



АКАДЕМИЈА НАУКА И УМЈЕТНОСТИ
РЕПУБЛИКЕ СРПСКЕ



СРПСКА АКАДЕМИЈА
НАУКА И УМЕТНОСТИ



ALMA MATER
EUROPAEA
THE UNIVERSITY FOR LEADERSHIP

ТЕХНИЧЕСКИ УНИВЕРСИТЕТ
ГАСПОВО

ХИХ МЕЂУНАРОДНИ НАУЧНИ СКУП САВРЕМЕНИ МАТЕРИЈАЛИ 2026

ПРОГРАМ РАДА И КЊИГА АПСТРАКАТА

XIX INTERNATIONAL SCIENTIFIC CONFERENCE CONTEMPORARY MATERIALS 2026

PROGRAMME AND THE BOOK OF ABSTRACTS

Бања Лука, 10–11. септембар 2026. године
Banja Luka, September 10th to 11th, 2026

**XIX МЕЃУНАРОДНИ НАУЧНИ СКУП
САВРЕМЕНИ МАТЕРИЈАЛИ 2026**

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Академија наука и уметности Републике Српске

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ЧЕТВРТАК, 10. СЕПТЕМБАР 2026. ГОДИНЕ

- Долазак и смјештај пленарних предавача у хотелу „Босна” у Бањој Луци
- Долазак и смјештај учесника научног скупа који живе изван Бање Луке у хотелима по избору

ПЕТАК, 11. СЕПТЕМБАР 2026. ГОДИНЕ

- 08.30 Регистрација учесника научног скупа (АНУРС)
- 09.00 Отварање конференције
- 09.20 Пленарна предавања
- 14.00 Постер презентације
- 15.00 Дискусија
- Затварање конференције

THURSDAY, SEPTEMBER 10, 2026.

- Arrival of the plenary speakers and accommodation in the hotel „Bosna” in Banja Luka
- Arrival of the participants and accommodation in the hotels optionally

FRIDAY, SEPTEMBER 11, 2026.

- 08.30 Registration of the participants in the ASARS
- 09.00 Opening of the Conference
- 09.20 Plenary session
- 14.00 Poster presentations
- 15.00 Discussion
- Closing ceremony

ПЕТАК, 11. СЕПТЕМБАР 2026. ГОДИНЕ

FRIDAY, SEPTEMBER 11, 2026

СВЕЧАНО ОТВАРАЊЕ СКУПА

OPENING CEREMONY

(09.00– 09.20)

- Скуп ће отворити и учеснике поздравити
предсједник Владе Републике Српске,
др Саво Минић
- The event will be opened and the participants welcomed
by the Prime Minister of the Republic of Srpska,
Savo Minić, Ph.D.
- Поздравно обраћање гостију
- Welcome speeches of the guests

РАДНИ ДИО СКУПА
WORKING SESSION
(09.20 – 14.00)

ПЛЕНАРНА ПРЕДАВАЊА
PLENARY SESSION
(09.20 – 14.00)

- 9.20 – 9.40 Nenad Filipović
Testing and Modeling of the Toxicity for Microfluidic Devices
- 9.40 – 10.00 Ljupčo Kocarev
Transformative Path of AI: From AI Agents to Agentic AI
- 10.00 – 10.20 Janos Santa
Optimizing Production Efficiency Through Lean Six Sigma: A Data-Driven Approach to Variation and Waste Reduction with the support of Artificial Intelligence
- 10.20 – 10.40 Ivana Radonjić Mitić, Iliya Zhelezarov
Enhancement of Eco- and Energy-Saving Technologies at the Technical University of Gabrovo
- 10.40 – 11.00 Domenico Guida, Marco Claudio De Simone
From Multibody Modeling to Automatic Machine Code Generation: Experimental Identification and Optimization of Sloshing Dynamics for Pharmaceutical Applications
- 11.00 – 11.20 Coffee Break

- 11.20 – 11.40 Ljubomir Majdandžić
Photovoltaic Power Plant with a Capacity of 62.1 kWp on the Building of the Croatian Energy Regulatory Agency
- 11.40 – 12.00 Duško Dudić
Characteristics of AC Currents Produced by the Human Body
- 12.00 – 12.20 Predrag Dašić
Application of Artificial Intelligence in Reliability Analysis of Technical Systems
- 12.20 – 12.40 Slavica Maletić
Low Frequency Dielectric Properties of Epoxy-Based Composites Reinforced with Graphite Flakes and Exfoliated Expanded Graphite
- 12.40 – 13.00 Snežana Papović
The New Ionic Additives for Safer and Durable Electrolytes in Lithium-ion Batteries
- 13.00 – 13.20 Ivan Stevović
AI-Supported Management of Polluting Substances from TPP and Production of Green Construction Materials
- 13.20 – 13.40 Sanja Stojanović
Biomaterials for Regenerative Medicine and Wound Healing: Current Perspectives and Novel Strategies
- 13.40 – 14.00 Maria Savanović
From Photocatalytic Powders to Reusable Materials: Sustainable Strategies for Water Purification

ПОСТЕР ПРЕЗЕНТАЦИЈЕ POSTER SESSION

(14.00–15.00)

1. Gorana Mrđan, Dragana Mekić, Suzana Apostolov,
Đendi Vaštag, Borko Matijević
*Study of the Intermolecular Interactions of Para Phenyl
Substituted Asymmetrical Biscarbohydrazones*
2. Dragana Mekić, Đendi Vaštag, Gorana Mrđan,
Borko Matijević, Suzana Apostolov
*Experimental and Computational Evaluation of
Lipophilicity and Ecotoxicity Thiocarbohydrazone Derivatives*
3. Suzana Apostolov, Dragana Mekić, Gorana Mrđan,
Borko Matijević, Đendi Vaštag
*RP-TLC Descriptors as Predictors of the Selected
Biological Properties of Thiocarbohydrazones*
4. Dejana Savić, Milica Balaban, Dajana Janjušević,
Sanja Pržulj, Vesna Antić, Aleksandra Tasić
*Brewer's Spent Grain as a Sustainable Bio-Based Adsorbent for
the Removal of Selected Pesticides From Aqueous Media*
5. Srđan Preradović, Dino Hasanagić, Vesna Antić, Milica Balaban
*Valorization of Brewer's Spent Grain as a Nutrient-Rich By-Product:
Influence of Drying Conditions on Its Chemical Composition*
6. Dajana Janjušević, Dejana Savić, Milica Balaban, Vesna Antić
*Thermal Behavior of Poly(Lactic Acid) Biocomposites Reinforced
with Brewer's Spent Grain*
7. Božidar Ilić, Svjetlana Zeljković, Saša Zeljković
*Evaluation of Waste Glass as a Partial Growing Medium
Replacement for Horticultural Plants: A Pilot Study*

8. Dragana Cerović, Slavica Maletić, Ivan Petronijević, Dušan Popović, Blanka Škipina, Biljana Pećanin, Dragana Grujić, Branka Ružičić
Investigation of Physical Properties of Antistatic Protective Fabric
9. Biljana Pećanin, Slavica Maletić, Dragana Grujić, Branka Ružičić, Manja Kurečić, Alen Erjavec, Dragana Cerović, Blanka Škipina
Influence of BaTiO₃ Particle Size on the Dielectric Properties of PLA Composites
10. Dragana Grujić, Branka Ružičić, Aleksandar Savić, Ljiljana Topalić-Trivunović, Blanka Škipina, Biljana Pećanin, Branka Đuza, Dragana Cerović, Andreja Rudolf
Antibacterial Protection and Thermophysiological Comfort of Gloves for Cold Functionalized with Phase Change Materials and Agrimonia Arbutifolia L. Extract
11. Dragana Grujić, Branka Ružičić, Blanka Škipina, Aleksandar Savić, Biljana Pećanin, Tanja Rauš, Saša Papuga, Stefano Vecchio Cipriotti, Dijana Jelić
Thermophysiological Comfort of Clothing Functionalized with Salvia Rosmarinus Essential Oil and Phase Change Materials Based on Polyvinyl Alcohol
12. Pavle Lončar, Vladan Mičić, Ivan Ristić, Nebojša Vasiljević
Synthesis of Novel Polymeric Materials for Advanced Water Treatment
13. Dijana Jelić, Din Avdispahić, Dragoljub Mirjanić, Slavko Mentus
Schiff Bases Derived from 2-Aminophenol and Substituted Benzaldehydes: Thermal Stability and Degradation Mechanism
14. Marija Mitrović, Nebojša Vasiljević, Regina Fuchs-Godec, Kristina Đerić, Vladan Mičić, Milorad Tomić
Wild Oregano as a Green Steel Corrosion Inhibitor in 3% NaCl Solution
15. Duško Kostić, Mitar Perušić, Srećko Stopić, Nebojša Vasiljević, Jelena Vuković, Vladimir Damjanović, Radislav Filipović, Svetlana Pelemiš
Modification of Tionite by Alkaline Roasting for Improved Titanium Leaching

16. Srđan Vuković, Svetlana Peleš, Danijela Vuković, Aleksandar Vuković
Radioecological Behavior of Cesium-137 in the Environment
17. Aleksandra Mitrović, Jelena Lamovec, Svetlana Peleš
Forensic Memory of Materials: How Engineering Materials Record, Preserve, and Reveal Past Mechanical, Thermal, and Chemical Events
18. Dušan I. Ilić, Siniša M. Vučenović, Stevo K. Jaćimovski, Jovan P. Šetrajčić
A Study of The Energy Spectra and Phonon States in Crystalline Nanofilm Structures
19. Siniša M. Vučenović, Jovan P. Šetrajčić
Overview of Contemporary Research in Materials Physics
20. Nikola R. Vojnović, Igor Mandić, Jovan P. Šetrajčić
Analysis of the Spectrum of Electronic States in a Crystalline Nanofilm with a Complex Lattice
21. Slobodan Gnjato, Tatjana Popov, Goran Trbić
Evaluating Hydrological Drought of the Trebišnjica River Based on the Streamflow Drought Index (SDI)
22. Milan Pantić
Fundamentals of Quantum Physics and Applications in Quantum Technologies
23. Zoran Govedar
Condition of Coppice Beech Forests in the Republic of Srpska and Management Methods – Case study in the Lopare area
24. Isak Karabegović, Mustafa Tabaković, Midhat Tabaković
Integration of Biomaterials Into Service Robotic Systems for Medical Applications: contemporary Trends and Future Development Directions
25. Rade Biočanin, Jovan Vasiljević, Marijana Milikić
Synergistic Approach in the Organization of Transport of Hazardous PTT Shipments Using Artificial Intelligence

26. Jovan Vasiljević, Rade Biočanin
Multi-Criteria Optimization of Environmental Safety Dangerous PTT Shipments, Using Artificial Intelligence
27. Maja Vuković, Vladan Mičić, Nebojša Vasiljević
Optimization and Comparative Analysis of Conventional and Modern Methods for the Extraction of Bioactive Compounds from Orange Peel
28. Vojkan Zorić, Nenad Kapor, Radovan Radovanović, Jovana Zorić
Application of Scanning Electron Microscopy with Energy-Dispersive X-ray Spectrometry (SEM/EDS) in the Forensic Analysis of Micro-traces from a Real Event
29. Mihajlo Zorić, Marijana Regojević, Marko Rodić, Ljiljana Vojinović-Ješić, Mirjana Radanović
New Cocrystal of Copper(I) Complexes with a P-Donor Schiff Base
30. Kaloyan Ivanov, Dragomir Vassilev
Applied Model for Compliance with ESG/CSRD in Manufacturing Enterprises
31. Anđela Ristić, Nebojša Vasiljević, Dario Balaban, Goran Tadić
Simulation, Optimization and Heat Integration of LPG Fractionation System
32. Nikola Cekić
Stone Facades in Modern Architecture
33. Jelena Marković, Goran Marković, Ivan Stevović
Economic and Environmental Aspects of Waste Management – "Meteris" Landfill Case Study
34. Ivan Stevović, Mihailo Jovanović, Jovana Jovanović
Artificial Intelligence and Sensor Theory in Environmental Monitoring
35. Zoran Ćurguz, Dragoljub Mirjanić, Milan Popović
The Effect of Air Exchange Rate on Indoor Radon Concentration

36. Perko Vukotić, Ranko Zekić
Radon in public kindergartens in Montenegro
37. Ivan Lasić, Jelena Đorđević, Dražan Primorac, Aco Janićijević
"In Vivo" Measurements of Radionuclide Activity in the Entire Human Body and Determining the Degree of Health Risk Due to Contamination
38. Ivan Lasić, Aco Janićijević, Vesna Radumilo, Dražan Primorac
Management of Population Health Risk Levels by Measuring the Ambient Radiation Dose Equivalent at the Location of a Nuclear Facility
39. Zoran Petrović, Bojana Pečenica, Aleksandra Radulović, Dragana Kešelj, Pero Dugić, Sabina Begić, Tatjana Botić
Characterization of 80–200 μm Silica Gel and Its Influence on Soybean Oil Bleaching
40. Đorđe Milošević, Marija Branković, Sreten Perić, Radovan Radovanović, Mihael Bučko, Fatima Živić
Comparative Evaluation of Hydrogel Density Measurement Methods
41. Neđo Đurić, Dijana Đurić, Zlatko Maksimović
Overview of the State of Geothermal Energy in the World
42. Stevo K. Jaćimovski, Dane Subošić, Dušan I. Ilić, Jovan P. Šetrajčić
Analytical Dispersion Model of Multilayered Structures (ADMM) in Air Pollution Distribution Analysis
43. Darko Divnić, Dragoljub Mirjanić, Esad Jakupović
ANURS Laboratory for Solar Energy - A Comprehensive Scientific and Technical Analysis, Infrastructural Capacities, and Application in the Light of Contemporary Research
44. Ivana Radonjić, Nemanja Pudar, Milutin Petronijević, Tatijana Dlabach, Ilija Knežević, Lana Pantić, Dragoljub Mirjanić
Seawater Influence on PV Panels Performances

45. Predrag Dašić, Snežana Topalović, Marija Simić, Dragica Milanović
Uses of Circular Economy Business Models within Manufacturing Companies
46. Marina Karić, Predrag Dašić, Goran Mihajlović, Jelena Erić Obućina
Models of Kinets of Convection-Condensation Drying of Biomaterials
47. Vladimir Lukić, Đorđe Mirjanić, Predrag Dašić
Intelligent and Smart Materials: Structures and Structural Systems
48. Radovan Nikolić, Zvonko Petrović, Dragica Novaković, Predrag Dašić
Modeling of Plastomer Products as a Basis for Injection Mold Design
49. Predrag Dašić, Raul Turmanidze, Aleksandar Ašonja
Development Trends in Micro and Nano Turning for Processing Modern Composite Materials
50. Predrag Dašić, Slađana Beljić Miletić, Suzana Jakovljević
Application of AI-Based Geographic Information System for Water Quality Assessment
51. Sandi Božičković, Ratko Garić
Application of Artificial Intelligence in Predicting the Electrical Properties of Solid Materials
52. Bruno Bojić
The Role of Artificial Intelligence for Managers of Mining and Metallurgical Companies
53. Stevo Najman, Milena Radenković Stošić, Sanja Stojanović
In Vivo Evaluation of Biomaterials for Regenerative Medicine: Application of Various Animal Models
54. Vladan Mirjanić, Milesa Srećković, Đorđe Mirjanić, Svetlana Pelemiš, Aleksandar Bugarinović, Milica Vlahović
Application of Laser in Dentistry in Different Time-Space Parameters

55. Milesa Srećković, Aco Janićijević, Aleksandra Janićijević,
Radovan Gospavić, Jelena Ilić, Sofija Petković
*Interaction of Coherent Radiation with Matter
in an Interval of Six Decades*
56. Aleksandra Radulović, Igor Đukić, Vladan Mirjanić, Mirsad Kadić
*Electromyographic Evaluation of the Effects of an
Occlusal Splint in Individuals with Bruxism*
57. Stojko Vidović, Jelena Bećarević, Vanja Vidović
Association of the FABP2 Polymorphism with Acute Myocardial Infarction
58. Renata Josipović, Irena Kuzmanović Radman, Tijana Adamović,
Adriana Arbutina, Marija Obradović, Marijana Arapović Savić,
Mirjana Umićević Davidović, Ognjenka Janković,
Marijana Popović Bajić, Vladan Mirjanić
*In Vitro Evaluation of Water Sorption and Solubility
of Three Dental Materials*
59. Josipa Karij Trivunović, Vladan Mirjanić
*Mother's Oral Microbiome and Child's Oral Health Development:
The Role of Genetics, Epigenetics and Preventive Care*
60. Josipa Karij Trivunović, Vladan Mirjanić
*Personalized Dentistry - The Future of Treatment Based
on the Patient's Genetic Profile*
61. Josipa Karij Trivunović, Vladan Mirjanić
*Antibacterial Properties of Nanomaterials
in Jaw Orthopedics*
62. Darko Manjenčić, Marijana Vasić, Milica Ivanović, Mladen Nikolić,
Zorana Milosavljević, Vladan Mičić, Pero Dugić
*Catalytic Innovations in Base Oil Production:
Enhancing Reaction Selectivity Through Molecular Refining*

63. Darko Manjenčić, Marijana Vasić, Bojan Slavić, Predrag Pravdić, Milena Deljanin, Anja Manjenčić, Milorad Tomić
Advanced Materials in Engineering for Protection Against Electromagnetic Radiation
64. Rade Biočanin
Modern CBRN Materials for Protection and Decontamination in Emergency Situations (In War and Peace)
65. Sonja Ketin, Boban Kostić, Rade Biočanin
Remote Sensing of Methane and Carbon Dioxide for Climate Change Monitoring
66. Irena Kuzmanović Radman, Radmila Arbutina, Tijana Adamović, Adriana Arbutina, Vladan Mirjanić, Renata Josipović, Mirjana Umićević Davidović, Marijana Arapović Savić, Saša Marin, Nataša Trtić
Assessment of Periapical Status of Endodontically Treated Teeth Using the Pai Index
67. Goran Kolarević, Dragoljub Mirjanić, Aleksandar Kostovski, Goran Marošević
Radiation Protection in the Design of Bunkers for CT Simulators
68. Tijana Adamović, Ognjenka Janković, Valentina Veselinović, Nataša Trtić, Verica Pavlić, Vladan Mirjanić, Renata Josipović, Irena Kuzmanović Radman, Adriana Arbutina, Borut Kosec, Rebeka Rudolf
Dose-Dependent Effect of Gold Nanoparticles on Thermal Conductivity, Diffusivity, and Effusivity of PMMA Denture Base Resin
69. Dražan Jaroš, Bojan Pavičar
Does the Collimator Rotation Have an Influence on the Dose Distribution in the VMAT Planning for Head and Neck Cancer?
70. Predrag Kuzmanović, Dušan Mrđa
Corrosion of Depleted Uranium Penetrators as a Source of Uranium(VI) in the Environment of the Balkans

71. Ivana Janković, Nada Čitaković, Biljana Vučetić Tadić, Marin Tadić
Magnetic Properties of Cube-Like and Rounded Hematite Nanoparticles Synthesized by Hydrothermal Synthesis Method
72. Jovana Savić, Milica Rančić, Mlađan Popović, Ivana Gavrilović-Grmuša
Modification of Starch-Based Wood Adhesive with Citric Acid to Improve Moisture Resistance
73. Pavel Kovač, Mirfad Tarić, Borislav Savković, Lubomir Soos, Dušan Ješić
The Quality of the Worked Surface of the Hardened Material Obtained by Turning Processing with Different Tool Materials
74. Dušan Ješić, Pavel Kovač, Borislav Savković, Branislav Dudić, Branko Štrbac, Katarina Stojanović
Determination of Friction in Biomechanical Joints Using Artificial Intelligence
75. Dušan Ješić, Pavel Kovač, Lubomir Soos, Borislav Savković, Ildiko Mankova
Tribologyproperties of Austempered Ductile Iron as Function of Their Structure
76. Branislav Dudić, Dušan Ješić, Borislav Savković, Pavel Kovač, Branko Štrbac
Global Development and Technological Progress of Lithium Batteries
77. Branislav Dudić, Dušan Ješić, Borislav Savković, Pavel Kovač, Branko Štrbac
Contribution of Heat Pumps to Energy Efficiency and Sustainable Development
78. Radmila Lišanin, Marija Stojmenović, Jelena Gulicovski, Milan Kragović
pH-Dependent Phenol Removal from Aqueous Solutions using a Sustainable Carbon Adsorbent Derived from Food Waste

79. Radmila Lišanin, Marija Stojmenović,
Jelena Gulicovski, Jovana Bukumira, Milan Kragović
*Characterization of Carbon Adsorbent Obtained by Carbonization
of Organic Household Waste for Use in Water Treatment*



ABSTRACTS

PLENARY PRESENTATIONS

TESTING AND MODELING OF THE TOXICITY FOR MICROFLUIDIC DEVICES

Nenad Filipović

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BIOIRC Research and Development Center Kragujevac, Kragujevac, Serbia*

Abstract: The safety assessment of new chemicals and nanomaterials is a major burden for the health and regulatory sectors, with strong pressure to reduce reliance on animal testing through New Approach Methodologies aligned with the Safe-and-Sustainable-by-Design framework. Within the EU-funded TOXBOX project, we combine modular in vitro organ-on-a-chip (microfluidic) systems with in silico predictive models to characterise the short- and long-term toxicity of chemicals across multiple length and time scales. This work presents the testing-and-modelling workflow developed for the TOXBOX microfluidic device, coupling experimental read-outs (microscopy, electrochemical sensors, ELISA, biomarkers) with two complementary modelling families. Physics-based models – including a finite-difference skin model – simulate the diffusion, concentration and distribution of chemicals within the tissue and predict the depth and temporal evolution of toxic effects (0–48 h), while QSAR models relate molecular structure to activity. Machine-learning models provide data-driven prediction directly from experimental data: a deep-learning classifier (DenseNet with soft attention) for skin microscopy images, a cell-viability model, and a classifier of morphological differences in zebrafish embryos. On held-out data the image classifier achieved high discrimination (ROC/PR analysis), retaining useful accuracy even with limited labels. All models are being verified and validated against experimental and public data and integrated into the TOXBOX platform, enabling faster, cheaper and more ethical toxicity screening and supporting subsequent life-cycle assessment.

