry.

Keywords: quality; safety; process; food; HACCP; juices.

Using 3D technology to design moisture sensors

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The work focuses on alternative methods of designing humidity sensors. One of the techniques for testing the environmental parameters of building materials is the TDR technique, which uses, among others, invasive sensors. Sensors available on the market are made of various materials that have different strength properties. The article discusses 3D modeling technology that can be used in the sensor design process. 3D printing methods were presented. Materials used in 3D printing are discussed, in particular PLA and ABS. Environmental factors such as humidity in building materials were characterized and the need to design sensors was presented. Programs used in the modeling process and 3D printing itself were also presented. The materials and methods discuss the 3D printer used in the printing process. The article presents the concept of making a sensor housing for testing material moisture measurements. The sensor prototype was 3D printed. The benefits of using 3D technology in the design of such sensors are presented.

Keywords: 3D; TDR sensors; 3D printers; PLA.

Use of earth-building techniques as an architectural design issue

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In recent decades, earth construction has been subjected to extensive research for its adaptability in various environmental conditions, yielding diverse results depending on the applied techniques. Earth as a building material offers numerous opportunities for shaping the living environment. These possibilities have been harnessed since ancient times. Various techniques were employed depending on the region, enabling the creation of distinct effects, both in terms of architectural details and the potential for constructing buildings of varying sizes.

Buildings constructed using earth-based techniques advanced the utilization of materials such as unfired brick, molded earth, and rammed earth. These techniques have evolved over the centuries in numerous countries. The past decades have demonstrated increasingly versatile applications of earth-based materials and their derivatives, ranging from theoretical "Martian settlements" to structures serving as shelters in disaster-prone areas, such as earthquake-stricken regions, as well as residential and public utility buildings.

This poster showcases a cross-section of contemporary design trends within the realm of natural construction and the potential for using earth in the creation of sustainable living environments. The development of this work is based on an archival review of available literature and exemplary projects shared on online platforms.

Keywords: sustainable architecture; natural architecture; earth construction.

Multiple impact response of titanium-based FMLs in numerical simulations

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Fibre metal laminates (FML) were widely recognized as impact-resistant materials, which are able to be used instead of classical composite structures. Next to the aluminium-based FMLs intense research is done on FML variants containing titanium and its alloys. The properties of titanium make FMLs more impact resistance than ones of aluminium. Most of the research was done so far in conditions of single impact being highly expected, but the risk of the next strike is large either. Thus, the finite element analysis was performed to study such a scenario. For the LVI experiment repeated up to nine times for the 5 J of impact energy, numerical models of titanium-carbon and titanium-glass laminates were prepared with regard of interfacial interactions and separate metal layers and composite layers behaviour. The convergence assessment was done on the basis of experimental values. Also, the ability to predict the damage initiation and propagation for each part of the laminate was validated. The models appeared to recreate the behaviour of the FML registered by means of experimental methods. A satisfactory convergence of validated physical magnitudes and propagation of delaminations after consecutive impacts was reconstructed likewise.

Keywords: fibre metal laminates; low velocity impact; finite element analysis; impact resistance.

Interventional architecture in Europe in the 21st century

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Intervention architecture is an approach that involves designing buildings or spaces to quickly resolve crisis situations. In the first decades of the 21st century, a period of conflicts, wars, social tensions, migration crisis and also extreme weather and natural disasters, intervention architecture plays a major role in shaping the urban and social landscape.

Contemporary intervention architecture engages in projects dealing with humanitarian crises such as migration and refugees. Such projects include the design of refugee shelters, camps for homeless people, as well as public spaces that promote social integration and acceptance of cultural diversity. The scope of the research covered events taking place from 2000 to the present day in Europe, in which intervention architecture plays an important role. Reference was made to the current state of knowledge, scientific research and the media situation. The article analyzes the typology of architectural, functional and technical solutions for temporary accommodation and housing facilities and attempts to determine their suitability for individual users.

Keywords: intervention architecture; natural disasters; disasters in 21st century Europe.

The Effect of Filler Size on the Structure and Selected Functional Properties of Silorane-based Powder Composites

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Powder hybrid nanocomposites are materials in which nano- and microparticles of various sizes and shapes act as reinforcement. Silorane matrix-based polymer nanocomposites belong to a specific group of these composites. Compared to methacrylate resins, siloranes are characterized by advantages such as low polymerization shrinkage and limited water sorption.

The aim of this study was to explore the feasibility of creating light-cured nano- and micro-composites based on siloranes, reinforced with a ceramic filler – silanized glass of the SiO2-BaO-B2O3-Al2O3 system, with particle sizes ranging from 180 nm to 2 μm. 9 series of samples were prepared, differing in both the weight content of the fillers and the percentage of each glass fraction. The pilot study conducted included measurements of the composite strength under three-point bending conditions and the conversion degree, assessed using Fourier Transform Infrared (FTIR) spectroscopy techniques. The results were complemented by structural observations using scanning electron microscopy (SEM) and micro-computed tomography (μCT).

Preliminary findings indicated differences between the tested series of materials in terms of both mechanical properties and the degree of conversion. Agglomerates of nanoparticles were observed in the nanocomposites, which adversely affected the functional properties of the experimental materials. The findings suggest the necessity to refine the method of composites manufacturing in order to improve particle dispersion in the matrix.

Keywords: nanocomposite; hybrid nanocomposite; silorane-based composite; polymer composite.