Keywords: toxicity; microfluidic devices; organ-on-a-chip; predictive modeling; machine learning; TOXBOX.

TRANSFORMATIVE PATH OF AI: FROM AI AGENTS TO AGENTIC AI

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Abstract: Agentic AI represents a transformative shift from isolated AI agents to societies of interacting agents that pursue complex goals with limited supervision. This talk unifies multidisciplinary theories of agency with modern AI systems to clarify what is novel about Agentic AI. We trace the evolution of AI agents, spanning traditional, large language model (LLM)-based, human digital twin (HDT)-based, embodied, and artificial general intelligence (AGI)-oriented agents. An Agentic AI system is defined as a collective that integrates perception, reasoning, planning, memory, action, and learning, exceeds the capabilities of its components, and collaborates with other systems. We outline the near-term evolution toward richer cyberspace ecosystems, including emerging agentic HDT-based and agentic AGI-oriented systems, while highlighting open problems and challenges in AI ethics.

We begin by discussing the immediate cognitive consequences of deploying Generative AI and Agentic AI. In particular, although a large language model is a powerful statistical system that predicts tokens rather than an entity that truly thinks and reasons like a human, its generated output constitutes a form of passive action. While this action is expressed only through text or speech, it directly influences the human mind, whether by assisting with routine writing or fundamentally altering how we approach complex problem-solving. This passive influence manifests differently depending on the domain of application, creating distinct risks in technical disciplines compared to the humanities.

In mathematics, physics, and engineering, the validation of generated text is relatively straightforward because the underlying rules are deterministic and rely on strict structural logic. For instance, if an AI system generates code, that code can be compiled and executed; if it calculates a fixed point of differential equations, the resulting value can be plugged back into the vector field to verify its accuracy. The danger in these domains lies not in ideological bias, but in technical hallucination. Because the autoregressive loop of the model merely predicts the statistically most probable next token, it can occasionally merge symbols that appear flawless but contain fatal, subtle mathematical errors. Consequently, users must adopt a conservative approach, acting as indispensable human supervisors to detect these technical flaws.

Conversely, in humanities and social sciences, the risks shift from individual technical errors to systemic cultural biases embedded within the architecture of the

AI itself. The embedding space, the multidimensional mathematical framework used by artificial intelligence, is constructed by tokenizing massive corpora dominated by digitized data from the Anglophone world. As a result, the geometric "gravity" of the model's vector space is heavily skewed toward Western historical, philosophical, and political frameworks. When a model is prompted to analyze a complex social phenomenon, its self-attention mechanism naturally pulls vectors toward the densest clusters in the training data, which predominantly reflect Eurocentric, industrialized, and individualistic perspectives. Without deep expertise in cultural anthropology, sociology, or global history, a user might mistake a fluent, confident response for an objective truth. In these fields, the risk extends beyond mere factual inaccuracy to the systematic homogenization of cultural nuances and the outright suppression of non-Western epistemologies.

This pervasive influence on both technical validation and cultural perception ultimately alters human cognitive habits, leading to deeper psychological dependencies. Generative AI's rapid growth disrupts the balance between human cognition and technology, prompting concerns that constant cognitive offloading may permanently degrade unassisted reasoning. To investigate this phenomenon, we adapt the Bivariate Latent Change Score model from cognitive-aging research into a continuous-time framework to track fluid and crystallized intelligence. We extend this system by incorporating a fast variable for machine intelligence, which couples with human cognitive traits via Hill-function modifiers. This phenomenological framework accounts for both the positive and negative impacts of AI, mathematically defining the boundaries between AI-induced cognitive decline and cognitive augmentation.

Using Tikhonov's theorem, a singular-perturbation reduction collapses the model onto a two-dimensional slow manifold, where we identify two key equilibrium bifurcations. First, a saddle-node bifurcation occurs when AI interaction weakens the cross-coupling between fluid and crystallized intelligence, destroying the stable positive equilibrium of human capability. Second, a supercritical Hopf bifurcation emerges from altered reverse coupling and reduced fluid self-feedback, driving the system into sustained periodic oscillations between the two human cognitive variables. We conclude by outlining the socio-technical conditions that trigger each dynamical regime and discussing future research directions for safeguarding human cognition.

This work was conducted in collaboration with the East China University of Science and Technology (Shanghai), Fudan University (Shanghai), Tsinghua University (Beijing), and the University of the Chinese Academy of Sciences (Beijing).

Keywords: Agentic AI; large language models; human–AI interaction; cognitive offloading; cognitive augmentation; AI hallucinations; cultural bias; cognitive dynamics; bifurcation analysis; AI ethics.

OPTIMIZING PRODUCTION EFFICIENCY THROUGH LEAN SIX SIGMA: A DATA-DRIVEN APPROACH TO VARIATION AND WASTE REDUCTION WITH THE SUPPORT OF ARTIFICIAL INTELLIGENCE

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Abstract: While numerous enterprises struggle to identify practical implementations for Artificial Intelligence, executive optimism remains significant, with approximately 50% of management anticipating major advancements within a three-year horizon. When strategically embedded within corporate frameworks, AI possesses the capacity to bolster operational output and refine quality across various functions. Synergizing AI with the rigorous, empirical framework of Six Sigma accelerates the deployment of quality enhancement protocols aimed at eradicating flaws and mitigating process fluctuations. The current research utilizes empirical data from a manufacturing firm to evaluate the relationship between output volume and specific variables contributing to production instability. Within moments, AI delivered a comprehensive assessment, providing not only the correlation results mandated by Six Sigma standards but also identifying potential underlying factors for the observed discrepancies. We would like to encourage professionals to involve Artificial Intelligence in their complex data analyses, and in the same time encourage companies to make the usage of Artificial Intelligence accessible. These AI-driven computations are considered entirely dependable and have undergone thorough validation.manually. For entirely practical reasons we used Gemini, as we have the google user licence which protects our data from being used by Gemini for further development.

Keywords: Six Sigma, automation, quality improvement, variation, data analytics.

ENHANCEMENT OF ECO- AND ENERGY-SAVING TECHNOLOGIES AT THE TECHNICAL UNIVERSITY OF GABROVO

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Abstract: With a strong industrial base in its mixed economy, Bulgaria's productivity on average is still two to three times lower than the EU. Research and development in mechatronics and smart technologies, especially promoting automation, digitalization, and innovative manufacturing processes can enhance Bulgaria's industrial competitiveness and more efficient production of high-quality products. In order to be aligned with EU's policy frameworks of energy efficiency and sustainability, research in energy-saving technologies is of high importance, leading to reduced energy costs for businesses and households, improved competitiveness, and lower carbon emissions. Center of Competence “Smart Mechatronic, Eco- and Energy-Saving Systems and Technologies” (CoC SMEEST) project with the Technical University of Gabrovo (TU-Gabrovo) acting as the leading institution and principal coordinator represents the logical result for building on the research infrastructure, expertise and results. In the Center of Competence development period, TU-Gabrovo guided the transition of SMEEST towards a sustainable, internationally connected and industry-oriented research and innovation organisation. The Center of Competence promotes collaboration among research teams, industry partners, and the broader community while ensuring the center's success in the field of smart mechatronics, eco- and energy-saving systems, and technologies. In addition to national partnerships, the CoC has established many international partnerships, including with the University of Niš in Serbia and technical universities in the Czech Republic and Turkey. CoC SMEEST forms the foundation of the research infrastructure at the Tech Park of the Technical University of Gabrovo, which is a partner of the Science and Technology Park Niš. Together, they are co-founders of the Alliance of Science and Technology Parks and Innovative Ecosystems in South East Europe. In this paper the main objectives of the project are presented with the aim of accelerating eco- and energy saving technologies for improving industrial competitiveness and efficient high-quality production, while innovations developed by CoC contribute to the EU's transition to a greener economy and enhance the global response to climate change.

Keywords: eco-technologies; energy-saving technologies; Technical University of Gabrovo; Center of Competence; SMEEST.

FROM MULTIBODY MODELING TO AUTOMATIC MACHINE CODE GENERATION: EXPERIMENTAL IDENTIFICATION AND OPTIMIZATION OF SLOSHING DYNAMICS FOR PHARMACEUTICAL APPLICATIONS

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Abstract: Robotic handling of partially filled pharmaceutical containers can induce liquid sloshing, leading to air-bubble formation and ambiguous visual signals during inspection, with a consequent increase in false rejects. This work presents an integrated model-based methodology for incorporating liquid dynamics directly into robotic motion planning, from multibody simulation to automatic machine-code generation and experimental validation.

The liquid motion is represented through an equivalent pendulum model whose parameters are calibrated using CFD data and experimental observations. The resulting model is integrated into a multibody representation of the robot–container system to predict the sloshing response generated by different motion laws. Trapezoidal and minimum-jerk trajectories are compared, with the latter designed to reduce impulsive excitation while maintaining suitable process performance. The generated joint trajectories are subsequently translated into executable robot programs through an offline programming workflow, enabling direct implementation on a FANUC industrial robot.

Experimental validation is performed using a dedicated test bench combining robot motion acquisition and a vision-based system for indirect measurement of the liquid free-surface angle. Direct logging of the tool-center-point velocity on the robot controller is used to quantify discrepancies between commanded and actual motion and to refine the simulation inputs. Time-domain and frequency-domain analyses show that the equivalent-pendulum model captures the dominant sloshing dynamics, with a mean frequency error of 4.2%, while also highlighting condition-dependent damping effects and amplitude discrepancies under more severe operating conditions.

The results demonstrate that sloshing can be treated as an explicit design constraint in robotic trajectory generation. The proposed framework establishes a direct link between liquid-dynamics modeling, optimized motion laws, automatic robot-code generation, and experimental validation, providing a basis for more general and industrially applicable robot–container–liquid simulation workflows.

Keywords: Liquid sloshing; multibody modeling; robotic motion planning; equivalent pendulum; minimum jerk; machine-code generation; experimental validation; pharmaceutical applications.

PHOTOVOLTAIC POWER PLANT WITH A CAPACITY OF 62.1 KWP ON THE BUILDING OF THE CROATIAN ENERGY REGULATORY AGENCY

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Abstract: The results of the operation of the photovoltaic power plant installed on the building of the Croatian Energy Regulatory Agency (HERA) will be presented. This photovoltaic power plant with a peak power of 62.1 kWp confirms its commitment to sustainable development and the use of solar energy. With electricity production of 68,920 kWh, 73% of the building's total consumption of 94,194 kWh is covered. This project represents an important contribution to reducing greenhouse gas emissions and promoting the green transition in the public sector. The new Energy Efficiency Act, which has come into force, sets stricter rules for public bodies and entrepreneurs to save energy consumption by 2030 and reduce greenhouse gas emissions by 2050.

Keywords: photovoltaic power plant, solar energy, energy efficiency, renewable energy, greenhouse gas emissions, green transition.

CHARACTERISTICS OF AC CURRENTS PRODUCED BY THE HUMAN BODY

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Abstract: Measurements of electrical signals on the human body find significant application in modern medical diagnostics. The distribution of electric potentials in the human body is a sufficient reason for the existence of current flows, different types of external stimuli can change these flows and generate new ones. The variety of biochemical and associated mechanical processes occurring in the body suggests a complex time-space pattern exhibited by the associated electrical currents. The aim of this presentation is to present the characteristics of AC currents that can be detected by electrodes placed on different parts of the body. AC current flows are characterized using the Fourier transform with and without external electrical excitation.

Keywords: medical diagnostics; bioengineering; alternating currents.

APPLICATION OF ARTIFICIAL INTELLIGENCE IN THE ANALYSIS, ASSESSMENT AND PREDICTION OF THE RELIABILITY OF TECHNICAL SYSTEMS

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Abstract: Reliability of technical systems is a numerical value that represents the probability, at a specified confidence level, that the technical system will successfully perform the function for which it is intended, without failure, within the specified performance limits, taking into account the system's prior operating time, over a specified mission duration. Reliability of technical systems is a very complex concept and represents one of the most important characteristics of systems in general or technical systems in particular and one of the key factors in their safety, availability, economic efficiency and overall efficiency throughout their life cycle. In order to determine the reliability parameters, a thorough understanding of the system is required. Reliability is strongly influenced by stochastic processes, so the selection of appropriate reliability indicators is based on the probability of the occurrence of an event, failure, etc.

Based on the experimental data obtained by monitoring failures of components of technical systems in the phase of real exploitation, it is possible to establish a theoretical reliability model of components and subsystems of technical systems using traditional methods based on statistical models and artificial intelligence (AI) methods and models.

Determining the reliability of the components of technical systems can be determined using conventional methods: on the basis of an a priori assumption that the experimental data follow a specific theoretical probability distribution & on the basis of the choice of the theoretical probability distribution that best approximates the experimental data (according to the characteristics of the theoretical distributions, on the basis of comparative analysis, etc.).

The paper will present the structure and application possibilities of two software systems RATSC-CTD and RATSC-CA, developed by the author of this paper. The choice of the theoretical reliability model for the RATSC-CTD software system is mainly based on the recommendations presented in the BS standards (BS-5760-1:1996 and BS-5760-2:1994). The choice of the theoretical model of reliability in the software system RATSC-CA is based on the comparative analysis of different models of theoretical probability distributions and the choice of the distribution model that best approximates the experimental data. The RATSC-CA software

system incorporates elements of artificial intelligence (AI) in it when choosing the best-fitting and most appropriate distribution model on the basis of which the reliability of the technical system can be predicted.

The paper also discusses the application of artificial intelligence (AI) methods and models in the analysis, assessment and prediction of the reliability of complex technical systems. Special attention is paid to: artificial neural networks (ANN), machine learning (ML) and deep learning (DL) methods, fuzzy-logic systems (FL), hybrid intelligent models, etc. Their application enables the timely detection of failures as well as the possibility of identifying their causes, assessing the remaining useful life of components and predicting the probability of failure. The integration of artificial intelligence with data collected from sensors, the Industrial Internet of Things (IIoT) and real-time monitoring systems creates the basis for the development of predictive maintenance (PdM) and intelligent reliability management. It is concluded that artificial intelligence (AI) methods and models represent a significant direction in the development of modern reliability engineering and an important basis for decision-making based on big data (BD).

Keywords: Reliability, reliability analysis (RA), failure prediction, technical system, artificial intelligence (AI).

LOW FREQUENCY DIELECTRIC PROPERTIES OF EPOXY-BASED COMPOSITES REINFORCED WITH GRAPHITE FLAKES AND EXFOLIATED EXPANDED GRAPHITE

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Abstract: Epoxy resins are the most widely used conventional thermosetting plastics with applications in many industries, including automotive, chemical, aerospace, military, electronics and computers. Most cured epoxy resins are amorphous, non-conducting thermosets that exhibit good mechanical strength, toughness, and resistance to corrosion and strong chemicals. Numerous epoxy-based composites have been created by doping an epoxy matrix with various fillers, such as ceramics, metal compounds, and carbon-based nanostructures. Carbon fillers, such as graphite, graphene, carbon nanotubes, carbon black, can be used to reinforce electrically insulating epoxy matrices in order to enhance mechanical strength, thermal conductivity and flame resistance, without compromising the insulating properties of polymer composites. Electrically insulating materials with high thermal conductivity performance are required for portable electronics and can also be used as thermal adhesives, flame retardants, and high-voltage insulators.

A comparative analysis of the dielectric properties of composites based on a bisphenol A–epichlorohydrin (DGEBA) epoxy matrix loaded with two types of graphite with different degrees of exfoliation is presented here. Graphite flakes (GF) obtained by prolonged milling of bulk graphite, and exfoliated expanded graphite (EEG) sheets were used as fillers to obtain two series of composites. The loading amounts of the fillers ranged from 1 wt.% to 15 wt.% for GF flakes and 7 wt.% for EEG sheets. Dielectric measurements were carried out over a wide temperature range (170–350 K) and a low frequency range (30 Hz–120 kHz). We analyzed the morphology and microstructure of the composites using scanning electron microscopy (SEM), X-ray diffraction (XRD) and Fourier transform infrared (FTIR) spectroscopy.

Dielectric measurements revealed that all composites filled with graphite flakes (GF) are electrically insulating. Their dielectric losses are low ($\tan\delta < 0.20$). Composites loaded with exfoliated expanded graphite (EEG) sheets exhibit different dielectric performance. Non-Ohmic conduction through the barrier-tunneling

effect between EEG flakes separated by an epoxy layer was observed in the epoxy/EEG-3 and epoxy/EEG-5 composites. Significant increases in dielectric permittivity ($\epsilon_r=70$), tangent loss ($\tan\delta=573$ at 30 Hz) and AC conductivity (σ_{AC}) were observed in the epoxy/EEG-7 composite with 7 wt.% EEG loading. Its AC conductivity at low frequencies was five orders of magnitude higher than that of pure epoxy and remained independent of frequency, suggesting the presence of long-range conductive pathways and an Ohmic conduction mechanism over macroscopic distances.

Keywords: composites, graphite nanosheets, dielectric properties, percolation threshold.

THE NEW IONIC ADDITIVES FOR SAFER AND DURABLE ELECTROLYTES IN LITHIUM-ION BATTERIES

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Abstract: Lithium-ion batteries (LIBs) are becoming increasingly important for electrifying the modern transportation system and, thus, hold the promise to enable sustainable mobility in the future. However, their large-scale application is hindered by severe safety concerns when the cells are exposed to mechanical, thermal, or electrical abuse conditions. These safety issues are intrinsically related to their superior energy density, combined with the (present) utilization of highly volatile and flammable organic-solvent-based electrolytes. Improving the thermal stability of electrolytes and the safety of LIBs is one of the imperatives of our investigations.