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Influence of thermal impact on the physical and mechanical properties of cement pastes modified with basalt powder

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The cement industry is one of the world's major sources of carbon dioxide emissions. As demand grows for building materials, it is necessary to reduce the cement industry impact on the climate changes. One promising solution is the use of alternative cementitious materials, such as basalt powder (BP), to reduce CO_2 emissions. The study was aimed at evaluating the impact of BP as a substitute for cement, on physical and mechanical properties under elevated temperature conditions. Cement pastes containing up to 50 % BP by weight relative to the weight of cement, were tested. The BP cement pastes were subjected to thermal loading in a range between 20-500 °C. Properties such as tensile strength, compressive strength, specific density and apparent density, and shrinkage were analyzed. The tests showed relatively similar results of physical and mechanical properties of BP modified samples with respect to the reference cement paste, suggesting that BP is a promising solution for the construction industry. The most favorable results were obtained for cement pastes with the addition of basalt meal at 5 % and 10 %.

Keywords: basalt powder; cement pastes; thermal load; mechanical properties; physical properties.

Development of a method for short-term forecasting of energy yield in solar-powered systems

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Renewable energy sources are constantly gaining in importance. This has been particularly noticed over the last two decades. This was caused by the increasingly visible depletion of fossil fuel resources and the tightening of EU directives specifying the share of renewable energy sources in the total energy balance of member countries. The use of renewable energy sources makes it possible to minimize the impact of secondary waste on the environment and reduce greenhouse gas emissions. Diversification of energy supplies through the use of renewable energy sources ensures compliance with the principles of sustainable development. The ever-growing interest in RES necessitates the integration and proper control of systems powered by renewable energy sources.

Globally, in 2021, buildings accounted for 30% of global final energy consumption and 27% of total energy sector emissions. In European Union countries, most energy is used for heating and cooling in buildings and industry. Current household statistics indicate that 79% of the total final energy consumption is spent on heating and hot water. In months with increased outdoor air temperatures, the demand for cooling increases, both in the residential and industrial sectors. Due to climate change and the increase in average outdoor temperature, the share of cooling in the energy balance is constantly increasing. Reducing energy consumption in the construction sector can be achieved by improving the building's energy balance or developing technology. This can reduce energy consumption, costs and peak electricity demand without compromising the required level of comfort.

The energy needed to meet all needs is currently obtained mainly from conventional sources, which include solid fuels (hard coal, lignite and peat), liquid fuels (crude oil, fuel oil, diesel oil, gasoline), gaseous fuels (natural gas) and nuclear fuels (uranium). Renewable energy production is still unable to cover energy consumption at certain times of the day, and large-scale energy storage is currently extremely limited. For this reason, interest in conventional energy is still high. It results from the advantages of these fuels, which include high energy accumulated per unit of mass or volume and mastered extraction and processing technology. However, producing energy from non-renewable resources involves discharging large amounts of waste into the natural environment. A significant part of this waste are greenhouse gases (mainly carbon dioxide), which contribute to increased global warming and thus to climate change. Achieving carbon neutrality goals over the next few years will require a massive shift away from fossil fuels. The basis of this energy transformation is the electrification of energy systems and the growing use of renewable energy sources to power them. Renewable energy sources are created as a result of the activity of the Sun, geothermal energy inside the Earth or the gravitational influence of the Moon. They provide forms of energy such as solar energy, geothermal energy, water energy, wind energy and biomass. The energy potential contained in renewable energy sources is many times higher than the total current demand. The use of renewable energy sources provides many benefits, not only environmental but also socio-economic. These include increasing the number of jobs in the community, which contributes to greater prosperity for local people, and creating a healthier environment through the use of clean energy technologies. Integrating solar installations into power grids is difficult because solar energy is highly dependent on climate and geography. Changing weather conditions cause voltage penetrations and surges, system instability, ineffective utility planning and financial losses. Forecasting models that enable more efficient integration and operation of solar systems can help, as it is important to consider their expected energy efficiency in order to better plan the production, storage and distribution of heat.

Data-driven models have greater feasibility than physical methods. Traditional physical modeling methods focus on examining equivalent photovoltaic cell circuits. And then deriving the output power based on the input parameters of the numerical weather forecast (including temperature, humidity and global radiation). However, the physical method requires complex calculations and many circuit

parameters (including series, shunt resistors, various temperature coefficients and diode influence factors). Due to the advantages of artificial intelligence methods, they are now widely used in various forecasting applications. According to the data input used, data-driven models can be divided into three types: time series, sky imaging, and numerical weather forecast (NPP). Time series models depend on long-term historical data, which are typically used in long-term or medium-term solar power forecasting. The most commonly used model is linear models based on the autoregressive (AR) method, which is simple but inflexible. In addition, there are also nonlinear methods based on time series. Compared to linear methods, nonlinear approaches can significantly improve forecasting accuracy thanks to adaptability and self-actualization. Moreover, thanks to the development of imaging technology, both sky imaging methods and satellite monitoring techniques are used in the prediction of photovoltaic power. However, the image-based model requires more computation and higher hardware costs, and may also encounter camera occlusion issues, making further promotion difficult. The NPP-based PV forecasting method usually classifies weather types and then feeds the NPP data into the trained model for prediction. It is obvious that the prediction model based on learning network is the main direction of the future development of photovoltaic power forecasting technology.