The challenges, which so far prevent the widespread replacement of organic carbonate-based electrolytes, will also be mentioned. Starting from rather “facile” electrolyte modifications by (partially) replacing the organic solvent or lithium salt and/or the addition of functional electrolyte additives, conceptually new electrolyte systems, including ionic liquids (ILs) are considered. Ionic liquid/organic solvent mixtures are investigated as potential optimal electrolytes for LIBs that can combine low flammability, good thermal stability and high electrical conductivity. That approach provides a great chance of developing highly functionalized, new electrolyte systems, which may overcome the afore-mentioned safety concerns related to conventional electrolytes, also offering enhanced mechanical, superior thermal performance, electrochemical performance and safety tolerance to both overcharge and thermal abuse.

Acknowledgments: This research was supported by the Science Fund of the Republic of Serbia, GRANT No 11036, *The new ionic additives for safer and durable electrolytes in lithium-ion batteries* - SafeLi.

Keywords: Lithium-ion batteries, ionic liquids, thermal stability, electrochemical performance.

AI-SUPPORTED MANAGEMENT OF POLLUTING SUBSTANCES FROM TPP AND PRODUCTION OF GREEN CONSTRUCTION MATERIALS

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Abstract: Thermal power plants generate significant quantities of industrial by-products that represent both environmental burdens and valuable secondary resources. Fly ash, bottom ash, flue gas desulfurization gypsum, and other combustion residues frequently occupy large landfill areas, contaminate surrounding soil and groundwater, and contribute to greenhouse gas emissions. This paper presents an integrated framework for the intelligent management of thermal power plant pollutants through artificial intelligence techniques and their transformation into green construction materials. The proposed methodology combines automated waste characterization, machine learning prediction models, process optimization, and life-cycle-oriented decision support. Artificial intelligence continuously analyses physicochemical properties of industrial residues and identifies the most appropriate utilization pathways for cementitious composites, geopolymer binders, road construction materials, and carbon-mineralized products. The proposed system simultaneously minimizes environmental impacts, reduces disposal costs, decreases natural resource consumption, and increases the mechanical performance of final construction materials. The presented concept demonstrates that artificial intelligence can significantly improve production efficiency while supporting circular economy principles and industrial decarbonization strategies. The developed framework represents a comprehensive decision-support model that connects environmental protection, sustainable resource management, and intelligent manufacturing into a unified industrial ecosystem suitable for future low-carbon construction technologies.

Keywords: Polluting Substances, thermal power plants, artificial intelligence, circular economy, green construction materials.

BIOMATERIALS FOR REGENERATIVE MEDICINE AND WOUND HEALING: CURRENT PERSPECTIVES AND NOVEL STRATEGIES

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Abstract: Regenerative medicine relies heavily on the development of advanced biomaterials engineered to restore and improve damaged tissue functions. Overcoming the challenges of tissue regeneration requires a highly multidisciplinary approach that spans material design, advanced manufacturing, and rigorous biological evaluation. This plenary lecture presents an overview of recent achievements from our research projects, focusing on the design, characterization, and application of diverse biomaterials tailored for both hard and soft tissue repair. A significant part of the presentation will highlight results from our ongoing CHRONOWOUND project, which addresses the complex challenges of chronic wound healing. Within this framework, we showcase advanced pharmaceutical formulations—such as bioactive-loaded hydrogels and collagen-based matrices—engineered to exert antimicrobial, anti-inflammatory, and immunomodulatory effects while accelerating tissue regeneration. To further personalize wound management, this project integrates additive manufacturing (3D printing) with machine learning models to fabricate patient-specific dressings based on individual wound geometries. Finally, drawing from our extensive experience in biomaterial testing, the lecture will discuss the critical role of preclinical evaluation. We will share insights into various *in vitro* cellular systems and *in vivo* animal models used in our research to assess biocompatibility and biofunctionality prior to clinical translation, evaluating their respective advantages and limitations. Ultimately, this presentation illustrates how combining novel biomaterials design with advanced technology and robust testing models drives the future of regenerative therapies.

Acknowledgements: This research was supported by the Science Fund of the Republic of Serbia, program PRISMA, #7617, Multilevel approach to study chronic wounds based on clinical and biological assessment with development of novel personalized therapeutic approaches using *in vitro* and *in vivo* experimental models – CHRONOWOUND and by the Ministry of Science, Technological Development and Innovation (Contract No. 451-03-34/2026-03/200113).

Keywords: biomaterials, regenerative medicine, wound healing, *in vitro* cell models, *in vivo* animal models.

FROM PHOTOCATALYTIC POWDERS TO REUSABLE MATERIALS: SUSTAINABLE STRATEGIES FOR WATER PURIFICATION

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Abstract: This topic will focus on the application of different photocatalytic materials for the degradation of organic pollutants under environmentally relevant conditions. Particular attention will be devoted to the transition from semiconductor powders to immobilized and reusable systems. Photocatalysts, such as TiO_2 and ZnO , have demonstrated significant potential for the treatment of contaminated water. However, TiO_2 and ZnO are usually applied in powder form, which makes their separation and recovery after treatment challenging, potentially contributing to additional costs and secondary contamination. Immobilization on suitable supports represents a promising strategy for improving catalyst handling, stability, and reusability. This study involves synthesis and characterization of semiconductor-based photocatalytic materials, as well as their application in water purification. Different approaches to catalyst immobilization and reuse will be discussed. Furthermore, the advantages and limitations of suspended and supported systems will be illustrated through selected examples of dye degradation. Overall, the presented results indicate that the future development of photocatalytic water treatment should be directed toward stable, recoverable, and reusable materials capable of maintaining high pollutant degradation efficiency over multiple treatment cycles.

Keywords: TiO_2 , ZnO , immobilized photocatalysts, organic pollutants, water treatment, reusability.

POSTER PRESENTATIONS

STUDY OF THE INTERMOLECULAR INTERACTIONS OF PARA PHENYL SUBSTITUTED ASYMMETRICAL BISCARBOHYDRAZONES

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Abstract: Carbohydrazones are compounds obtained by condensation of carbohydrazide with various aldehydes or ketones. Depending on the amount of added carbonyl compound, mono- or bisubstituted derivatives (symmetrical or asymmetric) can be formed during synthesis. In this paper, bisubstituted asymmetric carbohydrazones obtained by condensation of the remaining free amino group of para-phenyl monocarbohydrazones with acetone were investigated. For the seven obtained compounds, intermolecular interactions were quantified using solvatochromic models. The influence of solvents on the spectral properties of bis-carbohydrazones was examined using Kamlet-Taft's and Catalan's models using the multiple linear correlation of solvatochromic energies. Following the aforementioned models, correlations with Hansen's solubility parameters were also performed to obtain additional information on the present interactions. The results obtained are part of the physicochemical characterization of the newly synthesized compounds, which is essential as a basis for further research into their applications and biological activity.

Keywords: carbohydrazones, Hansen's solubility parameters, intermolecular interactions, LSER, solvatochromic models.

EXPERIMENTAL AND COMPUTATIONAL EVALUATION OF LIPOPHILICITY AND ECOTOXICITY THIOCARBOHYDRAZONE DERIVATIVES

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Abstract: The development of biologically active compounds requires a comprehensive understanding of the relationships between molecular structure, physicochemical properties, biological activity, and environmental behavior. Among molecular descriptors, lipophilicity plays a crucial role in determining the bioavailability and distribution of chemical compounds within biological systems and the environment. Owing to their structural diversity and broad spectrum of biological activities, thiocarbohydrazone derivatives have attracted considerable attention, highlighting the importance of assessing their potential environmental impact. Understanding the relationship between molecular structure, lipophilicity, and ecotoxicity is essential for predicting the environmental behavior of newly synthesized compounds and evaluating their ecological risk. Experimental lipophilicity was determined by reversed-phase thin-layer chromatography (RPTLC), yielding the chromatographic parameters R_M^0 and m , while partition coefficients and ecotoxicity parameters were calculated using various computational tools. The relationships between the chromatographic parameters and the calculated $\log P$ values, as well as the ecotoxicity parameters, were analyzed using linear regression analysis, yielding satisfactory mathematical models. The obtained results indicate that the chromatographic parameters are reliable predictors of the lipophilicity and ecotoxicity of the investigated thiocarbohydrazone derivatives.

Keywords: thin-layer chromatography, lipophilicity, thiocarbohydrazone, ecotoxicity.

RP-TLC DESCRIPTORS AS PREDICTORS OF THE SELECTED BIOLOGICAL PROPERTIES OF THIOCARBOHYDRAZONES

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Abstract: Thiocarbohydrazone derivatives constitute an important class of organic compounds characterized by thiocarbonyl ($C=S$) and imine ($-C=N-$) functional groups, which govern their electronic properties, chemical reactivity, and interactions with biological targets. Their structural diversity enables systematic investigation of the influence of substituents on physicochemical properties, particularly lipophilicity. Since lipophilicity strongly influences the absorption, distribution, metabolism, and elimination of compounds, its reliable assessment is essential for understanding their pharmacokinetic behavior. Although lipophilicity is commonly estimated using *in silico* approaches, chromatographic descriptors are important experimental indicators of this property. This study investigated the effects of substituent type and the organic modifier in the mobile phase on the chromatographic behavior of a series of bis-substituted thiocarbohydrazones, and evaluated the relationships between RP-TLC descriptors and *in silico* lipophilicity and pharmacokinetic parameters. The chromatographic descriptors R_M^0 and m were determined by reversed-phase thin-layer chromatography (RP-TLC) in two chromatographic systems. The chromatographic behavior of the investigated compounds was influenced more strongly by substituent type than by the organic modifier. Linear regression analysis revealed strong correlations between the RP-TLC descriptors and the *in silico* lipophilicity parameters, as well as statistically significant correlations with selected pharmacokinetic parameters.

Keywords: thin layer chromatography, thiocarbohydrazones, lipophilicity, pharmacokinetic properties.

BREWER'S SPENT GRAIN AS A SUSTAINABLE BIO-BASED ADSORBENT FOR THE REMOVAL OF SELECTED PESTICIDES FROM AQUEOUS MEDIA

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Abstract: Pesticides are significant pollutants of aquatic ecosystems, prompting extensive research into the development of sustainable materials for their removal. Brewer's spent grain, the main by-product of the brewing industry, represents a lignocellulosic biomass with considerable adsorption potential arising from its porous structure and the presence of various functional groups. This paper discusses the potential of brewer's spent grain as a bioadsorbent for the removal of selected pesticides from aqueous solutions, with emphasis on its structural characteristics, adsorption capacity, and factors influencing process efficiency. The importance of brewer's spent grain in the context of green chemistry, circular economy, and waste valorization is also considered. Previous studies indicate that brewer's spent grain is an environmentally friendly, renewable, and cost-effective adsorbent with significant potential for water purification.

Keywords: brewers' spent grain, bio-based adsorbent, pesticides, water purification, circular economy.

VALORIZATION OF BREWER'S SPENT GRAIN AS A NUTRIENT-RICH BY-PRODUCT: INFLUENCE OF DRYING CONDITIONS ON ITS CHEMICAL COMPOSITION

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Abstract: Brewer's spent grain (BSG) is the main solid by-product of the brewing industry and is primarily used as animal feed, despite its potential as a source of nutritionally valuable compounds. This study investigated the influence of different drying conditions on the chemical composition of BSG and evaluated its potential for food applications and further valorization. BSG samples were analyzed to determine moisture content, macro- and microelement composition, lipid, protein, total nitrogen, and sugar contents. The analytical results were compared to assess the effect of drying conditions on the chemical composition of BSG and the preservation of its nutritionally valuable constituents. The findings provide a basis for the further valorization of brewer's spent grain as a valuable secondary raw material for food applications.

Keywords: brewer's spent grain, moisture content, mineral composition, lipids, proteins, total nitrogen, sugars.

THERMAL BEHAVIOR OF POLY(LACTIC ACID) BIOCOMPOSITES REINFORCED WITH BREWER'S SPENT GRAIN

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Abstract: Poly(lactic acid) (PLA) biocomposites reinforced with brewer's spent grain (BSG) represent a sustainable alternative to conventional plastic materials. This study investigates the influence of BSG particle size and filler content on the thermal properties of PLA/BSG biocomposites. Thermal characterization was performed using differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA). The results showed that the incorporation of BSG promoted PLA crystallization, with the composite containing 10 wt.% BSG exhibiting the highest degree of crystallinity. A slight decrease in thermal stability was observed with increasing filler content, while the thermal degradation mechanism of PLA remained unchanged. The obtained results indicate that the thermal properties of PLA/BSG biocomposites can be tailored by appropriate selection of BSG particle size and filler content, confirming their potential as sustainable engineering materials.

Keywords: poly(lactic acid); brewer's spent grain; biocomposites; thermal properties; differential scanning calorimetry; thermogravimetric analysis.

EVALUATION OF WASTE GLASS AS A PARTIAL GROWING MEDIUM REPLACEMENT FOR HORTICULTURAL PLANTS: A PILOT STUDY

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Abstract: Intensive agricultural and horticultural practices have accelerated the depletion of plant-available silicon in soils, increasing the demand for sustainable substrate alternatives and resource recovery strategies. This pilot study investigated the feasibility of utilizing mechanically processed consumer waste glass (soda-lime glass) as a partial replacement for conventional growing media. The waste glass was crushed and milled into fine particles with partially rounded edges to prevent root damage and was evaluated using a 630 µm sieve. Preliminary trials were conducted using bean (*Phaseolus vulgaris*) seedlings across three hydroponic treatments (0, 3, and 5% ground glass) and a parallel soil experiment (0% and 5% ground glass). These results indicate that the inclusion of waste glass does not inhibit root development. Hydroponic cultivation with 5% glass stimulated more pronounced lateral root formation and darker leaf coloration. Under soil conditions, the 5% glass substrate noticeably enhanced growth, increasing the average root length from 13.3 cm (control) to 20.3 cm. These preliminary findings suggest that waste glass can serve as a functional structural substrate component, potentially improving aeration, drainage, and possibly indicating gradual silicon delivery, although further larger-scale replication is needed to confirm its statistical significance and long-term biochemical effects.

Keywords: Waste glass, Circular economy, Growth medium, Silicon fertilization, Substrate aeration, *Phaseolus vulgaris*.

INVESTIGATION OF PHYSICAL PROPERTIES OF ANTISTATIC PROTECTIVE FABRIC

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Abstract: For the use of antistatic protective fabrics, it is important that they retain their properties even after prolonged use. In this paper, the influence of mechanical wear (abrasion) on the optical and dielectric properties of fabrics, cotton/polyester blend with carbon fiber, after 1000, 5000 and 10000 abrasion movements was analyzed. Analysis of the UV-Vis spectrum in the interval from 200 to 800 nm showed that the white fabric sample with a higher fabric weight and thickness shows higher reflection in almost the entire tested range compared to the blue fabric sample with a lower fabric weight and thickness. The abrasion process caused a slight decrease in the reflection in the white fabric sample, while the blue sample showed a slight increase in the reflection in the visible part of the spectrum. Measurements of the effective dielectric permittivity and dielectric loss tangent were performed in the frequency range from 30 Hz to 120 kHz. With an increase in the frequency, the values of the dielectric properties decreased for all samples, while the changes caused by abrasion were relatively small. By determining the static coefficient of sliding friction, the highest values were obtained for fabric-fabric tribocouples, then for fabric-aluminium, and the lowest for fabric-steel tribocouples. The white fabric sample exhibited higher coefficients of friction than the blue fabric.

Keywords: abrasion, reflection, dielectric properties, coefficient of friction.

INFLUENCE OF BaTiO₃ PARTICLE SIZE ON THE DIELECTRIC PROPERTIES OF PLA COMPOSITES

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Abstract: Polylactic acid (PLA) has emerged as a promising bio-based polymer matrix for composite materials. To enhance the dielectric properties of polymers, barium titanate (BaTiO₃) is commonly used as a high-permittivity ceramic filler. Its dielectric performance is strongly influenced by particle size, particularly when the filler dimensions are reduced to the nanoscale. In this study, micro- and nanosized BaTiO₃ particles were incorporated into a PLA matrix under identical processing conditions. Dielectric measurements were performed in the frequency range from 30 Hz to 60 kHz. The incorporation of nano-BaTiO₃ particles in polymer matrix resulted in a greater increase in dielectric permittivity compared with micro-composites. The 20 wt.% nano-BaTiO₃ composite exhibited comparable permittivity to the 30 wt.% micro-BaTiO₃ composite, indicating that similar enhancement can be achieved with lower filler content. The addition of BaTiO₃ had no significant effect on electrical conductivity or dielectric losses, while the increased dielectric permittivity remained stable over the investigated frequency range. This suggests that the dielectric performance of PLA can be effectively enhanced without compromising its insulating properties.

Keywords: PLA, BaTiO₃, polymer composites, dielectric properties.

ANTIBACTERIAL PROTECTION AND
THERMOPHYSIOLOGICAL COMFORT OF GLOVES FOR COLD
FUNCTIONALIZED WITH PHASE CHANGE MATERIALS AND
AGRIMONIA ARBUTIFOLIA L. EXTRACT

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Abstract: Outdoor activities or work at low temperatures (freezers, construction sites, food processing plants, mining) expose the human body to the risk of frostbite. Hand function is particularly impaired when skin temperature decreases, as handiness and the ability to handle materials are reduced. Maintaining stable hand temperature can facilitate working conditions and improve thermophysiological comfort. This study investigated the effect of treating textile materials with *Aronia arbutifolia* L. extract and phase change materials (PCM) on the antibacterial properties and thermophysiological comfort of gloves designed for cold climates. Sodium sulfate decahydrate was used as PCM. Prototypes of glove liners were developed using futer knitted fabric, with a smooth outer surface and an inner layer formed of knitted loops providing a softer and warmer texture. PCM and *A. arbutifolia* L. extract in the form of an alginate paste were applied to the knitted fabric by screen printing. The antibacterial activity of the printed fabric was confirmed by the agar diffusion method against *Staphylococcus aureus* and *Escherichia coli*. Thermophysiological properties of glove liners were defined by testing air permeability and thermal characteristics (thermal resistance and thermal conductivity coefficient), as well as by evaluating physiological parameters of subjects during wear trials. Measurements of skin temperature and relative humidity using MSR devices demonstrated that the incorporation of PCMs into glove design contributes to improved thermal regulation under cold conditions.

Keywords: phase change materials, *Aronia arbutifolia* L., thermophysiological comfort, antibacterial protection.

THERMOPHYSIOLOGICAL COMFORT OF CLOTHING FUNCTIONALIZED WITH *SALVIA ROSMARINUS* ESSENTIAL OIL AND PHASE CHANGE MATERIALS BASED ON POLYVINYL ALCOHOL

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Abstract This study investigates how the amount of polyvinyl alcohol (PVA), calcium chloride hexahydrate and di-sodium hydrogen phosphate heptahydrate, as phase change materials (PCMs), influenced the improvement of thermophysiological comfort in clothing. PCMs in the form of a paste with added *Salvia rosmarinus* essential oil (SREO) were applied to cotton knitted fabrics (Co) and T-shirts by screen-printing. Physiological parameters of the subjects (skin temperature and humidity), together with the amount of stored and released heat, confirmed that PVA in PCMs helped maintain body temperature within the comfort zone. MSR sensors showed that T-shirts printed with PCMs containing higher PVA concentrations stabilized skin temperature in the range of 33–34.5 °C and reduced skin humidity by 35%. In addition to thermoregulation, incorporation of SREO imparted antibacterial activity against *Staphylococcus aureus* and *Escherichia coli*. Such multifunctional textiles offer promising applications in sportswear and medical clothing, where both thermal comfort and antimicrobial properties are essential.

Keywords: polyvinyl alcohol; phase change materials; *Salvia rosmarinus* essential oil; thermophysiological comfort; antimicrobial textiles.

SYNTHESIS OF NOVEL POLYMERIC MATERIALS FOR ADVANCED WATER TREATMENT

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Abstract: Water pollution is one of the major global and regional environmental challenges facing modern society. The presence of heavy metals, suspended solids, organic pollutants, and colloidal impurities in industrial and municipal wastewater necessitates the development of efficient, selective, and economically sustainable technologies for their removal. Conventional water treatment methods are often insufficiently effective in removing specific and persistent pollutants, which has shifted the focus of the scientific community toward the development of advanced materials. In this context, polymeric materials, particularly polymers based on acrylic monomers, are of considerable importance due to their chemical tunability, high affinity for ionic and polar species, and the possibility of precise structural control.

The aim of this study is to provide a comprehensive overview of the theoretical foundations underlying the application of acrylic polymers in water treatment, as well as to present experimental investigations into the synthesis of pure acrylic polymers and copolymers of acrylic acid and maleic anhydride, with particular emphasis on microwave-assisted synthesis. The synthesized polymers and copolymers were thoroughly characterized using FTIR, DSC, XRD, and viscometric methods. The results confirmed successful (co)polymerization, controlled molar mass, and the formation of structures exhibiting pronounced intermolecular interactions. Based on the overall findings, it may be concluded that microwave-assisted synthesis of polyacrylate (co)polymers represents a sustainable, environmentally friendly, and economically viable approach to the development of functional materials for water treatment and the protection of industrial equipment.

Keywords: adsorption, polymeric materials, water treatment, synthesis.

SCHIFF BASES DERIVED FROM 2-AMINOPHENOL AND SUBSTITUTED BENZALDEHYDES: THERMAL STABILITY AND DEGRADATION MECHANISM

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Abstract: Schiff bases represent an important class of organic compounds characterized by the presence of an azomethine ($-C=N-$) functional group and are widely recognized for their structural diversity and broad spectrum of biological activities. Understanding their thermal stability and degradation mechanisms is essential for their further development and application. In this study, Schiff bases were synthesized through the condensation of 2-aminophenol with substituted benzaldehydes, and their thermal stability and degradation kinetics were investigated. Thermal behavior and kinetic parameters were evaluated using thermogravimetric (TG) analysis in combination with kinetic software to determine the activation energy (E_a), pre-exponential factor (A), and the most probable reaction mechanism. The obtained results provide valuable insights into the relationship between molecular structure and thermal stability, supporting the further development of these compounds as thermally stable bioactive molecules with potential biochemical applications.

Acknowledgments: The research was supported through the interacademic cooperation (SANU and ANURS) project “Kinetics of reaction on phase boundary gas/solid–thermal stability of metal oxides and pharmaceutical products in oxidation and reduction atmosphere”. S.M. is thankful for support through projects: No 451-03-34/2026-03/200146 and F-190.

Keywords: Schiff bases, thermal stability, kinetics, degradation mechanism.

WILD OREGANO AS A GREEN STEEL CORROSION INHIBITOR IN 3% NaCl SOLUTION

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Abstract: This paper examines the possibility of using wild oregano extract (*Origanum vulgare*) as an environmentally friendly corrosion inhibitor for two types of steel in 3% NaCl without and with the addition of an inhibitor. The inhibitor efficiency was analyzed by gravimetric methods and electrochemical tests (Tafel polarization and electrochemical impedance spectroscopy) at extract concentrations of 0.5; 1.0 and 1.5 g/L and exposure times of 2, 4, 6, 8, 24, 72 and 168 hours. The addition of the extract significantly reduces the corrosion rate, with an increase in the protection factor compared to the uninhibited solution. For Steel 1, the highest efficacy was achieved at 1.5 g/L of extract, while for Steel 2, favorable efficacy was achieved already at an extract concentration of 1.0 g/L. The obtained results indicate that wild oregano extract forms a protective adsorption layer on the surface of steel, which is why it can be used as a green corrosion inhibitor.

Keywords: wild oregano, green inhibitor, corrosion, steel, 3% NaCl.

MODIFICATION OF TIONITE BY ALKALINE ROASTING FOR IMPROVED TITANIUM LEACHING

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Abstract: Tionite residue, generated as a by-product in titanium dioxide production, represents a potentially valuable secondary source of titanium. However, its direct hydrometallurgical processing is limited due to the presence of titanium mainly in the form of TiO_2 with a rutile structure, which is highly stable and poorly soluble under conventional leaching conditions. Therefore, this study investigates the possibility of thermal treatment of tionite with sodium carbonate, with the addition of sodium chloride as a fluxing agent, in order to obtain a structure more suitable for subsequent leaching and titanium extraction.

The treatment was carried out at 900 °C. The presence of Na_2CO_3 is expected to promote alkaline activation of the stable rutile phase, while NaCl contributes to improved reaction conditions during roasting. In this way, tionite can be transformed into a more reactive form, which may represent an important step in the development of a sustainable process for the valorization of this industrial residue. The significance of this approach lies in the use of secondary raw materials for the production of titanium compounds, contributing to waste reduction and more efficient management of critical raw materials.

This research was conducted as part of the EUROTITAN project, focused on the development of new routes for obtaining titanium and titanium compounds from secondary sources.

Keywords: tionite, titanium dioxide, rutile, alkaline roasting, sodium carbonate.

RADIOECOLOGICAL BEHAVIOR OF CESIUM-137 IN THE ENVIRONMENT

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Abstract: Cesium-137 (^{137}Cs) is one of the most significant long-lived anthropogenic radionuclides in the environment. As a nuclear fission product with a physical half-life of approximately 30.2 years, it entered the biosphere primarily through atmospheric nuclear weapons testing, controlled releases from nuclear facilities, and nuclear accidents, among which Chernobyl and Fukushima stand out in terms of scale and consequences. The aim of this review is to synthesize current knowledge on the sources, atmospheric transport, deposition, migration, bioavailability, and transfer of ^{137}Cs in terrestrial and aquatic ecosystems.

The behavior of ^{137}Cs following deposition is determined by its physicochemical form, precipitation, soil and sediment properties, hydrological processes, and the time elapsed since contamination. In mineral soils, the Cs^+ ion binds strongly to clay minerals, particularly illite, thereby reducing its mobility and availability to plants. In soils with a low clay content and a high proportion of organic matter, it may remain bioavailable for a longer period. Its redistribution is facilitated by vertical migration, erosion, surface runoff, and particle transport.

Owing to its chemical similarity to potassium, ^{137}Cs is taken up by plants, microorganisms, and fungi, while its transfer to higher trophic levels occurs primarily through the consumption of contaminated food. Potassium deficiency enhances its uptake, whereas the application of potassium fertilizers generally reduces soil-to-plant transfer. In aquatic systems, ^{137}Cs binds to suspended particles and sediments, from which it may be remobilized when environmental conditions change.

Keywords: Cesium-137; radioecology; radionuclide migration.

FORENSIC MEMORY OF MATERIALS: HOW ENGINEERING MATERIALS RECORD, PRESERVE, AND REVEAL PAST MECHANICAL, THERMAL, AND CHEMICAL EVENTS

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Abstract: In forensic investigations, materials are traditionally treated as passive carriers of damage, rather than as active sources of information about past events. However, modern material science reveals that engineering materials inherently record mechanical, thermal, and chemical histories through permanent or transient changes in their structure and properties. This paper introduces and formalizes the concept of forensic memory of materials, defining materials as silent witnesses capable of preserving evidence of loading conditions, environmental exposure, and failure mechanisms over time. A comprehensive review is presented, classifying forensic material memory according to the dominant physical mechanism: mechanical (plastic deformation, residual strain fields, fracture morphology), thermal (phase transformations, heat-affected zones, transient thermal signatures), chemical (oxidation, degradation, corrosion products), and microstructural (grain evolution, defects, texture changes). The temporal stability of each memory type is discussed, distinguishing between short-term, medium-term, and long-term forensic indicators, with emphasis on their relevance for event reconstruction. Special attention is given to advanced full-field measurement techniques, such as digital image correlation and infrared thermography, which enable non-contact detection and visualization of latent material memory that is often invisible to conventional forensic methods. The paper highlights critical challenges, including the absence of standardized forensic protocols for interpreting material memory, the risk of misattributing similar damage to identical causes, and the growing need for interdisciplinary frameworks combining engineering mechanics, materials science, and forensic analysis. By bringing together knowledge from different fields, this work presents material forensic memory as a common framework for understanding the history of material damage and failure. The proposed approach provides a foundation for future experimental studies, standard development, and the integration of physics-based evidence into forensic decision-making. Ultimately, recognizing materials as active recorders of past events enhances the reliability, objectivity, and scientific validity of modern forensic investigations.

Keywords: forensic materials science; material memory; digital image correlation; infrared thermography; failure analysis; non-destructive evaluation.

A STUDY OF THE ENERGY SPECTRA AND PHONON STATES IN CRYSTALLINE NANOFILM STRUCTURES

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Abstract: Phonon spectra and states in spatially very confined structures in one dimension – crystalline ultrathin – nanofilm were studied as a continuation of research on quasi two-dimensional systems. A comparison was made with the corresponding quantities in unconfined (bulk) crystal structures. By solving the Hamilton equation of motion, a system of homogeneous differential equations was formulated for determining the amplitudes of small mechanical disturbances (phonons) that propagated through the observed system. From the conditions of non-triviality of the solution of this system of equations, the phonon dispersion law was obtained with the main characteristic – the appearance of energy gaps. In the model structure, acoustic phonon branches of the optical type arise as an exclusive consequence of the finite boundaries of the system. The gap sizes determine the different thermodynamic behavior of the film structures.

Keywords: ultrathin crystalline films, energy spectra, optical type of phonons.

OVERVIEW OF CONTEMPORARY RESEARCH IN MATERIALS PHYSICS

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Abstract: Contemporary research in materials physics (a scientific discipline within condensed matter physics) is focused on the development of new materials and technologies that will have a major impact on the energy efficiency, ecological sustainability and environmental preservation, but also the development of quantum computers. This very dynamic research combines quantum effects (usually related to the nano-world) that are expressed and observable at the macroscopic level. In addition to the pronounced speed in scientific research, contemporary research is also very extensive, so in this paper we have limited ourselves to the leading 5 topics that are most significant in material physics. Whether these topics will remain relevant or be replaced by new, currently unknown ones, time will tell.

Keywords: topological materials, superconductivity, thermoelectrics, 2D materials.

ANALYSIS OF THE SPECTRUM OF ELECTRONIC STATES IN A CRYSTALLINE NANOFILM WITH A COMPLEX LATTICE

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Abstract: The energy spectra and spatial distribution of electrons in crystalline nanofilms with two sublattices were determined here using the method of two-time and temperature-dependent Green's functions. Compared to the properties of bulk samples, the small thickness, the presence of boundaries and the energetic change of boundary parameters lead to changed or completely new physical properties and specific effects, which are crucial for fundamental knowledge of the mechanisms of these changes, for more precise application in nanotechnology. The paper examines the influence of boundaries and perturbation energy parameters on the relevant physical properties of these structures. It was found that the energy spectrum has two allowed and one forbidden band, and that localization of some of the electronic states can also occur in the observed nanofilm. By analyzing the spatial distribution of these states, we determined that the probability of finding electrons is particularly high at the film boundaries and decreases towards its inner layers. These states have a direct impact on modifying the transport characteristics of the material.

Keywords: electrons, crystalline nanofilm, complex lattice, Green's functions, energy spectra and gaps.

EVALUATING HYDROLOGICAL DROUGHT OF THE TREBIŠNJICA RIVER BASED ON THE STREAMFLOW DROUGHT INDEX (SDI)

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Abstract: One of the key issues facing modern society is water scarcity. Hydrological drought is a natural phenomenon characterized by a prolonged period of below-normal water availability, during which water resources may become insufficient to meet existing demands. The main goal of this study was to assess hydrological drought of the Trebišnjica River. To determine hydrological drought of the studied river, we applied the Streamflow Drought Index (SDI) and calculated annual, summer (April–September) and winter (October–March) SDI values. The index was computed using mean monthly streamflow data from the Grančarevo gauging station for the period 1961–2025. Subsequently, the Mann–Kendall trend test was applied to assess temporal changes in SDI values over the study period. Our analysis revealed two long-lasting distinct drought episodes that can be identified between 1988/89 and 2002/2003 and between 2014/2015 and 2024/2025. SDI values remained predominantly negative throughout these periods, with several pronounced deficits observed in 1988/89 (–1.71), 1989/90 (–1.85), 1992/93 (–2.15), 2001/2002 (–1.73) and 2016/2017 (–1.87). The Mann–Kendall test results show a decreasing trend of annual and seasonal SDI values, whereas significant decreasing tendencies were found for the annual and summer values. Overall, our findings suggest a shift in hydrological conditions in the Trebišnjica River towards increasingly dry conditions.

Keywords: drought, Streamflow Drought Index, Trebišnjica River, Bosnia and Herzegovina.

FOUNDATIONS OF QUANTUM PHYSICS AND APPLICATIONS IN QUANTUM TECHNOLOGIE

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Abstract: Since its inception, quantum mechanics has been accompanied by fundamental questions concerning the nature of measurement, the limitations on determining physical quantities expressed by Heisenberg's uncertainty principle, the status of locality, and the possibility of a deeper ontological structure of the theory. These questions, initially often treated as philosophical, gradually acquired precise mathematical formulations during the development of the theory and became subjects of experimental testing. Contemporary developments in quantum theory demonstrate a strong interdependence between fundamental research and technological applications. Conceptual problems of quantum mechanics have evolved into the foundation of experimental platforms that today enable quantum computing, communication, and sensing technologies. At the same time, quantum technologies provide feedback to fundamental questions, opening possibilities for testing quantum phenomena on increasingly large scales, including the preservation of superposition and the status of gravity within a quantum framework. This interaction between theoretical foundations and technological development points to a continuous and bidirectional process in which both the understanding of quantum phenomena and their practical implementation are shaped simultaneously.

Keywords: foundations of quantum physics, quantum measurement, measurement problem, quantum superposition, quantum computing, quantum communication, quantum technologies.

CONDITION OF COPPICE BEECH FORESTS IN THE REPUBLIC OF SRPSKA AND MANAGEMENT METHODS – CASE STUDY IN THE LOPARE AREA

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Abstract: The total area of forest stock (area of forests and forest land) in the Republic of Srpska is 1,338,489 ha or 54.4% of the total area of the Republic of Srpska. Coppice forests account for 421,125 hectares or 31.4%. The largest areas are occupied by beeches (126,252 ha) and oaks (124,069 hectares), while other mixed forests occupy 170,804 hectares. In the previous management, these forests were not given adequate attention and were most often left to spontaneous natural development. This was reflected in the quality of these forests, as well as the varying degrees of habitat degradation. Depending on the degree of degradation of stands and habitats, they are divided into three categories: high-quality coppice stands in a good and preserved habitat, poor-quality scion stands in a good and preserved habitat and poor-quality scion stands in a poor and deforested habitat. Depending on the categorization, the breeding measures of the conversion of forests into a high silvicultural form are defined on the example of outcrop beech forests in the area of Lopare.

In the research, permanent sample surfaces were set up and data were collected using common dendrometric methods. For the analysis and determination of the volume of stands, tables of taxation elements for beech in the territory of Bosnia and Herzegovina were used. In addition to descriptive statistics, the method of statistical testing was applied in order to determine the significance of differences for the basic elements of the structural structure of stands. The obtained results show that, depending on the degree of degradation, breeding measures of direct and indirect conversion to high cultivation form should be carried out in order to improve the quality and productivity of stands.

Keywords: Coppice forests, categorization, silvicultural measures, stand quality.

INTEGRATION OF BIOMATERIALS INTO SERVICE ROBOTIC SYSTEMS FOR MEDICAL APPLICATIONS: CONTEMPORARY TRENDS AND FUTURE DEVELOPMENT DIRECTIONS

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Abstract: The implementation of advanced Industry 4.0 technologies is increasingly evident across all sectors of modern society, with robotics—both industrial and service-oriented—playing a particularly significant role. The growing deployment of service robots in medical institutions introduces new design paradigms, in which materials that come into direct contact with patients and clinical environments are of critical importance. This paper analyzes the application of biomaterials in shaping the structural and functional characteristics of service robotic systems intended for use in healthcare facilities. The research focuses on the principles of biomaterial selection, their biocompatibility, resistance to sterilization processes, and their ability to adapt to the complex requirements of medical applications while ensuring mechanical reliability and operational safety. Particular attention is devoted to contemporary research directions involving smart and responsive polymers, bioinspired composite structures, and additive manufacturing technologies, which enable the development of customized and patient-centered robotic solutions. Furthermore, the paper emphasizes the importance of interdisciplinary collaboration among engineering, biomedicine, and materials science, highlighting biomaterials as a decisive factor in the continued development of safe, adaptive, and sustainable service robots in medical applications.

Keywords: biomaterials, service robotics in medicine, biocompatibility, smart materials, Industry 4.0.

SYNERGISTIC APPROACH IN THE ORGANIZATION OF TRANSPORT OF HAZARDOUS PTT SHIPMENTS USING ARTIFICIAL INTELLIGENCE

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Abstract: The modern postal and telecommunication distribution systems (PTT) within the global "universe of chaos" face continuous security threats and asymmetric risks during the transit of hazardous materials. The managerial approach to solving the problem of package shipment is the basic characteristics and the essence of modern management in courier services, without which it is impossible to imagine a more efficient operation, work and development. Transportation of hazardous materials has to be organized according to certain regulations, which are defined for each means of transportation, in order to minimize the risk of accidents. Hazardous materials shipments using courier services with transport reliefs are possible with "limited quantities" and "exclusion under transport category. This paper formulates an innovative, synergistic approach in the organization and security of transport PTT corridors through the direct implementation of artificial intelligence (AI) and intelligent predictive systems. Traditional, reactive logistical models exhibit structural vulnerabilities when dealing with technogenic hazards, deliberate diversions, and secondary contamination. The proposed solution is based on the concept of multi-layered situational awareness in both cyber and physical spaces, where AI algorithms perform dynamic risk assessment, analysis of weather anomalies, and real-time calculations of potential contamination dispersion within the designated zones. Through the application of radical transparency principles, logistics flows become fully secured, transforming the written scientific word into an impenetrable technical and ethical shield that preserves the biological substrate and environmental purity for all present and future generations.

Keywords: dangerous goods, transportation of dangerous shipments, PTT logistics, situational awareness, predictive monitoring, artificial intelligence (AI), environmental security.

MULTI-CRITERIA OPTIMIZATION OF ENVIRONMENTAL SAFETY DANGEROUS PTT SHIPMENTS, USING ARTIFICIAL INTELLIGENCE

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Abstract: The expansion of e-commerce and the globalization of logistical chains have led to a drastic increase in the frequency of undeclared and hidden hazardous materials within standard postal and transport flows, posing a severe threat to ecological safety, public health, and ecosystem stability. The clearly defined objective of this co-authored paper is to establish an innovative, hybrid multi-criteria optimization (MCO) model that integrates the AHP and TOPSIS mathematical methods with artificial intelligence (AI) algorithms, enabling predictive risk identification and dynamic routing of transport vehicles carrying hazardous cargo.

Transport and storage of dangerous goods (ADR) involves strictly regulated handling of substances that can endanger human health and the environment. In our region, the Law on the Transport of Dangerous Goods is applied, harmonized with the international ADR agreement, which includes certified packaging, trained drivers, proper marking of vehicles and special storage conditions to prevent accidents. Considering the repectiveness of this academy and scientific gathering, this work requires the highest level of methodological rigor, precise terminology (especially in the field of transportation of dangerous shipments, eco-security and postal technologies) and a clear contribution to applied artificial intelligence. This paper presents a comprehensive scientific and professional study focused on solving critical challenges in the management of dangerous goods within postal systems. Beyond technical and technological aspects, this paper affirms a broader humanistic approach, according to which the awareness of negative anthropogenic impacts on the planet implies a responsibility to rectify these processes through new management systems. By addressing the critical issue of nuclear, chemical, and biological (CBRN) accidents in postal networks, the proposed model contributes to the fundamental structural changes necessary for implementing the concept of sustainable development, ensuring ecosystem protection for both present and future generations. Special emphasis in the paper is placed on operational experience from the domain of chemical, biological, radiological, and nuclear (CBRN) defense in preventing hazardous accidents. The empirical part of the research

was conducted through a structured survey questionnaire consisting of 6 thematic blocks on a representative sample of 180 respondents from the fields of logistics, defense, and ecology. The data processing results confirm that the application of the proposed MCO-AI model enables a transition from a reactive to a predictive ecological defense system, minimizing risks to the population and natural resources while maintaining the economic sustainability of transport and the principles of sustainable development.