Due to its practical applicability, the method of forecasting future solar energy yield should meet three requirements:

- Simple implementation – The methods should not require significant computational effort or depend on third-party software, so that they are platform independent and easy to implement on commercially available controllers.
- Automatic adaptation – Methods should automatically adapt to changes throughout the year (e.g. seasonal changes), minimizing the effort of re-parameterization.
- Wide applicability – The methods should enable the description of many different solar collector or photovoltaic installations, in terms of application, size, orientation and climatic conditions.

Currently it was found that there is no forecasting method that would allow predicting solar energy yield and meet the three above-mentioned requirements regarding simplicity of implementation, automatic adaptation to changing conditions and that would be widely used. For this purpose, steps have been taken to develop a forecasting method that will meet the above-mentioned features. Additionally, it will be universal, i.e. it can be used both for the installation of solar collectors and photovoltaic systems. As mentioned earlier, forecasting the power generated can have a positive impact on the operation of energy systems.

Keywords: renewable energy sources; forecasting; demand response.

Impact of measurement conditions and measurement strategy on the accuracy and repeatability of positioning of a milling plotter

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The key aspect in assessing the dimensional and shape accuracy of a part is the accuracy of a CNC machine tool. Due to increased demand for high precision, machine tools and their assemblies as well as manufactured parts must meet stringent geometrical, kinematic, quality, and performance requirements. In order to achieve and maintain an accuracy of a few micrometres, numerous machine errors affecting the final quality of a product must be controlled and compensated for. These errors may result from irregularities and inaccuracy in the implementation of motion and its trajectory, inaccuracy of displacement (shaped, linear, point and angular), lack of accuracy and repeatability of CNC axis positioning or the occurrence of backlash in the drive system. The paper presents the experimental results of a study investigating the accuracy and repeatability of positioning a 3-axis milling plotter using a laser interferometer. Experiments were conducted using variable measurement strategies and measurement conditions. Cause-and-effect relationships were established for the tested components, as well as a measurement uncertainty budget was determined. Experimental data were obtained with the laser interferometer, which made it possible to determine the impact of the measurement conditions and measurement strategies on the positioning values. A statistical analysis was performed, and the accuracy and repeatability of positioning of the machine tool were determined. Models of tested components were built. Results obtained with different measurement strategies were compared and a correlation analysis was performed.

Keywords: accuracy; positioning; strategy; laser interferometry; CNC diagnostics.

Effect of the oral environment on the degradation of dimethacrylate resins blends modified with liquid rubber

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Composite materials based on dimethacrylate resins are widely used in dentistry for the restoration of teeth's tissues. They have excellent mechanical and esthetic properties, as well as the ability to bond to the enamel. However, in a humid oral environment, these composites can absorb water based liquids, such as saliva and beverages, which can significantly affect the degradation of the dental composite and leach unreacted monomers. Excessive fluid absorption can have a detrimental effect on the structure and function of the resin, as it can reduce the mechanical and physical properties, leading to a shortened life of the dental restoration, and cause the filler to separate from the matrix. The purpose of this study was to determine the water sorption characteristics and wetting angle of light-curing resins blend modified with liquid rubber. The material used in the study was a resin mixture with a composition of 20% wt. BisGMA, 30% wt. BisEMA, 30% wt. UDMA and 20% wt. TEGDMA. The Hypro 2000X168LC VTB liquid rubber (Huntsman International LLC, USA) was used as a modifier at 0%, 5%, 10%, 15%, 20% by weight in the resin mixture. The test method was in accordance with ISO 4049.

Keywords: water sorption; liquid rubber; composite materials.

An overview of the use of artificial intelligence in architecture

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Artificial intelligence is playing an increasingly significant role in the field of architecture, bringing new possibilities and innovations in project creation. The development of this new field using artificial intelligence can assist architects in designing complex projects and models. AI algorithms have the ability to analyze thousands of architectural projects, detecting patterns and suggestions that help designers in creating innovative and efficient projects. The application of AI-based tools can lead to entirely new paradigms in architecture, such as smart buildings that adapt to users' needs in real-time or biomimetic structures where designs are inspired by nature and optimized using algorithms. Research on the application of artificial intelligence in architecture is an area of intensive development, opening doors to many innovative solutions in spatial design. The scope of research in the application of artificial intelligence in architecture includes a review of implemented tools and solutions in building design.

Keywords: artifical intelligence; architecture; design projects; smart buildings.

Application of machine learning to identify activated sludge organisms

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The presentation shows the use of machine learning, and more specifically the YOLO algorithm, to recognize activated sludge organisms, with particular emphasis on Vorticella cilliades.

Keywords: SBR; machine learning; waterwaste; electronic eye; sewage treatment.

Utilizing fluorescent dye to innovatively investigate fibrillary nanocellulose distribution within cement matrices

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Achieving a uniform dispersion of nanocellulose within a cement matrix, contingent on optimal mixing and pre-treatment of nanocellulose, is pivotal for enhancing the mechanical and durability properties of the composite.

The research aims to scrutinize the dispersion of fibrillary nanocellulose in a cement matrix utilizing a fluorescence labeling technique.

An exhaustive literature survey was conducted, culminating in the selection of four fluorescent dyes for the fluorescence labeling examination. Nanofibrillated cellulose (NFC) was procured from The Process Development Center at The University of Maine, Orono. Initially, an analysis was carried out to discern the degree to which the nanocellulose assimilated the dyes, employing fluorescence microscopy, Confocal Laser Scanning Microscopy (CLSM), and spectrofluorometry. Subsequent to this, one dye, which showcased optimum absorption by the NFC, was singled out. Following this, trials were conducted to ensure that the cement grains did not absorb the chosen dye, as that would preclude accurate determination of nanocellulose dispersion within the material. Three distinct cement slurry mixes were crafted, each with different water-to-cement (w/c) ratios of 0.35, 0.4, and 0.45. For every w/c ratio, three samples were produced with varying fluorescent nanocellulose contents: 0.05%, 0.1%, and 0.15%. A total of 9 samples of dimensions 160×40×40 mm were fabricated. These were manually sectioned (to prevent water from a saw affecting the analysis) into comparable thicknesses, and the nanocellulose distribution was ascertained using a UV lamp.

The adopted methodology enabled the determination of the NFC distribution within the cement matrix, revealing variances associated with the w/c ratio and the NFC quantity utilized.

The proposed technique successfully mapped the distribution of NFC within the cement matrix, marking a novel achievement in this research domain, as per available knowledge.

Keywords: nanocellulose; cement matrix; cellulose nanofibrils; CLSM imaging; UV.

Adhesion of modified epoxy glue to concrete

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Nowadays, FRP composites are widely used in construction. Their beneficial features serve to strengthen structural elements made of various materials and increase their durability. For example, reinforcing tapes are connected to the beam by gluing. In a glued joint its effectiveness depends on the participation of various types of adhesion. When reinforced concrete elements are strengthened, the roughness and structure of the concrete surface contributes to the formation of a specific connection. It is the main point of analysis and research undertaken by scientists. When transferring the load from the element to the FRP tape it is possible to destroy the glued joint due to adhesive delamination or destruction of the tape. Therefore, it is important to prepare the concrete surface very carefully, apply the adhesive and bond it to the substrate and the tape. During the analyses the performance of the glued joint is most often considered in shear, peeling or tearing. Each of these quantities depends on the adhesion and cohesion phenomena of the adhesive. Its modifications may lead to a significant change in adhesion to the substrate and thus increase its durability. Among the most frequently considered methods of modifying polymers (resins) used as adhesives, the possibility of adding fillers is taken into account, which lead to increased adhesion through chemical reactions with molecules of polymer chains and the concrete substrate. The study presents the results of testing of adhesives modified with the addition of two types of fillers - microsilica and carbon nanotubes. The main goal of the research was to increase the adhesion of adhesives to concrete substrates modified by grinding and sandblasting. A modified version of the pull-off study was used as a method to directly assess the effectiveness of modified resins.

Keywords: adhesive; sonication; filler; profilometry.

Effects of heat treatment and shot peening on 17-4PH steel manufactured using DMLS technology

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Additive manufacturing (AM) technology despite being known for some times is still an open field of research. Materials, requiring advanced engineering, are typically developed for specific application. Medical and aerospace applications along with die forms are often made in small batches and with complex shapes. These complex shapes may be challenging to manufacture; however, Additive Manufacturing trivializes the process of producing these complex shapes. 17-PH steel, also designated as AISI 630 or X5CrNiCuNb16-4, was introduced after World War II to address the need for material with high mechanical performance. In order to create such material, the age hardening process, also known as the precipitation hardening process was introduced. This treatment can significantly increase the mechanical performance of certain grades of steel if performed well; however, manufacturers are not recommending this process as a post-treatment. Moreover, different manufacturing techniques influence the final microstructure and properties of the material. Other method for increasing the mechanical performance of surface layer is shot peening. Shot peening may also significantly increase the wear resistance and fatigue strength of the component. This study investigates the influence of the postprocesses on the DMLS 17-4PH steel. To investigate the effects of those treatments, optical and SEM microscopy was applied. Chemical composition was investigated along the phase composition using XRD method. Surface characteristic of the archived material was investigated by hardness and roughness measurements.

Keywords: 17-4PH; DMLS; heat treatment; shot peenig.

The effect of bone remodelling around the implant defect reconstruction

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Bones are capable of carrying high loads while maintaining a low mass. This is due to the ability to self-optimise the structure of bone tissue. This is demonstrated by bone remodelling processes, which continually take place in the bone in an attempt to maintain mechanical balance at the level of the tissue (micro and meso scale) and of entire anatomical elements (macro scale). The increase in the activity and number of individual cells (osteoblasts and osteoclasts) resulting from a local change in mechanical conditions (implant placement) leads to a change in the intensity of the processes of intercellular substance formation or resorption. As a result, the structure and shape as well as the mechanical parameters of the bone are altered.

The aim of the present study was to analyse the bone remodelling occurring around the implant used for bone defect reconstruction. The bone remodelling process was simulated using a computational algorithm with numerical methods and Ansys Parametric Design Language (APDL). The basis of the algorithm should be the author's mathematical model describing the phenomena occurring in the bone tissue as a result of implant placement. The main results of the simulations were the patterns of bone density distributions including changes resulting from functional adaptation. It is possible to observe, that the most intensive bone remodelling has occurred around the corners of the implant; metallic implant (pure titanium) provided more intensive stimulation of bone remodelling compared to PEEK implant. Some weaknesses were noted in the simulation of bone remodelling using the Huiskes-Weinans procedure. Further development of the model, taking into account biological aspects of the bone remodelling process is necessary for further improvement of accuracy of bone adaptation prediction.

Keywords: bone remodelling; bone tissue; implant; numerical simulation.