Keywords: dangerous goods, dangerous postal items, transport of items, risks and consequences, role of artificial intelligence (AI), multi-criteria optimization (MCO), ecological safety, sustainable development.

OPTIMIZATION AND COMPARATIVE ANALYSIS OF CONVENTIONAL AND MODERN METHODS FOR THE EXTRACTION OF BIOACTIVE COMPOUNDS FROM ORANGE PEEL

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Abstract: The aim of this study is to optimize the extraction process and a comparative analysis of conventional (maceration, Soxhlet, shaker) and modern (ultrasound-assisted extraction) methods for the isolation of bioactive compounds, total (poly)phenols and carotenoids, from dried and ground orange peel. The research was conducted in two phases: a preliminary analysis and a main part based on the Box–Behnken experimental design. In the preliminary phase (14 samples), the effects of shaker agitation speed (60–180 rpm), solvent type (water, 64% and 96% ethanol, acetone, chloroform), and extraction type at room temperature were investigated. Preliminary results showed that 96% ethanol combined with a shaker speed of 120 rpm was the most suitable for (poly)phenol extraction, yielding the highest content of 18.31 mg GAE/g of sample, while the best result for carotenoids was achieved at the same shaker speed but using chloroform as the solvent, with a value of 142.08 mg/100 g of dry matter. Based on the optimized parameters, a shaker extraction method at 120 rpm was applied in the main part of the study (15 samples) to examine the effects of the solid-to-liquid ratio (1:30, 1:40, 1:50), ethanol content (32%, 64%, 96%), and extraction time (20, 40, 60 min). The best results in the main part for total (poly)phenols were recorded for sample 4N, amounting to 15.95 mg GAE/g of sample (1:50 ratio, 96% ethanol, 40 min time), while the best result for carotenoids was achieved for sample 12N with a value of 183.52 mg/100 g of dry matter (1:40 ratio, 96% ethanol, 60 min time). The results confirm that conventional shaker extraction, guided by the optimal parameters of the Box–Behnken design with the use of 96% ethanol, provides remarkably high efficiency in isolating the target compounds from orange peel.

Keywords: Box–Behnken design, carotenoids, extraction optimization, orange peel, (poly)phenols.

APPLICATION OF SCANNING ELECTRON MICROSCOPY WITH ENERGY-DISPERSIVE X-RAY SPECTROMETRY (SEM/EDS) IN THE FORENSIC ANALYSIS OF MICRO-TRACES FROM A REAL EVENT

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Abstract: The presented work is the result of the research of samples in the forensic analysis of a real event. The material examined by the method of scanning electron microscopy with an energy dispersive x-ray spectrometer (SEM/EDS) was a polymer coating on fabric. The chemical elements carbon, oxygen and traces of the chemical elements silicon and calcium were detected on the examined samples, while aluminum was not detected. The determined microelemental composition of the surface polymer coating indicated that it is most likely silicone resin (polysiloxane) used for the production of water-repellent (DWR) coatings on sports clothing. The presence of calcium indicated that the coating was either enhanced with mineral additives (eg calcium carbonate) for strength or that the chemical element calcium was most likely a contaminant. Also, an analysis of the surface layers of the fibers was performed. The form of the investigated fibers indicated that they are natural, cotton fibers. Monochromatic images were also obtained on which their individual characteristics could be observed. All obtained results integrally contributed to the realistic picture of the event.

Keywords: forensic analysis, electron microscopy, microtraces of samples.

NEW COCRYSTAL OF COPPER(I) COMPLEXES WITH A P-DONOR SCHIFF BASE

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Abstract: In the reaction of warm methanolic solutions of the Schiff base 2-(diphenylphosphino)benzaldehyde-aminoguanidine (L) and CuBr₂ in a 1:1 molar ratio, ochre-colored crystals were obtained. The composition was assumed based on the elemental analysis, but the FTIR spectra showed slight differences between L and the obtained complex. However, SC-XRD confirmed that the resulting complex, with the formula $[\{\text{Cu}(\text{L})\text{Br}(\mu\text{-Br})\}_2][\text{Cu}_4(\text{L})_2\text{Br}_2(\mu_2\text{-Br})_2(\mu_3\text{-Br})_2] \cdot n\text{MeOH}$, is a cocrystal composed of two coordination compounds of L, in both of which the ligand coordinates in a monodentate manner through the phosphorus atom. One component of the cocrystal is a dinuclear Cu(I) complex containing two bromide ions acting as bridging ligands. The second component is a tetranuclear Cu(I) complex in which bromide ions exhibit triply bridging coordination to the metal centers. In the free ligand, the plane of the aminoguanidine moiety and that of the adjacent benzene ring form a dihedral angle of 42,76°, whereas in the complex structure they become nearly coplanar, with dihedral angles of 3,24° and 9,66° for the two crystallographically independent complex molecules, respectively.

Keywords: Schiff bases, complex, crystal, single-crystal X-ray diffraction.

APPLIED MODEL FOR COMPLIANCE WITH ESG/CSRD IN MANUFACTURING ENTERPRISES

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Abstract: The entry into force of the Corporate Sustainability Reporting Directive (CSRD) and the accompanying European Sustainability Reporting Standards (ESRS) present significant compliance challenges for the manufacturing sector in the European Union. Industrial enterprises face complex requirements regarding the collection and systematization of ESG data across the entire value chain, double materiality assessment, and auditability.

This paper proposes an applied model for achieving CSRD compliance, tailored to the specific operational characteristics of manufacturing companies. The developed framework covers five sequential stages:

1. Double materiality assessment (impact materiality and financial risks/opportunities);
2. Gap analysis against ESRS disclosure requirements;
3. ESG data integration into existing corporate IT systems (ERP/BI) for Scope 1, 2, and 3 emissions and resource efficiency;
4. Formulation of KPIs and decarbonization strategies;
5. Audit readiness and verification prep.

The model was tested on a sample of manufacturing enterprises. The results demonstrate that this structured framework reduces data collection time and resources by over 30%, enhances supply chain transparency, and ensures a seamless transition from traditional financial reporting to integrated sustainability reporting. The paper provides a practical roadmap valuable for executive management, ESG managers, and financial controllers.

Keywords: CSRD, ESRS, double materiality, ESG reporting, manufacturing enterprises, sustainable development, decarbonization, Scope 1-3 emissions.

SIMULATION, OPTIMIZATION AND HEAT INTEGRATION OF LPG FRACTIONATION SYSTEM

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Abstract: Liquefied petroleum gas (*LPG*) fractionation systems are energy-intensive plants whose efficiency significantly depends on the selection of operating parameters for individual columns and the potential for process integration. This paper presents a methodology for process simulation and optimization of individual columns within a distillation train (deethanizer–debutanizer–depropanizer–butane splitter) as well as the evaluation of heat integration opportunities using the DWSIM process simulator.

For each column, the optimal combination of the number of theoretical stages and the reflux ratio was determined while satisfying the required product quality specifications. Based on the resulting optimal operating conditions, the potential for process heat integration using a heat pump was analyzed. In the proposed configuration, the energy released in the debutanizer condenser is recovered and utilized to meet the reboiler duty requirements of the depropanizer and the butane splitter.

An analysis of energy flows was performed to evaluate the effects of the proposed solution on reducing external heat demand and improving the overall energy efficiency of the plant. The obtained results confirm that the combination of process optimization and heat integration represents an effective approach to enhancing the performance of *LPG* fractionation systems.

Keywords: distillation, optimization, simulation, heat integration.

STONE FACADES IN MODERN ARCHITECTURE

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Abstract: A comprehensive review of contemporary facades from different parts of the world, created after 2000, reveals that the exceptionally good physical-mechanical and attractive aesthetic and design properties of stone material, as well as its durability, have determined a large number of architects and designers to realize their creations of building facade surfaces through architectural projects. This research presents examples of buildings with successfully designed facades by great creators of today's global eco-urban architecture scene: Daniel Libeskind, Renzo Piano, Alvaro Siza, Kengo Kuma and others, who perfectly understood the essential, performance value of decorative, diverse stone cladding for the aesthetic improvement and longevity of facades. By skillfully choosing a natural, durable stone material, they have provided significant conceptual guidelines for designers, conservation experts and engineers to further influence the new conceptual development of facade engineering, the use and preservation of stone facades. Whether they are objects from the cultural and historical heritage or modern architectural physical structures.

Keywords: stone facades, architecture, form properties, aesthetics, longevity.

ECONOMIC AND ENVIRONMENTAL ASPECTS OF WASTE MANAGEMENT – "METERIS" LANDFILL CASE STUDY

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Abstract: Industrial waste management has become one of the major challenges of contemporary environmental protection systems due to its significant impacts on soil, water, air quality, and public health. This study examines the economic and environmental dimensions of waste management through a case study of the *Meteris* landfill located in Vranje, Serbia. The research is based on the analysis of operational documentation, statistical records of disposed waste covering the period from 2018 to 2023, and the relevant legislative and institutional framework governing waste management. Particular attention is given to identifying the principal challenges associated with industrial waste management, including limited waste separation and treatment capacities, insufficient implementation of circular economy principles, and inadequate institutional coordination among stakeholders. The findings indicate that although certain improvements have been achieved in landfill operation and waste handling practices, landfilling remains the dominant disposal method, while recycling and material recovery rates remain relatively low. The study emphasizes the necessity of modernizing waste management systems through investments in recycling infrastructure, advanced waste treatment technologies, continuous environmental monitoring, and stronger enforcement of environmental regulations. The proposed measures could significantly reduce environmental risks, improve resource efficiency, and support the transition toward sustainable waste management practices consistent with the principles of the circular economy.

Keywords: industrial waste materials; waste management; Meteris landfill; circular economy; environmental protection; sustainable development.

ARTIFICIAL INTELLIGENCE AND SENSOR THEORY IN ENVIRONMENTAL MONITORING

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Abstract: Environmental monitoring increasingly depends on dense sensor networks, remote platforms and automated analytics capable of transforming heterogeneous measurements into timely knowledge for decision making. This paper examines how artificial intelligence and sensor theory can be integrated to improve the reliability, interpretability and usefulness of environmental monitoring systems. The central argument is that AI can enhance detection, prediction and response only when it is coupled with rigorous sensor theory, including calibration, uncertainty quantification, sampling design and validation against reference observations. The paper reviews applications in air, water, soil, climate and ecosystem monitoring, emphasizing Internet of Things architectures, machine learning, deep learning and remote sensing. It also discusses methodological requirements for data preprocessing, sensor fusion, model selection and uncertainty-aware inference. The results indicate that AI-enabled monitoring can increase spatial and temporal resolution, reduce operational costs and support proactive environmental management, but these benefits depend on transparent models, robust calibration, representative training data and governance frameworks that protect data quality and public trust. The paper concludes that sustainable environmental monitoring should be designed as an integrated socio-technical system in which sensors provide traceable measurements, AI provides adaptive interpretation, and human expertise ensures accountability and context-sensitive decisions.

Keywords: artificial intelligence, sensor theory, statistics, environment, sustainable development.

THE EFFECT OF AIR EXCHANGE RATE ON INDOOR RADON CONCENTRATION

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Abstract: The main part of the radiation dose that people receive from natural radioactive sources is due to inhalation of radon and its decay products. It has been proven that exposure to high levels of radon (^{222}Rn) increases the risk of developing lung cancer in humans, especially in indoor spaces in combination with tobacco smoke. Radon is a natural gas and originates from the decay chain of uranium (^{238}U), which is found in soil and rocks. In the outdoor atmosphere, its concentrations are lower, but in buildings the concentration can rise to dangerous levels. Therefore, its monitoring can help in giving recommendations for the introduction of protective measures against high radon concentrations. Radon measurement was performed with the Rad 07 device (active method) in indoor spaces. Five rooms in schools where radon was continuously measured for seven days are shown. The rooms had different air exchange rates, which is reflected in the results on radon concentration levels. The research results have great practical application, especially in rooms that are closed for a long period of time. It has been shown that the air exchange rate plays a key role in radon concentrations and thus on the effective dose received by students and school employees.

Keywords: radon, active method, Rad 07, radon concentration.

RADON IN PUBLIC KINDERGARTENS IN MONTENEGRO

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Abstract: Radon was continuously measured over a 9-month period (September–June) in 434 ground-floor rooms of all 69 public kindergartens in Montenegro, using passive Radosys RSFV detectors. Radon activity concentrations in the rooms ranged from 3 to 1583 Bq/m³ (AM = 202 Bq/m³, Med = 133 Bq/m³), while the average radon concentrations at the ground-floor level of the kindergartens ranged from 24 to 1229 Bq/m³ (AM = 216 Bq/m³, Med = 148 Bq/m³).

The Shapiro–Wilk test rejects the hypothesis of a log-normal distribution of radon concentrations in individual rooms, but also indicates that the average radon concentrations at the ground-floor level of the 69 kindergarten buildings do not significantly deviate from a log-normal distribution ($p > \alpha = 0.05$).

Fourteen of the 69 kindergartens (20.3%) had average ground-floor radon concentrations above 300 Bq/m³. At least one ground-floor room with a radon concentration above 300 Bq/m³ was found in 25 kindergartens (36.2%), while 4 kindergartens (5.8%) had at least one room with a radon concentration above 1000 Bq/m³. In total, 91 ground-floor rooms (21%) had radon concentrations above 300 Bq/m³.

The most critical situation was found in one kindergarten in the capital city, where radon concentrations in all six ground-floor rooms ranged from 424 to 1583 Bq/m³. For employees working in this kindergarten, the annual effective dose due to radon inhalation is estimated to range from 2.7 to 10.0 mSv according to UNSCEAR, and from 5.0 to 18.7 mSv according to ICRP.

Keywords: radon, kindergartens, indoor radon, radon concentration, effective dose, Montenegro.

"IN VIVO" MEASUREMENTS OF RADIONUCLIDE ACTIVITY IN THE ENTIRE HUMAN BODY AND DETERMINING THE DEGREE OF HEALTH RISK DUE TO CONTAMINATION

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Abstract: Determining the presence and impact of radionuclides and their products in the environment is very important from the aspect of human health protection. The use of radionuclides in industry, medicine, and scientific research often contributes to a certain dose of radiation that a person receives through inhalation, ingestion of food, or direct exposure to radiation sources. Exposure to ionizing radiation is expressed by the effective dose, and it is estimated that a person on average receives an effective dose of 2.4 mSv per year from natural radiation. The fact that certain harmful effects are not manifested immediately does not exclude their occurrence later, during the lifetime of individuals exposed to radiation or even in some later generations of a given population. Therefore, with every exposure, you should keep in mind the ALARA principle (ALARA - As Low As Reasonably Achievable), a generally accepted international concept of preventive protection, according to which any unnecessary exposure to radiation should be avoided and necessarily reduced to the minimum possible extent. The radiation risk for the whole body or individual organs is determined through the effective dose or tissue dose equivalents and the corresponding probability coefficients adopted by the International Committee on Radiation Protection: Recommendations 2007 of the International Commission on Radiological Protection, Publication number 103 (The 2007 Recommendations of the International Commission on Radiological Protection, ICRP Publication 103). In order to apply consistent monitoring to control internal exposure, direct measure-

ments were carried out in this work - measurement of radionuclide activity in the entire human body (Whole Body Counter-WBC). This type of measurement is based on the detection of ionizing radiation emitted from the human body using detectors placed in the immediate vicinity of the body. During the previous period, before the establishment of the current work regime, the optimization of the WBC system was carried out by purchasing new equipment, adequate reconstruction of the space, as well as professional training of the staff who perform measurements. The results presented in this paper showed a significant improvement in detection efficiency and reduction of measurement uncertainty in accordance with the recommendations of the International Atomic Energy Agency - IAEA. (International Atomic Energy Agency – IAEA).

Keywords: Population protection from radiation, effective dose, ALARA - preventive protection system, radiation detectors, Whole Body Counter.

MANAGEMENT OF POPULATION HEALTH RISK LEVELS BY MEASURING THE AMBIENT RADIATION DOSE EQUIVALENT AT THE LOCATION OF A NUCLEAR FACILITY

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Abstract: The increased degree of risk to the population and other biosystems and, in general, a negative and potentially harmful impact on the environment in the vicinity of nuclear facilities from artificial sources of radiation, is a very current task and security challenge. That is why the characteristic parameters of the ambient environment in the surroundings of such facilities are permanently monitored and reliable measurements are carried out in terms of monitoring the fulfillment of conditions and the safety of the operation of nuclear facilities. If deviations from the standard and expected results are registered during the regular operating mode of nuclear facilities, a responsible and adequate response is taken according to the appropriate safety centers and bodies of the corresponding state institutions. All such activities in eventual cases with increased risk are undertaken in accordance with the law on radiation and nuclear safety and security and the rulebook on the limits of exposure to ionizing radiation and measurements. The basic and ultimate goal of conducting the aforementioned measurements is to take preventive and timely, continuously prescribed measures to prevent an increase in the level of risk at the site of the functioning of the nuclear facility, which, in conjunction with other risk factors, could lead to an eventual accident. One such responsible and comprehensive concept of safety risk management of this kind requires a systematic examination of radioactivity in the environment in the vicinity of nuclear facilities. This includes, among other things, the examination of the level of radioactive contamination of

the air by continuous measurement of the strength of the ambient dose equivalent of gamma radiation in the air, measurement of meteorological parameters as well as mathematical modeling of the distribution of radionuclides in the boundary layer of the atmosphere. Examination of the level of radioactive air contamination by continuous measurement of the strength of the ambient dose equivalent of gamma radiation in the air in the vicinity of nuclear facilities was carried out and presented in this paper. The planned measurements were carried out by an accredited method in accordance with the requirements for the competence of testing laboratories according to the standard SRPS ISO/IEC 17025:2017 (Examination of the level of external radiation by continuous measurement of the strength of the ambient dose equivalent in air: EPA HASL 300:1997)

Keywords: nuclear facilities, control of safety conditions, risk levels, ambient dose equivalent, air contamination.

CHARACTERIZATION OF 80–200 MM SILICA GEL AND ITS INFLUENCE ON SOYBEAN OIL BLEACHING

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Abstract: Due to its porous structure and high specific surface area, silica gel is widely used in various adsorption processes. Crude soybean oil contains various impurities, including phosphatides, tocopherols, sterols, pigments, free fatty acids, and trace metals. The reduction or complete removal of these impurities is achieved through several refining steps, one of which is the bleaching process using commercial bleaching earths and activated clays with high specific surface areas and excellent adsorption capacities.

In this study, silica gel (particle size 80–200 µm; Zeochem, Zvornik) and an imported commercial bleaching earth were used for bleaching crude soybean oil supplied by Viktoria Oil (Šid, Serbia). The bleaching process was carried out at 95 °C for 30 min using bleaching agent concentrations of 0.5, 1.0, 1.5, and 2.0% (w/w). The silica gel and commercial bleaching earth were characterized using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy (SEM/EDS), Brunauer–Emmett–Teller (BET) surface area analysis, and laser particle size analysis. The results showed that the silica gel exhibited a 2.91-fold higher specific surface area and a 2.69-fold greater total micropore volume than the commercial bleaching earth, while its average pore diameter was 2.07-fold smaller. The d10 and d50 particle size values of the silica gel were 3.01- and 1.46-fold higher, respectively, than those of the commercial bleaching earth, whereas the d90 values were comparable. Energy-dispersive X-ray spectroscopy (EDS) analysis at 1000× magnification showed that the silica gel consisted of 62.79% O and 33.13% Si, with minor amounts of Na, Cu, Zn, Hf, and W.

The bleaching efficiency was evaluated by physicochemical analyses and gas chromatography with flame ionization detection (GC-FID). The results showed that no soap residues remained in the soybean oil after bleaching. In addition, the peroxide value, chlorophyll content, and free fatty acid content decreased, while only slight changes were observed in the oil color and fatty acid composition. Furthermore, the use of silica gel during the bleaching process resulted in lower soybean oil losses compared with the commercial bleaching earth.

Keywords: 80-200 μm silica gel, silica gel characterization (XRD, FTIR, SEM/EDS, BET), crude soybean oil, soybean oil bleaching, bleaching effect, fatty acid composition (GC-FID), oil loss

COMPARATIVE EVALUATION OF HYDROGEL DENSITY MEASUREMENT METHODS

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Abstract: This study compared two methods for determining the volume and density of 3D printed gelatin-based hydrogel samples. Nine different samples were analyzed using the sand displacement method and ImageJ software. In the first method, sample volume was calculated from the change in sand height. In the second method, volume was calculated from the projected area and measured sample height. The two methods gave different volume and density values, especially for samples with irregular shapes and variable heights. Sand entering the gaps between the printed lines may have affected the displacement measurements, while the ImageJ method assumed a uniform thickness across the sample. The significant differences in density values obtained using the two methods indicate that the choice of measurement technique can strongly influence the determined density of hydrogels. Therefore, further validation using multiple measurement approaches and comprehensive statistical analysis is needed to evaluate the accuracy and reliability of density determination.

Keywords: Gelatin-based hydrogel; 3D printing; density; measurement techniques; sand displacement; ImageJ.

OVERVIEW OF THE STATE OF GEOTHERMAL ENERGY IN THE WORLD WITH REFERENCE TO THE POSSIBILITY OF USING IT FOR THE PRODUCTION OF ELECTRICITY IN BOSNIA AND HERZEGOVINA

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Abstract: From the beginning of the first civilizations until today, hot water has been used. In the beginning, they were used according to their development, and over time they found a wider application, up to the possibility of using them for the production of heat and electricity. At the beginning of the 20th century, a random or well-designed experiment for that time, using steam from hot springs, started a generator that lit several light bulbs. The researcher was a prince and an industrialist, financially secure and ready for new research in this field. His thoughts were in the direction of using hot water energy (later called geothermal energy) for greater energy possibilities. Larderelo is the place where the first geothermal power plant was built, put into operation in 1913, with a power of 250 KW. Over time, it was demolished and rebuilt, and today it is a protected building of special historical value. It works with a reduced capacity of about 190 MW, and 34 geothermal power plants were built in this area, with a total installed capacity of 595 MW of electricity. It represents one of the largest complexes for the use of geothermal energy in the world.

More developed countries in the world give more importance to the use of geothermal energy sources, even though in terms of energy they participate in a smaller percentage. Somewhat less developed countries use a higher percentage of this energy, especially in countries where the water temperature is above 150 °C. Iceland leads the way with an energy utilization of around 87% in the total balance, followed by the Philippines with 27%. The advantage of geothermal power plants compared to other energy sources is that they have a high level of utilization during the year, 83-87%. The minimum water temperature for the operation of a geothermal power plant has been reduced to 90 °C today, which opens up the possibility of building geothermal power plants in the territory of the Republic of Srpska. The paper will list all the most important geothermal power plants in the world and their efficiency.

Keywords: hot water sources, thermal and electrical energy, economic and ecological aspects.

ANALYTICAL DISPERSION MODEL OF MULTILAYERED STRUCTURES (ADMM) IN AIR POLLUTION DISTRIBUTION ANALYSIS

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Abstract: The paper presents a semi-analytical solution of the time-dependent two-dimensional advective diffusion equation based on the discretization of the surface boundary layer (PBL) into N sublayers. In each sublayer, the advective diffusion equation is solved using the Laplace transform technique, taking into account the average value of the eddy diffusivity and the wind speed. The solution is semi-analytical since the real concentration of pollutants is found by numerically finding the inverse Laplace transform using the Gaussian quadrature method. The concentrations of air pollutants found by the ADMM method are compared with the concentrations found based on the Gaussian method for aerodispersion and with the results of measurements in experiments. The advantages and disadvantages of using the ADMM model in relation to the Gaussian model and other modern models that have been relevant in the analysis of aerodispersions of pollutants in recent years are stated.

Keywords: ADMM model, Gaussian model, inverse Laplace transform, Gaussian quadratures, parameterization of diffusion coefficient and wind speed, validation of aeropollutant concentration results.

ANURS LABORATORY FOR SOLAR ENERGY -
A COMPREHENSIVE SCIENTIFIC AND TECHNICAL ANALYSIS,
INFRASTRUCTURAL CAPACITIES, AND APPLICATION IN
THE LIGHT OF CONTEMPORARY RESEARCH

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Abstract: The Laboratory for Solar Energy at the Academy of Sciences and Arts of the Republic of Srpska (ANURS) represents a reference, central scientific research center dedicated to advanced spectral, monitoring, thermodynamic, and current-voltage (I-V) analysis of photovoltaic systems. Through long-term strategic and technological development, this institution has evolved from an initial test facility located on the roof of the Academy building into a highly integrated and technologically advanced laboratory complex. Today, the laboratory possesses unique research equipment for artificial solar simulation, precision metrology, and optical quality control of photovoltaic (PV) modules in accordance with the most rigorous international standards and regulations (IEC, ASTM).

Keywords: Solar energy, measurements, laboratory, renewable sources.

SEAWATER INFLUENCE ON PV PANELS PERFORMANCES

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Abstract: Photovoltaic (PV) panels in marine environments are often exposed to seawater wave-splash, salt spray, high humidity, strong winds that can decrease system performance, service life and reliability. When seawater splash on PV panels, after evaporation salt crystals are left behind on panels' front surface. Seawater distribution and salt accumulation depend on PV system construction and wave conditions. Also, certain environmental factors can make additional influence (e.g. higher wind speed lowers PV panels temperature, higher relative humidity has influence on solar radiation scattering and can decrease it). Although PV panels in marine environments experience specific challenges, in available literature there are not many papers examining PV power loss dependence on sea salt deposition. At the Faculty of Maritime Studies Kotor, University of Montenegro outdoor experiment was conducted in order to determine seawater influence on PV panels power. The experiment was performed outdoors, on the roof of the faculty building with no shadows where two identical flexible monocrystalline silicon PV panels power of 300 Wp were placed one beside the other. One PV panel remained clean during the experiment and the other one was sprayed with seawater taken from the Boka Bay in front of the faculty building. Spraying of seawater was performed evenly on the PV panel surface, as much as possible. After seawater deposition on the PV panel and seawater evaporation, electrical parameters of both PV panels were measured with SOLAR I-Ve 1500 V multifunction I-V curve tracer. Power of the PV panel covered with seawater salt crystals was on average 6.17% lower compared to the clean PV panel. Even after several depositions of seawater, power decrease was similar. Upon every next seawater application, some of the salt crystals were removed due to spraying of new seawater quantity. Similar happens in cases with wave-splashing, since waves remove evaporated salt crystals. Conducted experiments showed that repeated seawater splashing and salt crystals appearance after seawater evaporation do not have significant influence on PV panel's power.

Keywords: PV panel; seawater; power; marine environment.

USES OF CIRCULAR ECONOMY BUSINESS MODELS WITHIN MANUFACTURING COMPANIES

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Abstract: Circular economy (CE) represents a multidisciplinary, regenerative and modern economic model, which is based on the circulation of materials, in which waste from one factory or one product is recycled to create a raw material (new resource) for another factory or another new product. The circular economy (CE) focuses on the economic and environmental dimensions of sustainability and sustainable development (SD). In this way, the circular economy (CE) becomes a regenerative economic, industrial and economic model and system, in which the environment is taken into account, i.e. the natural eco-system, saves natural resources, reduces the amount of waste for disposal, reduces the emission of various gases, reduces waste, etc.

For the efficient functioning of the circular economy (CE), two business models are used: the circular business model (CBM) and the circular economy business model (CEBM), and the analysis of their application in manufacturing companies is the goal of this paper. The CBM and CEBM models represent a way of doing business in which products, materials, energy and resources are kept in use as long as possible, during the life cycle of the product, while the creation of waste is reduced to the smallest possible extent. And the main goals of the CBM and CEBM models are to establish a resource-efficient economic and business system of material, energy, resource and production flows throughout the entire product life cycle. For the successful application of CBM and CEBM models, a large number of efficient and modern frameworks, models, methods, tools, etc. are available.

The transition to CBM and CEBM models has become a key component of sustainable development strategies in all industries. In this way, they represent one of the key postulates of the development of a new society, in which the treatment of waste as a raw material enables significant financial effects and the effects of protecting natural resources, i.e. the effects of preserving the eco-system. Despite their potential to reduce environmental impact and promote resource efficiency, the implementation of CBM and CEBM models still faces a wide range of problems and obstacles, from technological and organizational to informational and regula-

tory challenges. The accelerated development and application of digital technologies (DT), in recent years, opens up the possibility of solving these problems and obstacles by improving transparency, coordination and adaptability within circular systems.

In practice, manufacturing companies still face challenges in translating the concepts of CBM and CEBM models into their corporate strategies and business models (BM). Consequently, the market penetration and application of these models is limited in many industrial sectors. Hence, the implementation of CBM and CEBM models in manufacturing companies requires changes that go beyond technological or product innovation and involve overall value creation and redefining business success. Therefore, it is necessary to develop special forms of organizational capacities that are based on new innovative CBM and CEBM models in order to adapt existing business models (BM) and create new ones based on the circular economy (CE).

Keywords: Product, material, energy, resources, circular economy (CE), circular business model (CBM), circular economy business model (CEBM).

MODELS OF KINETS OF CONVECTION-CONDENSATION DRYING OF BIOMATERIALS

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Abstract: Drying kinetics was monitored by the gravimetric (direct) method, i.e. by measuring the change in mass of wet material during drying. The course of drying is defined by the type and properties of the material, the type of moisture present (free, bound), the method of drying and the drying conditions. When the working conditions defined by the state of the experiment have been reached in the chamber, the sample on the support is placed on the scale and the measurement begins. In defined time intervals (from 1 hour), the mass of the wet sample is read. For each time interval, the moisture content of the sample can be calculated, provided that the initial humidity is known for all experiments defined by the experiment plan and that the dependence of the moisture content on time is drawn - a graphic display of the drying curve and the drying speed curves. The data from the graph served as the basis for approximating the drying curves of apples of the "red delicious" variety with a mathematical model - polynomial regression. A regression model that contains one dependent (w_s or $dw_s/d\tau$) and one independent variable (τ) is a simple regression model.

Based on experimental data, the paper analyzes the convective drying of an apple variety in a laboratory batch convective-condensation dryer of its own construction. The influence of process parameters on the drying kinetics of the widespread variety "red delicious", cut into rings, initial relative humidity around 87%, dried to the final around 7.5-8.5%, is being investigated. The drying kinetics is displayed as a drying curve and a drying speed curve. The drying curve describes the change in moisture content of the material during drying (time), and the drying speed curve describes the change in drying speed over time. The drying speed is observed under constant conditions and is defined by the amount of water that evaporates from its surface in a unit of time, whereby constant conditions mean: temperature t , relative humidity ϕ and air flow speed v .

Keywords: Convective-condensation drying, process parameters, drying kinetics, drying curve, drying speed curve, mathematical model, simple regression model.

INTELLIGENT AND SMART MATERIALS: STRUCTURES AND STRUCTURAL SYSTEMS

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Abstract: Intelligent and smart materials represent a group of functional materials that can register and recognize external changes in their environment and respond to them by controlled, predictable and efficient changes in their physical, chemical, mechanical and/or tribological properties. The concept of smart materials, smart structures and structural systems was introduced when scientists began to integrate electroactive materials with large structures as sensors and actuators in real-world conditions.

Examples of smart materials are: shape memory alloys, piezoelectric materials, magnetorheological and electrorheological fluids, thermochromic materials, photo-sensitive materials, self-healing materials, etc. And they are applied in mechanical engineering, construction, electronics, medicine, automotive industry, aviation, robotics, systems for monitoring the condition of structures, etc.

The paper provides an overview of current intelligent and smart materials and their sensor-actuator structural applications. Basic, multi-field optomagneto-piezoelectric-thermoelectric behavior is emphasized, and new transducer technologies applied to complex problems from many fields, including elasticity, electricity, temperature, magnetism, light, and other interactions. Material history, characteristics, material variations, limitations, sensor-actuator structural applications, and so on, all the way to piezoelectricity, electro- and magneto-measurable materials, electro- and magnetorheological fluids, polyelectrolyte gels, superconductors, pyroelectrics, photostrictive materials, and photoferroelectrics are discussed in detail.

Keywords: Intelligent materials, smart materials, sensors, actuators, crystals, structures.

MODELING OF PLASTOMER PRODUCTS AS A BASIS FOR INJECTION MOLD DESIGN

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Abstract: The use of plastics began in the middle of the last century. These materials experienced a significant expansion at the end of the same and the beginning of this century, and reaching the maximum of their application is expected in the middle of this century. It would be hard to imagine modern civilization without plastic. Today, plastic is indispensable, with a variety of applications, from everyday items to sophisticated scientific and medical instruments.

Processing of plastomer represents an important industrial branch both in the world and in our country. The participation of plastic parts is becoming more and more important in many areas of technology, such as: automotive industry, electrical engineering, electronics, telecommunications, computer technology, production of household appliances, chemical and pharmaceutical industry, medicine, etc. There is almost no industry in which plastic components are not present. The reduction of sources of natural materials also contributes to the increasing use of plastomers, which replace natural materials. The constant expansion of the range of polymer materials, with an ever-widening spectrum of characteristics, creates new opportunities for ever-widening application in all areas of the economy and everyday life of mankind.

In the plastic processing industry, and especially in the field of injection molding, computers and modern software enable efficiency and time savings, both in the product design phase (Computer Aided Design - CAD), and in the technology design phase (Computer Aided Manufacturing - CAM), and in the simulation and analysis phase (Computer Aided Engineering - CAE), and the design of spatially complex surface manufacturing technology turns into a routine process. The process of product design (CAD) is the subject of this work, which is the basis for the design of tools and injection molding technology. The SolidWorks software package was used successfully for all the mentioned phases of the injection molding technology design process. In this work, the application of the mentioned software is limited only to the first phase, modeling of plastic products.

Computer-aided design (CAD) is the process of designing products with the help of computers and includes activities that are separated between drawing on a computer and working on software systems that support automatic product design. CAD can also be defined as the application of computers and graphics software to assist in the creation, or improvement of product construction, from conception to documentation. Product modeling was done in the SolidWorks software package.

CAD represents a revolution in the field of plastics processing in recent decades and is the basis for tool design and computer simulation of injection molding and cooling processes. In contrast to the traditional methods of designing and making very expensive prototypes and subsequent debugging, it became possible to predict with a high degree of certainty that the new product will be obtained from the first attempt and at the same time meet the required quality.

Keywords: Product Modeling, Injection Mold Design, CAD (Computer Aided Design), CAM (Computer Aided Manufacturing).

DEVELOPMENT TRENDS IN MICRO AND NANO TURNING FOR PROCESSING MODERN COMPOSITE MATERIALS

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Abstract: Micro and nano turning are types of highly precise material machining methods with chip removal used to machine small diameter miniature rotary parts on a micro and nano scale. In micro and nano scraping, a very small layer (quantity) of material is removed from the surface of the rotating workpiece, with a diameter ranging from several hundred nanometers to several thousand micrometers, using a carving tool with a blade, most often to obtain the desired shape, dimension or surface quality.

Processing parameters (cutting speed, feed, cutting depth, etc.) in micro and nano turning vary depending on the technological requirements, the size of the lathe, the material of the workpiece and the material and shape of the cutting tool, whereby the cutting depth and dimensions of the cutting tool are significantly smaller than in classic turning.

In this paper provides an overview and trends in the development of micro and nano turning in the processing of modern composite materials. The determination of the mathematical model and the prediction of tool wear, functions of cutting forces and cutting temperature depending on the cutting mode and geometric parameters of the cutting tool when scraping various modern composite materials on a micro and nano scale were analyzed.

Keywords: Machining, turning, micro turning, nano turning, composite materials, mathematical modeling.

APPLICATION OF AI-BASED GEOGRAPHIC INFORMATION SYSTEM FOR WATER QUALITY ASSESSMENT

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Abstract: Water quality assessment (WQA) is a comprehensive and complex multidisciplinary process of evaluating the physical, chemical and biological properties of water in order to determine its state with respect to human impacts and intended uses. Determining and assessing WQA requires the integration, analysis and interpretation of large amounts of spatial, temporal, ecological, hydrochemical and other data. Conventional approaches to water quality monitoring are often based on measurements obtained from a limited number of sampling locations and predefined monitoring intervals. Although these approaches provide valuable information about the current state of water quality and water resources, they may not adequately represent spatial and temporal variations in water quality. To overcome these limitations and integrate heterogeneous datasets, identify complex relationships between environmental parameters, spatial prediction, and visualize water quality conditions, artificial intelligence-based geographic information systems (GIS) (AI-GIS or GeoAI) have been increasingly used in recent years. AI-GIS systems combine artificial intelligence (AI), artificial neural networks (ANN), machine learning (ML), deep learning (DL), and computer vision (CV) with spatial mapping data. This integration automates complex spatial analysis, extracts features from satellite and drone imagery, processes natural language mapping commands, and drives modeling and prediction for the real environment.

In this paper presents the analysis and application of the AI-GIS system for water quality assessment (WQA) and support for spatial decision-making and planning. AI-GIS systems integrate GIS capabilities with artificial intelligence (AI) and artificial neural networks (ANN), machine learning (ML) and deep learning (DL) methods to analyze water quality parameters and their spatial and temporal variability. The methodology includes collection and preprocessing of water quality data, georeferencing of sampling locations, integration of hydrochemical and environmental variables into a GIS environment, and application of selected AI-based models for classification, prediction, and spatial assessment of water quality. Depending on the characteristics of the available data set, parameters such as: pH, temperature, electrical conductivity, dissolved oxygen, turbidity, biochemical

oxygen demand, chemical oxygen demand, nitrates, phosphates, concentrations of selected heavy metals, etc. can be taken into account. Some authors include additional spatial factors in these analyses, including land use, soil characteristics, hydrological conditions, population density, industrial activities, proximity to potential sources of pollution, etc.

Keywords: Geographic information system (GIS), artificial intelligence (AI), water quality (WQ), water quality assessment (WQA).

APPLICATION OF ARTIFICIAL INTELLIGENCE IN PREDICTING THE ELECTRICAL PROPERTIES OF SOLID MATERIALS

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Abstract: The electrical properties of solid materials represent a set of physical characteristics that describe the behavior of a solid material in the presence of an electric field or electric current. They are very important for the selection of materials in electrical engineering, electronics, energy, mechanical engineering and modern technical systems. The most important electrical properties are: electrical conductivity (σ), electrical resistance (R), specific electrical resistance (ρ), dielectric properties, dielectric strength, electrical polarization, dielectric losses, etc.

This paper investigates the application of artificial intelligence to predict the electrical conductivity, electrical resistivity, band gap, and dielectric constant of solid materials. Machine learning models are developed using data on the chemical composition, crystal structure, temperature, and other physical characteristics of the materials. The performance of regression model, random forest (RF), and artificial neural network (ANN) models is evaluated using the coefficient of determination (R^2), mean absolute error (MAE), and root mean squared error (RMSE) metrics. The proposed approach enables the identification of complex relationships between material structure and electrical properties, accelerates material characterization, and facilitates the selection of functional materials for applications in sensors, power electronics, and IoT (Internet of Things) devices.

Keywords: Artificial intelligence (AI), solid-state physics, electrical conductivity, machine learning (ML), functional materials.

THE ROLE OF ARTIFICIAL INTELLIGENCE FOR MANAGERS OF MINING AND METALLURGICAL COMPANIES

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Abstract: Artificial intelligence (AI) represents one of the most significant digital transformation technologies of the modern industrial sector for the application of intelligent and smart production systems and Industry 4.0 (I4.0), and is increasingly gaining strategic importance in the management of complex production systems. Mining and metallurgical plants represent special complex industrial systems characterized by continuous production processes, high consumption of energy and raw materials, high maintenance costs, complex logistics, strict requirements regarding product quality and a significant impact on the environment. In such conditions, the application of artificial intelligence (AI) in cooperation with the concepts of M4.0 (management for industry 4.0) and Q4.0 (quality for industry 4.0) can significantly improve the quality and speed of managerial decision-making and contribute to increasing the competitiveness of mining and metallurgical enterprises.