Oil quality testing as a basis for warranty claims

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The objective of this presentation is to give an overview of the warranty claim processing using oil quality testing. A case study of the analysis of a warranty claim for a ultralight gyrocopter manufactured by Aviation Artur Trendak is presented. The warranty claim concerned engine damage due to oil contamination with fuel. The claim was about noticing fuel in engine oil by the customer. It was the warranter problem to prove the real amount of fuel dilution. It is known that engine oil used in engines powered by direct fuel injection may contain some level of fuel contamination. The only way to check the actual level of contamination was to proceed with the oil sample for the laboratory check. The biggest problem occurred when the customer did the same and the results were not exactly the same. The presentation shows the whole process of warranty claim processing from accepting the claim to partial solution of the problem. The discussion about possible ways to proceed in such situations was conducted. In the end the customer was satisfied but the problem of possible fuel contamination was not solved. The likely consequences of such action have been considered and described.

Keywords: gyroplane; engine oil; exploitation monitoring; warranty claim.

Innovative Cheneau brace as an optimised alternative to static orthosis improving idiopathic scoliosis therapy

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The subject of the research is the analysis of the dynamics of forces in the intelligent Cheneau brace prototype during clinical trials with a patient. The traditional Cheneau static brace is the main method for idiopathic scoliosis treatment. The orthosis corrects deformation of the spine by exerting multi-point pressure forces on the patient torso around the spine and thorax. The intelligent Cheneau brace is a portable system based on the STM32 microcontroller that collects forces values data at real time from sensors mounted on the orthosis in order to determine the reference range of applied pressures and to find the optimal values to increase the effectiveness of scoliosis treatment. For this purpose, a device with a frequency of 1 measurement per second was designed. The sensors used in the device were an in-house made thin-film graphene sensors. The described studies are part of the research for a doctoral dissertation. The comparison of collected results with X-rays of the spine in the brace from the whole treatment cycle allows to assess how wearing the brace impacts the effective correction of the spine curvature. Considering the analysis of a person's skeletal system and the generated pressures, it is possible to optimize the method of posture correction. Measurements for a patient along with periodical the X-ray images show a colossal improvement and decrease in the curvature of the spine. The observed regularity and preciseness in wearing the orthosis by the patient confirms the initial assumptions that the desired effectiveness of treatment is achieved by wearing the brace for 23 hours a day. Based on X-ray images, it can be numerically determined how much the angle of curvature (Cobb's angle) has decreased over the course of treatment in reference to measured forces and how it affects the effectiveness of therapy. The research described above is intended to highlight the need for research into the field of spine defects using modern technology.

Keywords: idiopathic scoliosis; brace; dynamic forces; Cheneau brace.

Wet vacuum impregnation as a modification of the malting process of barley grains of different varieties

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The study used the process of wet vacuum impregnation (WVI) of barley grains of the Xanadu and Kangoo varieties at the soaking stage. The effect of vacuum impregnation on the rate of water uptake by the grain under different temperature conditions, namely 12, 14 and 16 °C, was analysed. Grain for malting was soaked in a water-air system. The germination (malting) stage was carried out for 8 days at 12, 14 and 16 °C. Samples, taken on the 2nd, 4th, 6th and 8th days of steeping, were then dried using the traditional convection method. After a 3-month resting period, congress wort was produced from the malt. The wort parameters studied were viscosity index and wort extract content. The malt extract difference was also determined. Based on the results, it was concluded that the vacuum impregnation process significantly increases the water absorption of the grain and thus shortens the soaking and germination stage of the seed. On the other hand, grain variety had a strong effect on extract content and wort viscosity. Malting temperature only affected the viscosity index. The most important correlations of the parameters studied were noted for the number of days of malting.

Keywords: wet vacuum impregnation; barley malt; wort parameters.

Assessment of the condition using digital inventory methods in heritage

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Today, technology is playing an increasingly important role in people's lives. With its progress develops many industries in the market, this also applies to the construction industry. In circulation there are There are many methods in circulation today for acquiring spatial data of entire sites, building structures or machine parts. of land, building structures or machine parts, differing mainly in efficiency and accuracy.

The purpose of this work is to conduct, analyze, compare and use to perform assessments of the technical status of digital methods of acquiring spatial information in the construction industry. The presentation attempts to use digital methods to more accurately determine the technical condition of the object and carry out its repair. The digital methods used find their wide application in various industries, both in the historic preservation industry around the world.During the execution of this thesis, it was necessary to demonstrate skills in the use of specialized software, such as AutoCad, ReCap, Adobe Lightroom, Reality Capture, Faro Scene, GeoSlam Connect, Cloud Compare, and skills in using equipment from manufacturers such as DJI, Matterport, Faro, GeoSlam.

Keywords: technical condition assessment; inventory; digital methods; photogrammetry; lidar.

The influence of constructional and technological parameters on AC measurements and surface morfology of multilayered NiFe-SiO_2 nanocomposites

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Due to the exceptionally interesting electrical and magnetic properties of nanocomposites consisting of ferromagnetic materials in a dielectric matrix, multilayer NiFe-SiO2 nanocomposites were obtained. The entire sequence of technological processes using magnetron sputtering equipment in the presence of argon is presented, aimed at creating structures with a different number and thickness of layers, in two different measurement configurations. The alternating current frequencies in which the measurements were made ranged from 4 Hz to 7.92 MHz. To improve the implementation of measurement processes, a program was written to control the impedance meter in the MATLAB environment. The obtained measurement results were compared in terms of constructional parameters, such as thickness and number of layers, and technological parameters, such as annealing time. Structural analysis by scanning electron microscopy (SEM) was performed to investigate the effect of oxidation on the multilayer structures and confirm the granular structure of the nanocomposite. Conductivity graphs showed that the tested samples exhibit a hopping conduction mechanism. Additionally, by taking into account the phase shift angle versus frequency curve, an equivalent RC electronic circuit can be assembled, thus tailoring the potential applications of the obtained nanocomposites.