The application of artificial intelligence (AI) methods enables the collection, processing and analysis of large amounts of data generated during production, energy, logistics and business processes. Based on historical and real-time data analysis, AI-based systems can provide management with a more reliable basis for forecasting production, energy consumption, product quality, breakdowns, downtime and market changes. The particular importance is predictive maintenance (PdM), which, based on data from sensors and previous modes of operation of the equipment, can identify patterns that indicate the possibility of failure. In this way, directors are enabled to plan maintenance in a timely manner, reduce unplanned downtime and increase the availability of production capacity.

The aim of the paper is to analyze the role of artificial intelligence (AI) in the process of strategic and operational management of metallurgical plants, with a special focus on the possibilities of its application in the work of the director and top management of the company.

Keywords: Artificial Intelligence (AI), manager, management, mining and metallurgical companies, Industry 4.0 (I4.0), management for Industry 4.0 (M4.0), quality for Industry 4.0 (Q4.0).

IN VIVO EVALUATION OF BIOMATERIALS FOR REGENERATIVE MEDICINE: APPLICATION OF VARIOUS ANIMAL MODELS

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Abstract: Preclinical evaluation of biomaterials using relevant *in vivo* animal models remains a critical milestone in assessing complex host-biomaterial interactions that cannot be fully replicated *in vitro*. Over the course of our research projects, we have implemented and standardized various animal models to test biomaterials differing in composition, origin, physicochemical properties, architecture, and functional applications. Here, we outline the primary *in vivo* models used in our laboratory, detailing their application in evaluating biocompatibility, tissue integration, regenerative capacity, and healing kinetics. To evaluate biomaterials engineered for bone regeneration, a spectrum of orthotopic models was employed, including calvarial critical-sized defects in rats and rabbits, as well as femoral defects in rats and tibial/femoral defects in rabbits. Additionally, ectopic models involving subcutaneous and intramuscular implantation in mice and rats were utilized for bone-related assessments. For investigating cartilage and tendon repair, targeted injury models were established in rats. General *in vivo* biocompatibility, degradation profiles, and host tissue responses were evaluated through standardized subcutaneous implantation model in both mice and rats. Furthermore, to examine biomaterials intended for soft tissue applications, various incisional and excisional full-thickness wound healing models were implemented. This presentation provides a comprehensive summary of all utilized *in vivo* animal models—highlighting their methodology, specific advantages, limitations, and key recommendations for optimizing preclinical testing pipelines—along with representative results from our research on biomaterials with diverse characteristics and intended biomedical applications in regenerative medicine and tissue engineering.

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Keywords: *In vivo* evaluation, biomaterials, animal models, regenerative medicine, preclinical testing.

APPLICATION OF LASER IN DENTISTRY IN DIFFERENT TIME-SPACE PARAMETERS

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Abstract: Although in some highly developed countries, for economic reasons that will not be discussed now, dentistry is already advertised to use in work among the fastest and shortest pulses with many advantages. These are femtosecond lasers that also have their own history, and it is known that models change according to the parameters of power, energy and their respective densities, and that they must be discussed and essential and not considered only as a parameter.

Nevertheless, it is interesting, although it is not the subject of our research, that the search for the first lasers in the femtosecond domain leads to various data. It is only important that playing at the world level is again connected with Nobel Prizes for various geographical locations. On the other hand, since the first pulsed lasers in the "spikes" mode, many more types of lasers have appeared in government institutions, clinics and private laboratories. (The literature is full of advertisements and special handling equipment...).

In all three areas: - interaction with hard tissue, - liquid tissue, - saliva or prosthetic material of various natures, from waxes to porcelain and implants, it uses all the advantages of coherent processes from material processing, of which the first mentioned group of ultrafast lasers is the most comfortable for patients according to the literature in terms of duration and the feeling of "permanence".

In the paper, attention will be paid to some typical models with a focus on practicality, and on the other hand to selected older and newer, more exotic applications of lasers related to dentistry. Attention will also be paid to the choice of color determination from a metrological point of view in relation to more standard dental offers/methods. And here we mean the bases of the linear and non-linear

discipline of optics. Especially in dentistry, there are clear views on the trend of decreasing prices within 5-10 years for both generators and auxiliary instruments, as well as for the inclusion of more sophisticated techniques in work and recording, setting up diagnostics.

The issues of inclusion of pressure assessment, semimetric methods, durability assessment, crack formation... and the organization of experiments with the inclusion of polarization states of quantum generators, move from individual works to traditional tests, given that the technical faculties have mastered the basic theory and the transition to independently chosen problems.

Keywords: femtosecond lasers, diagnostics, remediation of pathogenic conditions, implants.

INTERACTION OF COHERENT RADIATION WITH MATTER IN AN INTERVAL OF SIX DECADES

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Abstract: The interaction of quantum generators after several decades is still full of new facts, both of experimental and theoretical nature, and it is constantly increasing in relevance. Many new branches/disciplines have been developed, there are many divisions, depending on the angle of observation, which covers both reality and simulations and unproven assumptions. We think that it is one of the most dynamic areas in terms of experiment, theory, formalisms, but it is also found at every step of measurement techniques: in application, in entertainment, in education, in the answers of artificial intelligence, well-established industrial applications, transport. There are new and old problems of an energetic nature, transformation coefficients for the most diverse paths of linear or non-linear nature (with emphasis on optics). The goal is always to increase the coefficients of transformation and useful effect, but achieving coherent states only refers to attributes and description. For medical problems, reparations or the selected pathogenic problem of the difference of input and output parameters and the occurrence of processes in the target (inorganic, organic and biological objects or prosthetic aids. It is often repeated that the issue of laser interaction has been the subject of numerous modeling and mass media applications for more than half a century, and many collections of this issue and scientific professional literature are devoted to quantum generators and interactions. It is a wide area, where the complete model should be changed only by 3 lengths of the basic pulse (or by shortening) and the physical properties should represent the target differently (phonon part, electronic part of several most important constants such as thermal diffusion, conductivity. On the other hand, it also affects the classic but modified laws of the relationship between electrical and thermal conductivity, and an explanation of how it should be done with a number, i.e. a function that is a complement to the Wiedeman-Franz law (now the name Lorenz is added). This is

also the case with the area which, on the one hand, is woven into nanoproblems and, on the other hand, touches on issues of the colonization of the Cosmos.

In the proposed work, the sketches of the laser interaction with the material will be followed, but the target and the interaction with a quantitative response (experiment/simulation in our conditions) will be specified in selected cases or well-established approaches. As far as possible, we will address the case of replacement with a brazen Elion technical one, which is already happening.

Keywords: quantum generator, metrology, efficiency, nonlinear optics.

ELECTROMYOGRAPHIC EVALUATION OF THE EFFECTS OF AN OCCLUSAL SPLINT IN INDIVIDUALS WITH BRUXISM

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Abstract: Bruxism is a disorder of the functional activity of the masticatory system manifested by clenching and grinding of the teeth during sleep or wakefulness. It is considered to have a multifactorial etiology, with central, neurophysiological, and psychological factors playing an important role. Prolonged parafunctional activity may lead to wear of the hard dental tissues, damage to the supporting structures of the teeth, hypertrophy and hypertonicity of the masticatory muscles, as well as pain and functional disorders of the temporomandibular joints. A stabilization occlusal splint is one of the most commonly used therapeutic modalities for alleviating the consequences of bruxism.

Objective: The aim of this study was to electromyographically evaluate the effects of stabilization occlusal splint therapy on the functional condition of the masseter muscles in individuals with clinical signs and symptoms of bruxism. It was hypothesized that the use of an occlusal splint would contribute to a reduction in the hypertonicity of the mandibular elevator muscles and mitigate the harmful effects of bruxism on the teeth and their supporting tissues.

Materials and Methods: The study included 20 patients, seven men and 13 women, aged 23 to 37 years. The participants were selected on the basis of medical history, a questionnaire, and a detailed clinical examination from a total of 105 individuals examined at the Clinic for Prosthodontics and Maxillofacial Surgery, Faculty of Dental Medicine, University of Belgrade. Following clinical analysis of the orofacial system and occlusion, electromyographic examination of the right and left masseter muscles was performed before and after stabilization occlusal splint therapy. The analysis was conducted at the Military Medical Academy in Belgrade. Changes in the duration of the SP1 and SP2 silent periods, expressed in milliseconds,

were evaluated as indicators of the functional condition and tension of the masseter muscles.

Results: Following stabilization occlusal splint therapy, a reduction in silent period duration was observed on both examined sides. In the right masseter muscle, the mean SP1 value decreased from 18.58 ± 2.47 ms before therapy to 15.95 ± 1.64 ms after therapy, while the SP2 value decreased from 41.42 ± 1.64 ms to 36.81 ± 1.63 ms. These differences were highly statistically significant ($p < 0.01$). In the left masseter muscle, the SP1 value decreased from 18.67 ± 1.87 ms to 14.38 ± 1.39 ms ($p < 0.01$), while the SP2 value decreased from 41.58 ± 2.50 ms to 38.08 ± 1.75 ms ($p < 0.05$). A reduction in silent period duration was recorded in almost all participants, except for one patient in whom the value on the left side remained unchanged.

Conclusion: The use of a stabilization occlusal splint resulted in a statistically significant reduction in the duration of the SP1 and SP2 silent periods in the masseter muscles. The electromyographic findings indicate a reduction in muscle tension and hypertonicity in individuals with bruxism. A stabilization occlusal splint may represent an effective therapeutic modality for alleviating the neuromuscular and dentoalveolar consequences of bruxism.

Keywords: bruxism; occlusal splint; electromyography; masseter muscle; silent period; masticatory system.

ASSOCIATION OF THE FABP2 POLYMORPHISM WITH ACUTE MYOCARDIAL INFARCTION

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Abstract: Background: Fatty acid-binding protein 2 (FABP2) is primarily involved in the intestinal absorption and intracellular transport of long-chain fatty acids. The rs1799883 polymorphism is associated with increased fatty acid binding affinity, which may contribute to atherogenic dyslipidemia and cardiovascular risk. Aim: To investigate the association of the FABP2 polymorphism with lipid profile parameters and selected cardiometabolic risk factors in patients with acute myocardial infarction (AMI). Methods: A cross-sectional observational study included 190 patients with acute myocardial infarction. FABP2 rs1799883 genotyping was determined by qPCR. Results: The distribution of FABP2 rs1799883 genotypes was 45.8% CC, 47.4% CT, and 6.8% TT. Allele frequencies were 69.5% for the C allele and 30.5% for the T allele, with genotype distribution consistent with Hardy-Weinberg equilibrium ($\chi^2=2.59$, $p=0.1075$). A statistically significant association was observed between FABP2 genotypes and serum LDL cholesterol levels ($p=0.0231$). TT homozygotes exhibited the highest LDL cholesterol concentrations, followed by CT heterozygotes and CC homozygotes. Total cholesterol showed a non-significant trend toward higher values in TT carriers ($p=0.0958$). Furthermore, FABP2 genotypes were significantly associated with smoking status ($p = 0.0260$), with a higher prevalence of smokers among T allele carriers than among CC homozygotes. A significant association was also found with sex distribution ($p = 0.0399$), with the TT genotype showing a higher proportion of females compared with the CT and CC genotypes. Conclusion: The FABP2 rs1799883 polymorphism was significantly associated with elevated LDL cholesterol levels in patients with acute myocardial infarction. Homozygosity for the T allele was associated with the highest LDL cholesterol concentrations, suggesting a potential contribution of this genetic variant to an atherogenic lipid profile. These findings suggest that FABP2 genetic variation may contribute to lipid metabolism disturbances and cardiovascular risk in patients with acute myocardial infarction.

Keywords: FABP2, acute myocardial infarction, lipid metabolism, genetic polymorphism, rs1799883.

IN VITRO EVALUATION OF WATER SORPTION AND SOLUBILITY OF THREE DENTAL MATERIALS

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Abstract: Introduction: Solubility and sorption are material properties that can directly affect their stability, integrity, and durability at the site of application. Aim: The aim of this study was to examine the solubility and sorption of a newly synthesised nanomaterial based on calcium aluminate, calcium silicate, and MTA. Materials and methods: The study used a nanostructured calcium aluminate synthesised by the hydrothermal sol-gel method from individual components of calcium aluminate ($\text{CaO} \cdot \text{Al}_2\text{O}_3$), calcite (CaCO_3), and barium sulphate (BaSO_4) as a radiopacifier, and a calcium silicate-based material. The mixed material was placed into plastic moulds 5 ± 0.1 mm in diameter and 2 ± 0.1 mm in height. After setting, the materials were kept in an incubator at 37°C for 24 h, after which they were removed from the moulds and liquid sorption of the materials was analysed. Eight specimens were prepared for each tested material ($n = 8$). MTA (Angelus, Londrina, Brazil) was used as the control material. Results: During 28 days of specimen storage in distilled and deionised water, liquid sorption for MTA was 12.71%, sorption for calcium silicate was 12.08%, while calcium aluminate showed a liquid sorption of 20.27%. Using Student's t-test, a difference was observed between calcium aluminate and MTA ($t = -7.094$; $p = 0.000005$) and between calcium aluminate and calcium silicate ($t = -7.026$; $p = 0.000006$), while the difference between calcium silicate and MTA was not statistically significant. Solubility for MTA was 8.53%, solubility for calcium silicate was 8.3%, while calcium aluminate showed a solubility of 23.68%. A significant difference was observed between calcium aluminate and MTA ($t = 4.828$; $p = 0.001308$) and between calcium aluminate and calcium silicate ($t = 4.817$; $p = 0.000951$), while the difference between calcium silicate and MTA was not statistically significant. Conclusion: The solubility and liquid absorption of the nanostructured calcium aluminate-based material were significantly higher compared with calcium silicate and MTA.

Keywords: solubility; sorption; calcium aluminate; calcium silicate; MTA; nanomaterials.

MOTHER'S ORAL MICROBIOME AND CHILD'S ORAL HEALTH DEVELOPMENT: THE ROLE OF GENETICS, EPIGENETICS AND PREVENTIVE CARE

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Abstract: The oral health of a child begins to take shape long before the first teeth appear. During pregnancy, the mother's body undergoes numerous hormonal, immunological and metabolic changes that can affect the composition of the oral microbiome and the occurrence of oral diseases. The oral health of a pregnant woman is not only important for her own health, but also plays a significant role in the development of the oral health of her child.

The mother's oral cavity is one of the first sources of microorganisms that the child encounters after birth. The transmission of oral bacteria from the mother to the child, especially cariogenic bacteria such as *Streptococcus mutans*, can affect the development of the child's oral microbiome and increase the risk of early childhood caries. However, the presence of individual bacteria in itself is not sufficient for the development of the disease, but their influence depends on the complex interaction of the microbiome, genetic factors and environmental influences.

Genetic factors play an important role in determining the structure and resistance of dental tissues, the composition of saliva, the immune response, and individual susceptibility to oral diseases. Variations in genes involved in enamel development and the body's defense mechanisms can contribute to different susceptibility to caries, developmental disorders of teeth, and periodontal diseases.

A special link between heredity and the environment is epigenetics, the field that studies changes in gene regulation without changing the DNA sequence itself. Factors such as maternal diet, stress, inflammatory processes, and the composition of the microbiome during pregnancy can affect the expression of certain genes and potentially shape the development of the immune system and oral health of the child.

Understanding the relationship between the mother's oral microbiome, genetics, and environmental factors emphasizes the importance of prenatal dental care. The oral health of the future child does not begin with the first tooth, but with the oral environment that we create even before his birth.

Keywords: pregnancy, oral microbiome, oral health, genetics, epigenetics, prevention.

PERSONALIZED DENTISTRY - THE FUTURE OF TREATMENT BASED ON THE PATIENT'S GENETIC PROFILE

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Abstract: Personalized dentistry is a modern concept of dental medicine focused on an individual approach to each patient, with the aim of improving the prevention, diagnosis and treatment of oral diseases. Unlike the traditional approach, which is based on the application of the same therapeutic procedures to different patients, personalized dentistry takes into account the unique biological characteristics of the individual, including the genetic profile, epigenetic changes, the composition of the oral microbiome, the presence of specific biomarkers, and environmental and lifestyle factors.

The development of genomics and molecular biology has enabled a more detailed understanding of the role of genetic factors in the development and progression of oral diseases. Individual genetic variations can influence the tendency to develop caries, periodontitis, peri-implant diseases, disorders of the development of dental structures and various forms of oral pathologies. Also, knowledge of the patient's genetic profile can contribute to a better risk assessment, earlier detection of diseases and the selection of the most appropriate therapeutic approach.

The use of saliva biomarkers, oral microbiome analysis, genetic testing, and advanced digital technologies open up the possibility of moving from a dentistry focused on treating existing disease to a dentistry focused on risk prediction and individual prevention. Such an approach allows for a better understanding of biological differences between patients and potentially increases the success of therapy and long-term treatment outcomes.

Keywords: personalized dentistry, genetic profile, genomics, biomarkers, individualized therapy.

ANTIBACTERIAL PROPERTIES OF NANOMATERIALS IN JAW ORTHOPEDICS

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Abstract: The development of nanotechnology has opened up new possibilities for the application of innovative materials in dental medicine, especially in jaw orthopedics.

Orthodontic therapy with fixed appliances often makes it difficult to observe oral hygiene due to the accumulation of dental plaque around brackets, orthodontic wires and adhesives. The result is an increased colonization of cariogenic bacteria, the appearance of enamel demineralization, the appearance of white spots, gingivitis, and the development of caries.

Incorporating nanoparticles into brackets, orthodontic wires, adhesives, and aligners aims to enhance their antibacterial properties and reduce the risk of caries development and enamel demineralization during orthodontic treatment. The most commonly used nanoparticles include silver (Ag), zinc oxide (ZnO), titanium dioxide (TiO₂), copper oxide (CuO), graphene oxide, and chitosan. Their action is based on inhibiting bacterial growth—particularly that of *Streptococcus mutans*, which plays a key role in the formation of dental plaque and caries. Consequently, the development of orthodontic materials with antibacterial properties has become a significant area of contemporary research.

Keywords: nanoparticles, antibacterial properties, dental plaque, caries, *S. mutans*, orthodontic appliances

CATALYTIC INNOVATIONS IN BASE OIL PRODUCTION: ENHANCING REACTION SELECTIVITY THROUGH MOLECULAR REFINING

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Abstract: Modern industrial infrastructure and technological advancement rely heavily on an extensive spectrum of mechanical systems, ranging from large-scale manufacturing facilities and transport networks to high-precision robotic devices. As traditional machinery undergoes a paradigm shift toward comprehensive automation and cyber-physical architecture, the demand for operational reliability becomes paramount. Crucial to all these heterogeneous assemblies is the continuous efficiency of primary dynamic components, such as bearings and power transmission systems, which fundamentally depend on advanced lubrication technology. Moving away from conventional manufacturing, this paper delivers a comprehensive analysis of the global lubricant market and modern production trends. Special emphasis is placed on evaluating diverse base oil processing methodologies, shifting the focus from historical solvent extraction toward advanced catalytic innovations and molecular refining. Furthermore, this study examines how targeted compositional modifications enhance the fundamental performance characteristics of base oils, aligning them with stringent contemporary industrial and environmental standards.

Key words: Lubricating oil manufacturing, mineral base oils, base oil refining, solvent extraction, hydrotreating.

ADVANCED MATERIALS IN ENGINEERING FOR PROTECTION AGAINST ELECTROMAGNETIC RADIATION

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Abstract: The growing concern over electromagnetic (EM) pollution has driven rapid advancements in the field of electromagnetic interference (EMI) shielding and EM wave absorption in recent years, with research focusing on carbon materials characterized by a large specific surface area and high porosity. Compared to other carbonaceous materials, biomass-derived carbon (BC) is considered an efficient and environmentally friendly material for this purpose. In this paper, we summarize recent achievements regarding BC materials for EMI shielding and EM wave absorption. Special emphasis is placed on the possibilities of their application in the manufacturing of protective housings for modern electronic devices used to access digital platforms. These innovative materials offer solutions that not only minimize unwanted radiation but also significantly contribute to the safety of human health in a technological environment. Following a brief overview of synthesis strategies for BC materials and a precise description of EM wave interference, strategies for enhancing their EMI shielding and EM wave absorption performance are discussed. Finally, existing challenges and future perspectives for such materials are briefly summarized.