Keywords: granular nanocomposite; magnetron sputtering; dielectric matrix; ferromagnetic metallic phase; annealing.

A new approach to soundscape analysis – the use of GIS tools and the crowdsensing method in research on environmental quality

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The poster describes the research methodology regarding a scientific project analyzing the soundscape of the city of Lublin based on acoustic measurements and geospatial data. The study aimed to examine the impact of spatial development on the subjective perception of the audiosphere and to determine the quality of Lublin's soundscape. The result of the project is an interactive map of Lublin's soundscape available in the form of a WebGIS mobile application. Thanks to the built-in social participation module, application users could independently rate individual recordings and share their reviews. The data collected in this way was subjected to statistical analysis to examine the relationship between the method of land development and the subjective feelings about the city's soundscape. The acoustic aspect and noise pollution of the environment is an essential element of spatial planning, hence, the thesis results find practical application in designing new public spaces with high acoustic values and acoustic revitalization tasks. The application prepared as part of the thesis is the first publicly available recording of the current sound landscape of Lublin. It is a starting point for further work on the city's audiosphere.

Keywords: GIS; soundscape; noise pollution; acoustic climate.

Changes of eukaryotic organisms community structures influenced by stormwater discharge – bioindication research aided with electronic senses

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The presented bioindication research analyzed the structures of periphyton eucaryotic organisms community, which depicts the state of the studied aquatic environment. The impact of stormwater discharge on the receiver at particular points was evaluated on the basis of selected species reaction to the substances appearing in the watercourse. The study of indicator organisms species and holistic analysis of their community structure based on entropy quantification can give information about a surface water without chemical tests which often causing a burden on the environment during the production as well as disposal of reagents that are consumed in many classical analyses. Application of electronic senses for supporting bioindication procedure and fast evaluation of water is also possible. Electronic senses applied in evaluation of surface water and stormwater quality directly used in bioindication purposes could be the electronic eye (matrix of sensors with programs for automatic image analysis) and for validation, electronic tongue and electronic nose.

Keywords: eukaryotic organisms; community structure; stormwater discharge; multidimensional data analysis; electronic senses.

Application of HPLC-ICP-MS coupled technique for direct determination of Iodinated Contrast Media (ICM) in hospital wastewater

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Iodinated Contrast Media (ICM) are chemicals containing iodine atoms in a molecule, introduced by various paths to the body. They cause an increase in the contrastness of images obtained during radiological research by increasing the differences in brightness in individual parts of these images. This translates into a better visualization of the body structures studied, and especially better visualization of pathological changes. These pharmaceuticals for people are safe, because we do not metabolize them – we excrete them in practically unchanged form. But when they get into the environment, biotransformation may be harmful.

This work presents a method of direct ICM determination as well as their transformation products, using high resolution liquid chromatography coupled with a ICP-MS technique. The coupling of HPLC with ICP-MS allows for very low detection limits of analyzed compounds at the level of low ppb and also allows to bypass the procedures of isolation, enrichment and purification of extracts, and thus significantly reduces the time of analysis. In addition, ion 127I does not have simple interferences, therefore the chromatograms obtained during analysis are easy to interpretation.

Keywords: environment; iodinated contrast agents.

Examining the effect of double excitation in a lumped parameter model for the implanted human middle ear

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Hearing stands as one of humanity's most vital senses, empowering communication through speech that has evolved over millennia. Moreover, hearing has been integral since the dawn of humanity, allowing individuals to perceive environmental cues and avert threats to their well-being. In the contemporary world, people experience a constant stream of auditory input both in their professional and domestic lives. Urban settings often subject individuals to persistent noise pollution, largely due to factors such as traffic congestion. According to the World Health Organization (WHO), it is projected that by 2050, around 2.5 billion individuals will grapple with varying degrees of hearing impairment, a substantial increase from the current estimate of approximately 1.1 billion [1].

The implantable middle ear hearing device (IMEHD) offers hope to individuals grappling with hearing loss, specifically those with conductive or mixed hearing impairments. This type of implant is surgically embedded and provides direct stimulation to the middle ear ossicles, enhancing the transmission of sound to the inner ear. By circumventing damaged components of the middle ear, the IMEHD offers substantial hearing enhancement, particularly beneficial for those ineligible for conventional hearing aids.

This study centers on a lumped parameter model representing the implanted human middle ear with five degrees of freedom.

The lumped parameter model for the implanted human middle ear, incorporating Kelvin-Voigt viscoelasticity, comprises five masses. Among these, three masses represent the middle ear's ossicular chain, specifically the malleus, incus, and stapes, while the remaining two masses are linked to the incus to represent the implant. The malleus serves as the initial mass, with the stapes as the final one. In this lumped parameter model, an exciting force is applied to both the malleus and the implant. All these masses are interconnected through springs and dampers.

The resonance curves obtained from the model of the implanted human middle ear provide a valuable insight into the dynamic behavior of this complex system. These curves illustrate the response of the middle ear to varying frequencies, shedding light on how the implanted components interact with the natural physiology of the ear.

Keywords: middle ear; ossicles; vibration; modelling.

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The influence of cross-linking conditions on the morphology of liquid crystal epoxy composites

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The investigation of two anisotropic epoxy composites was carried out. The first composite consists of a liquid crystalline epoxy monomer named p-phenylene bis[4-(10,11-epoxyundecanoyloxy)benzoate] (MU22) and aluminum diphenylphosphate nanorods (NP). The second composition contained p-phenylene bis(4-allyloxybenzoate) (DGE-MEZO II) and NP. The cross-linking conditions were determined using differential scanning calorimetry (DSC). Both nanocomposites were subjected to dynamic DSC analysis, during which the samples were heated at a constant rate of temperature. After the appropriate cross-linking conditions were established, the mixtures were also subjected to 3-hour isothermal analyses, which allowed researchers to determine the glass transition temperatures for the nanocomposites. A sample of the MU22/NP mixture was cross-linked in the presence of a magnetic field with an induction of 1,2 T. It was a factor that significantly influenced the ordering of mesogens in the nanocomposite. The degree of order and morphological properties were investigated using WAXS analysis. The DGE-MEZOII/NP nanocomposite was analyzed using the polarized light microscopy technique, which allowed the thermal transformations occurring in the mixture to be registered as pictures. The MU22/NP composition cured at 210°C for 180 min was established to be fully cured, while the best cross-linking conditions for the DGE-MEZOII/NP composition are 240°C for 180 min.

Keywords: liquid crystals; cross-linking; anisotropic epoxy composites; WAXS; morphology.

Transient temperature field of two semi-boundary functionally graded bodies during frictional heating

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Functionally graded materials (FGMs) are the group of nonhomogeneous materials with properties dependent on the spatial position. Expected distributions of FGMs properties are obtained by changing porosity, microstructure or composition across the volume of the material structure. Mainly, functionally graded materials are composites where the contribution of the component materials changes so that a specific variation of the material properties is achieved. Many results proved that properly controlled gradients of thermo–mechanical properties in the FGM can significantly improve the resistance to contact deformation and damage. FGMs are consider as advanced materials, resistance to wear and extreme temperature conditions. Often these materials are manufactured of the composition of two different materials. One is a ceramic to resist the severe thermal environment, and the other is a metal to maintain the structural rigidity. Due to their exceptional properties, functionally graded materials are widely used in lots of technology areas, including sliding systems under frictional heat loading, such as braking systems. Application of FGMs with thermal properties dependent on the distance from friction surface, allow to improve dissipation of generated heat, thus avoid overheating of the frictional elements and reduce the magnitude of thermal stresses. Therefore, thermoelastic contact behavior of functionally graded materials is an up–to–date scientific problem. In considered models, changes of thermal and mechanical material properties are assumed to be expressed by appropriate functions. Typically, the exponential or power dependencies of FGMs properties on the spatial position are incorporated to the analysis.

Modeling of the temperature and thermal stress distributions in such heavy–loaded frictional system is essential. Most of obtained exact solutions, known in literature, have been found for a homogeneous materials properties, due to the complexity of the solution achievement in case of heterogeneous properties. The purpose of this study is to investigate thermal behavior of two element tribosystem made entirely of functionally graded materials during frictional heating. Proposed model is based on the one–dimensional boundary–value problem of heat conduction for two semi–infinite bodies with frictional heat generation on their contact surface. The perfect thermal contact conditions on the friction surface and uniform contact pressure during braking was assumed. Thermal properties of frictional materials are considered to be nonlinear with an exponential distribution along the thickness. In order to solve formulated problem, the Laplace transform technique was used. Exact solution was obtained in the analytical form involving the modified Bessel functions. Based on developed model, the influence of exponential variations of thermal conductivities and diffusivities of friction materials along the thickness of the elements on the transient temperature distributions in a pad/disc system during braking was investigated.

Keywords: thermal problem of friction; temperature; functionally graded materials.

The attitudes of a selected group of consumers towards hunting

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Hunting is undoubtedly a vital element of protecting the natural environment. According to the current Hunting Law, hunting is the protection of game animals and managing their resources following the principles of ecology and rational agricultural, forest, and fishing management. The above-mentioned legal act defines four goals of hunting, namely: 1) protection, preservation of diversity, and management of game animal populations; 2) protection and shaping of the natural environment to improve the living conditions of animals; 3) achieving the highest possible individual condition and quality of trophies as well as the appropriate population size of individual game species while maintaining the balance of the natural environment; 4) meeting social needs in the field of hunting, cultivating traditions and promoting hunting ethics and culture.

Despite this, hunting is very often perceived by consumers as inhumane. This leads to negative consumer attitudes not only towards hunting but also towards the valuable raw material venison. This study aimed to determine respondents' attitudes towards hunting using a questionnaire developed and validated by Raftogianni, Kontsiotis, and Liordos (2022). 259 people participated in the study, of which 78.8% were women and 21.2% were men. The age range of the respondents was from 18 to 67 years of age. Most respondents stated that hunting animals bred and released by humans is unacceptable, but hunting wild animals is permissible if their population is large. 128 respondents saw a positive aspect of hunting as an element allowing for maintaining natural balance, while 100 respondents believed that hunting does not have such an effect. The remaining respondents showed ambivalent attitudes towards this statement. Respondents showed positive attitudes regarding the following statements: Hunting helps control predator populations; hunting helps control wildlife diseases. However, 67% of respondents said that hunting leads to the extinction of many animal species.

The above results justify the conclusion that there is a significant need to educate society about the purposes of hunting and the benefits derived from it. The lack of ecological awareness in this area may lead to negative consequences, such as avoiding the consumption of such valuable raw materials as game meat.

Keywords: hunting; attitudes; game meat; wild animals.

Comparison of selected physicomechanical features of cements of different quality levels

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One of the basic building materials is cement. Due to its functional characteristics, it is difficult to replace. Taking into account that: (1) cement production is a significant source of greenhouse gases, (2) the quality of cement, depending on external factors, determines the properties of concrete, (3) problems with the management of a product that doesn't meet the quality criteria are serious, selected physicomechanical properties of cement were compared with different levels of quality. The research material consisted of budget, standard, and premium cement from one manufacturer. The assessment included color, loose and tapped density, angle of repose, and humidity. Noticeable differences in the color of individual cement samples were found. The differences between the loose density of individual samples were statistically significant. However, the differences between the tapped densities were statistically insignificant. The differences in flowability were statistically insignificant. Humidity differences were statistically insignificant. Cement samples of different quality levels differed significantly in terms of color and loose density, which parameters should be considered critical in quality assessment.

Keywords: cement; quality; transport; storage.

Evaluation of the interface layer impact on fracture energy of the 3D printed multi-layered mortar composite

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Dynamic development of a 3D Printing (3DP) technology creates new type of structural materials. The most popular technology of 3DP used in civil engineering involves layer-by-layer deposition for structure creation. Structures manufactured in this technology behave as multi-layered composites with an additional cohesive layer between printed layers of the material. The cohesive layer, commonly known as an interface, behaves differently than the material used for printing, thus changes the composite's behaviour. This leads to modifications of its characteristics, which in itself generates new scientific problems. One of which is the behaviour during failure process. The aim of this experimental study is the evaluation of interface layer impact on the fracture energy of the multi-layered mortar composite created in a 3DP technology. The evaluation consists of comparison of the results acquired for the 3DP composite and the material used for its creation in form of classical specimens with dimensions similar to the 3DP specimens and varying levels of compaction. The specimens were subjected to 3-point bending under the condition of Loading-Unloading-Reloading. Digital Image Correlation (DIC) was used instead of the traditional clip-on extensometer for Crack Mouth Opening Displacement (CMOD) measurements. The DIC method avoids introduction of the external damaging tensile forces which lead to accelerated failure of the material. The achieved results indicate the difference between values of fracture energy acquired with forces applied perpendicular and parallel to layers' stacking direction. Moreover the acquired data can be directly used for numerical description of the composite.

Keywords: 3DCP; mortar; mechanics.

The impact of renewable energy sources on power grids in Poland

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Renewable energy sources (RES) are increasingly popular in Poland, especially photovoltaics, which is one of the main types of renewable energy and plays a key role in it. However, the industry has been facing serious difficulties for several years - a significant part of the medium-voltage grid is obsolete, which significantly limits or even prevents the connection of additional power to it, as well as negatively affects reliability factors and can lead to failures and sudden power outages. Renewable energy sources, such as solar, wind and biomass, account for a growing share of the Polish energy market and contribute to reducing emissions of harmful gases such as carbon dioxide, which has a positive impact on the environment. However, with the rapidly growing number of applications for local grid connection of distributed RES sources, space in the power system is beginning to run out. According to estimates presented by the Energy Market Agency, RES capacity in Poland at the end of June 2023 exceeded 25 GW (exactly 25,395 MW). These included wind, photovoltaic, biogas, biomass, hydroelectric and hybrid RES plants. Solar power plants have the largest capacity, with windmills taking second place in this regard. The podium is closed by biomass power plants. Unfortunately, such high dynamics and pace cannot withstand power grids. The ability to connect new generation sources is affected by the age of the grid. Currently, about 70% of overhead lines in Poland are more than 40 years old; in the EU, about 35-40% of the grid is between 20 and 40 years old, so it too needs modernization.

The problem of electricity generation and distribution in Poland is crucial, as exemplified by the energy crisis in past years. Of great importance here is the reliability of energy distribution and the predictability of events, which is monitored through the SAIDI and SAIFI indicators. Insufficient transmission capacity, poor technical condition and age of power infrastructure, require comprehensive modernization. The process of expanding and increasing the connectivity of power grids is not adequate to meet the growing demand for the growth of renewable energy sources in Poland.Increasing the share of renewable energy in the electricity system also has a positive impact on Poland's energy security, reducing dependence on fossil fuel imports. This allows Poland to achieve its CO_2 emission reduction targets and contribute to the fight against climate change. Today's investment in RES is a step towards a complete transition to domestic resources in the long term. It is about protecting the Polish economy from an analogous electricity shortage crisis in the future. Poland is taking steps to develop RES and adapt power grids to the changing situation. Investments in energy storage, smart grids and the development of management systems are being made to minimize the negative impact of RES on power grids. The solution to these problems is the conversion of overhead lines to cable, as well as the automation of grid operation and energy storage. Since rebuilding lines is a lengthy and costly process, a good solution may be to automate grid operation, including the development of systems for reconfiguring the grid and restoring power supply at the time of an outage or excessive energy production by RES sources.

Keywords: renewable energy sources; power grids; medium voltage networks; energetics.

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