Keywords: Electromagnetic pollution, electromagnetic interference (EMI) shielding, electromagnetic (EM) wave absorption, biomass-derived carbon, porous carbon materials, eco-friendly materials.

MODERN CBRN MATERIALS FOR PROTECTION AND DECONTAMINATION IN EMERGENCY SITUATIONS (IN WAR AND PEACE)

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Abstract: The contemporary postmodern environment is characterized by a high level of risk associated with the occurrence of emergency situations, ranging from natural disasters and technological accidents to current threats posed by CBRN terrorism, with particular emphasis on bioterrorism. The physical and biological disruption generated by such events requires a fundamental shift in the development of protective systems. This paper analyzes the application of new, advanced, structured, and smart materials in CBRN equipment and in systems intended for protection and decontamination. Guided by the principles of green chemistry, the focus is increasingly shifting toward nanosensors for rapid pathogen detection, antimicrobial polymers for collective and personal protection, and environmentally safe bio-decontaminants. In this way, advanced materials are no longer regarded merely as passive protective barriers, but as active components in prevention, crisis management, and the preservation of environmental security and societal mental homeostasis under conditions of destructive impacts.

Keywords: advanced materials, CBRN equipment, emergency situations, CBRN protection, decontamination, environmental security.

REMOTE SENSING OF METHANE AND CARBON DIOXIDE FOR CLIMATE CHANGE MONITORING

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Abstract: The paper presents the results of remote sensing of methane and carbon dioxide using a publicly available platform that enables remote data collection. The paper presents the use of the platform and the way in which data on methane and other carbon compounds are presented clearly and easily accessible to the public. Data were analyzed for several active plants that emit the aforementioned methane and other carbon compounds in complex process systems. Remote sensing can also be used to monitor climate change.

Keywords: remote sensing, climate change, methane, satellite view.

ASSESSMENT OF PERIAPICAL STATUS OF ENDODONTICALLY TREATED TEETH USING THE PAI INDEX

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Abstract: The quality of chemomechanical preparation, the choice of instrumentation technique (conventional manual versus rotary/biomechanical root canal instrumentation), as well as the three-dimensional hermeticity of the obturation and the adequacy of the coronal restoration, directly dictate the degree of intracanal infection elimination and the healing response of periapical tissues. The success of endodontic therapy is assessed by radiographic determination of the periapical index (PAI), whereby the persistence or enlargement of a periapical radiolucency is classified as a treatment failure.

Aim: To evaluate and compare the impact of the instrumentation technique (manual versus rotary), primary diagnosis, root canal obturation quality, and coronal restoration quality on the final radiographic periapical status (PAI) of endodontically treated teeth.

Material and Methods: This retrospective study included 29 endodontically treated teeth, divided according to the chemomechanical preparation method into a rotary instrumentation group (M; n=13) and a manual instrumentation group (R; n=16). The following parameters were compared: primary diagnosis (acute apical periodontitis – PAA, 37.9% or chronic apical periodontitis – PAH, 62.1%), coronal restoration quality (adequate: 55.2%; inadequate: 44.8%), and root canal obturation quality (adequate: 34.5%, homogeneous: 37.9%, short: 20.7%, and non-homogeneous: 6.9%). Periapical status (PAI scores 1–5) was analyzed individually and divided into two clinical categories: the first group consisted of teeth with PAI scores 1 and 2, defined as a healthy periapex (successful treatment outcome), while all scores greater than 2 (PAI > 2) indicated persistent apical periodontitis (treatment failure).

Results: In the total sample, the PAI 2 score had the highest frequency (31.03%), while the PAI 5 score was the least frequently recorded (6.90%). The use of rotary instrumentation (M) resulted in a significantly higher rate of treatment success (PAI 1 and 2 in 69.2% of cases), whereas manual preparation (R) was associated with a higher prevalence of persistent lesions with higher scores (PAI 3, 4, and 5 in 62.5%

of cases). A significant statistical correlation was observed between high PAI scores (4 and 5) and inadequate coronal restorations. Defective obturations (short and non-homogeneous fillings) were predominantly present in periapical processes with high PAI scores, where short obturation was identified in 83.3%, and non-homogeneous obturation in 100.0% of cases.

Conclusion: Post-treatment periapical status depends on the applied clinical protocols. Modern rotary instrumentation provides a significantly better periapical outcome compared to conventional manual root canal preparation. Endodontic failure is most frequently the result of the synergistic effect of inadequate coronal hermeticity (microleakage) and obturation defects. For long-term therapeutic success, a comprehensive multidisciplinary approach is required: precise rotary preparation, homogeneous obturation up to the anatomical apex, and a functional-aesthetic coronal restoration that ensures a high-quality marginal seal.

Keywords: PAI index; rotary instrumentation; manual root canal preparation; root canal obturation; marginal seal; apical periodontitis.

RADIATION PROTECTION IN THE DESIGN OF BUNKERS FOR CT SIMULATORS

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Abstract: Computed tomography (CT) unit is also used as a CT simulator in radiation therapy (RT), primarily for planning external beam radiotherapy. From the perspective of radiation protection, diagnostic CT scanners and CT simulators have identical radiation characteristics. The emitted photon beam is filtered at an X-ray tube voltage of 140 kVp. After passing through the patient, the primary beam is almost completely absorbed and attenuated by the rotating detector array and gantry components. Therefore, only the scattered radiation component is considered when calculating the required thickness of shielding barriers. Shielding calculations were performed using the Dose Length Product (DLP) method, which is based on the product of the Computed Tomography Dose Index (CTDI) and the total scan length, together with scatter factors obtained from experimental measurements on different CT systems. The CT scanner was installed at the center of a bunker measuring 7.5 m toward the control room, 5.0 m toward the corridor and adjacent examination rooms, and 3.5 m in height. The weekly workload is 125 patients, including 75 abdominal examinations (DLP = 850 mGy·cm) and 50 head examinations (DLP = 900 mGy·cm).

The design dose constraints recommended by NCRP Report No. 147 are 5 mSv per year (0.1 mSv per week) for the control room and 1 mSv per year (0.02 mSv per week) for adjacent areas, assuming occupancy factors of 1 for examination rooms and 0.125 for the corridor. The air kerma due to scattered radiation at a distance of 1 m from the isocenter was assumed to be approximately 1 mGy per CT examination, corresponding to 125 mGy per week. Applying the inverse square law, air kerma values at the shielding barriers were determined and corrected for occupancy factors. Subsequently, the transmission factor (B) and the required number of tenth-value layers (nTVLs) were calculated, where one tenth-value layer (TVL) is defined as the thickness of shielding material required to reduce the photon beam intensity to one-tenth of its initial value. The results indicate that the required lead shielding

thicknesses are 2.1 mm for the corridor, 3 mm for the examination rooms and ceiling, and 2 mm for the control room. The corresponding concrete shielding thicknesses are approximately 21 cm, 30 cm, and 20 cm, respectively. These findings confirm that CT facilities require thicker shielding barriers than other diagnostic X-ray installations. The effectiveness of the shielding is finally verified by radiation surveys performed on the outer surfaces of all shielding barriers, confirming compliance with the design dose constraints and identifying any potential shielding deficiencies.

Keywords: computed tomography (CT), dose length product (DLP), air kerma, tenth-value layer (TVL), shielding barriers, radiation protection.

DOSE-DEPENDENT EFFECT OF GOLD NANOPARTICLES ON THERMAL CONDUCTIVITY, DIFFUSIVITY, AND EFFUSIVITY OF PMMA DENTURE BASE RESIN

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Abstract: Polymethyl methacrylate (PMMA) is the most widely used denture base material; however, its relatively low thermal conductivity limits the transmission of thermal stimuli from food and beverages to the underlying oral tissues. Improving the thermal properties of PMMA may enhance thermal perception and contribute to a more natural oral sensory experience for denture wearers. Gold nanoparticles (AuNPs) have attracted considerable interest as functional nanofillers due to their unique physicochemical properties and potential to modify heat-transfer characteristics of polymeric materials. The aim of this study was to evaluate the effect of AuNPs incorporation on the thermal conductivity, thermal diffusivity, and thermal effusivity of heat-polymerised PMMA denture base resin and to assess the potential implications of these changes for the oral cavity environment. PMMA specimens containing 0 wt.% (Group A), 0.12 wt.% (Group B), 0.43 wt.% (Group C), and 0.74 wt.% (Group D) AuNPs were analysed. Thermal conductivity was measured using a Hot Disk Thermal Constants Analyser (TPS 2200, isotropic standard method); thermal diffusivity and thermal effusivity were calculated from the measured thermal conductivity and volumetric specific heat capacity, obtained from the same instrument, using standard thermal physics relations ($\alpha = k/\rho c_p$; $e = \sqrt{k\rho c_p}$). Measurements were performed in triplicate series under varying heating power and measurement time settings (30–150 mW; 10–320 s) to en-

sure methodological robustness. Data were analysed using SPSS, with one-way ANOVA and group comparisons against the control group; $p < 0.05$ was considered statistically significant. The incorporation of AuNPs resulted in a concentration-dependent increase in all evaluated thermal parameters. Thermal conductivity increased from 0.193 W/mK in the control group to 0.204 W/mK, 0.208 W/mK, and 0.210 W/mK in Groups B, C, and D, respectively. Similarly, estimated thermal diffusivity increased from approximately 0.111 mm²/s in the control group to 0.118, 0.120, and 0.121 mm²/s, while thermal effusivity increased from approximately 578 to 594, 600, and 603 Ws^{0.5}/m²K, respectively. These findings indicate an enhanced capacity of the nanocomposite materials to conduct, distribute, and exchange thermal energy. Within the limitations of this study, the incorporation of AuNPs improved the thermal properties of PMMA denture base resin. The observed enhancement may facilitate more efficient transmission of thermal stimuli within the oral cavity, potentially improving thermal perception and patient comfort during prosthesis use. AuNP-modified PMMA therefore represents a promising candidate for the development of advanced denture base materials with improved functional performance.

Keywords: polymethyl methacrylate; gold nanoparticles; denture base resin; thermal conductivity; thermal diffusivity; thermal effusivity; nanocomposites; oral environment.

DOES THE COLLIMATOR ROTATION HAVE AN INFLUENCE ON THE DOSE DISTRIBUTION IN THE VMAT PLANNING FOR HEAD AND NECK CANCER?

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Abstract: Aim of this study is to investigate if the collimator rotation has an influence on the dose distribution in volumetric arc therapy (VMAT) for head and neck cancer. The computed tomography (CT) scans of 10 patients were included in the study. VMAT plans, with two full arcs, were generated with two different approaches: first approach was to use collimator rotation of 30 and 330 degrees, and second approach was to use collimator rotation of 0 and 90 degrees. All plans were analyzed using dose volume histograms. Conformity index (CI) and heterogeneity index (HI) were calculated. Results for planning target volume (PTV) coverage and sparing organs at risk were similar for both approaches.

Keywords: Head and neck cancer radiotherapy, collimator angle.

CORROSION OF DEPLETED URANIUM PENETRATORS AS A SOURCE OF URANIUM(VI) IN THE ENVIRONMENT OF THE BALKANS

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Abstract: During NATO operations in Bosnia and Herzegovina in 1995 and in the Federal Republic of Yugoslavia in 1999, several tons of depleted uranium (DU) ammunition were used across the Balkan region, with a significant number of penetrators remaining in the soil after the conflicts ended. It is estimated that approximately 3 tons of depleted uranium were used in the conflicts in Bosnia and Herzegovina, while around 10 tons were used in Serbia and Montenegro. Although immediately after the conflicts attention was focused on radioactive particles and penetrator fragments, long-term corrosion of the remaining projectiles is now considered one of the most important environmental aspects of their presence in the environment. This review paper analyzes the oxidation and corrosion processes of depleted uranium penetrators, the mechanisms of uranium(VI) uranyl ion (UO_2^{2+}) formation and secondary uranium(VI) mineral phases, as well as the factors controlling uranium migration through soil and groundwater, which increases health risks. Available data show that corrosion of metallic uranium leads to the gradual transformation of poorly soluble U(IV) into mobile U(VI) species, primarily the uranyl ion and secondary minerals such as schoepite, metaschoepite, and becquerelite. In the presence of oxygen, moisture, and microorganisms, corrosion products with significantly higher solubility and mobility are formed compared to primary uranium oxides, enabling their migration through the soil profile. Field investigations conducted in Serbia and Bosnia and Herzegovina showed that penetrators found 18 months after the conflict had experienced a mass loss of 2–8%, while their complete degradation was estimated to take approximately 15–35 years, depending on geochemical conditions. At some contaminated sites in Serbia, activity concentrations of up to 2.3×10^6 Bq/kg for ^{238}U and up to 3,251 Bq/kg for ^{235}U were recorded, with confirmed presence of depleted uranium in soil samples around impact locations. Experimental and field studies have shown uranium migration through the soil profile to a depth of approximately 40 cm over a period of 7 years, where moisture content, carbonates, redox potential, and microbiological activity

play key roles in the formation and transport of U(VI). Although previous studies have generally not indicated contamination of drinking water in Serbia, the results confirm that corrosion products of remaining penetrators represent an active and long-term secondary source of uranium(VI) in the Balkan environment. Given the time elapsed since their use, it can be expected that a significant portion of the originally deposited depleted uranium has already been transformed into mobile oxidative products, which justifies the need for continuous monitoring of soil and groundwater, risk assessment for the population, and implementation of remediation measures at sites where remaining penetrators are still present. A review of the literature indicates insufficient investigation of contaminated sites in Bosnia and Herzegovina, which limits the formulation of comprehensive conclusions.

Keywords: radioactivity, uranium(VI), depleted uranium, environmental contamination, corrosion.

MAGNETIC PROPERTIES OF CUBE-LIKE AND ROUNDED HEMATITE NANOPARTICLES SYNTHESIZED BY HYDROTHERMAL SYNTHESIS METHOD

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Abstract: In this study hematite nanoparticles ($\alpha\text{-Fe}_2\text{O}_3$) of cube-like and rounded shape were synthesized via hydrothermal synthesis method by varying ethanol/water ratios. Particle shape directly influences physicochemical properties, magnetic behavior, and optical properties. The morphology and particle sizes of the synthesized samples were observed by scanning electron microscopy (SEM) and transmission electron microscopy (TEM). The magnetic properties of the hematite nanoparticles were investigated across a broad temperature range (50–300 K) and under various applied magnetic fields (up to 3 T) utilizing a vibrating-sample magnetometer. Cube-like hematite nanoparticles display ultra-low coercivity ($H_C = 21$ Oe) due to defect-minimized planar surfaces, whereas rounded hematite nanoparticles exhibit higher coercivity ($H_C = 306$ Oe) due to defect-rich curved surfaces and atomic misalignments. Understanding the shape-dependent magnetic properties of hematite ($\alpha\text{-Fe}_2\text{O}_3$) nanoparticles is essential for advancing their biomedical and nanotechnological applications. With low cytotoxicity and high biocompatibility, the synthesized hematite nanoparticles show promise for magnetic nanodevice development and biomedical applications.

Keywords: Hematite, hydrothermal synthesis, scanning electron microscopy, transmission electron microscopy, biomedical applications.

MODIFICATION OF STARCH-BASED WOOD ADHESIVE WITH CITRIC ACID TO IMPROVE MOISTURE RESISTANCE

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Abstract: Wood adhesives play a crucial role in the production of solid wood products and wood-based materials, as the quality of the adhesive bond directly affects the strength, durability, and reliability of the final product. Growing environmental and health concerns associated with conventional formaldehyde-based adhesives have increased interest in bio-based adhesives derived from renewable, biodegradable, and non-toxic raw materials. Starch is a promising material for this purpose; however, its pronounced hydrophilicity limits the moisture resistance of starch-based adhesive bonds. This study investigated the modification of a commercial starch adhesive with citric acid to improve the moisture resistance and mechanical properties of bonded wood joints. Beech (*Fagus sylvatica* L.) specimens were bonded using an unmodified starch adhesive and formulations containing 10%, 20%, and 30% citric acid relative to the dry starch mass. Because the specimens pressed at 120 °C disintegrated during conditioning and water exposure, indicating inadequate curing and poor moisture resistance, the pressing temperature was increased to 170 °C, with a pressing time of 10 min and a specific pressure of 1.5 MPa. The specimens were conditioned and exposed to water in accordance with SRPS EN 204:2016 requirements, while tensile shear strength was determined according to SRPS EN 205:2016. The control formulation exhibited the highest mean shear strength of 5.69 MPa, whereas the adhesives containing 10%, 20%, and 30% citric acid achieved mean values of 5.30, 5.33, and 5.33 MPa, respectively. Although citric acid caused a slight reduction in shear strength compared with the control, pressing at 170 °C considerably improved the integrity and moisture resistance of the bonded specimens, which remained intact after water exposure, unlike those pressed at 120 °C. The results demonstrate that pressing temperature is a critical factor in the performance of starch–citric acid bioadhesives because it affects the balance between starch esterification and acid hydrolysis. Further optimization of the adhesive formulation, pressing temperature, pressing time, and catalyst use is required to enhance both moisture resistance and mechanical performance.

Keywords: wood adhesive, bioadhesive, starch, citric acid, moisture resistance, shear strength.

THE QUALITY OF THE WORKED SURFACE OF THE HARDENED MATERIAL OBTAINED BY TURNING PROCESSING WITH DIFFERENT TOOL MATERIALS

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Abstract: The process of processing hardened steel is increasingly present in many laboratories and production facilities. The application of the processing process by scraping hardened materials instead of grinding is effective in terms of productivity, it gives a good quality of the processed surface and satisfactory durability of the tool. In recent years, a large number of scientists have been engaged in research into the cutting process in order to find the dependence between the cutting mode as input parameters and the output performance of the turning process of hardened materials. The paper also examined the influence of different types of tool material, different tool geometry, and tool wear on the output performance of the process.

In order to model cutting resistance, surface roughness and cutting temperature, experimental data and two types of models were used, using a central compositional three-factor plan and artificial intelligence.

Realized experimental research represents a special scientific contribution in this currently insufficiently researched area.

Keywords: hardened steels, turning, tool geometry, factor plan.

DETERMINATION OF FRICTION IN BIOMECHANICAL JOINTS USING ARTIFICIAL INTELLIGENCE

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Abstract: The anatomical structure that connects two bones is called a joint or joint. The paper investigates the occurrence of friction in the joints of artificial hip endoprostheses. It was pointed out that in artificial joints it is not possible to realize current friction, but only mixed friction for a specific endoprosthesis. The moments of friction and the coefficient of friction were determined depending on the lubricant and the load. In this work, knowledge based on artificial neural networks is applied, which enables a faster and more efficient process of automatic recognition of technological forms and the acquisition of knowledge based on technological patterns.

Keywords: bones, lubricants, tribology, modelling, artificial neural networks.

TRIBOLOGY PROPERTIES OF AUSTEMPERED DUCTILE IRON AS FUNCTION OF THEIR STRUCTURE

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Abstract: Tribological properties of Austempered Ductile (ADI), as well as of the other materials, can be determined by measuring the friction force in the tribo-mechanical systems (energetic aspect) and by measuring the chosen parameter of wear (economic aspect) on critical elements of tribo-mechanical systems.

Tribological properties of nodular cast irons (ADI) EN-GJS-500-7 and EN-GJS-700-2, that are treated isothermally and classical procedures, are investigated a long time on tribometer "Pin and Disk". The friction coefficient and PQ index are used for identification tribological properties of nodular cast irons in contact with carbide steel.

In this paper is presented a part of experimental results about influence of two parameter of metalurgical structure of nodular cast iron EN-GJS-500-7 on its tribological properties.

Keywords: nodular cast iron, heat treatment, friction, wear.

GLOBAL DEVELOPMENT AND TECHNOLOGICAL PROGRESS OF LITHIUM BATTERIES

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Abstract: Nowadays, modern batteries have achieved significant progress, with their energy density and safety in use significantly increased. Lithium batteries represent one of the key technologies of the modern energy sector and play a significant role in the process of global energy transition. A battery is an electrochemical device composed of several components made of different types of materials, on which many aspects of its operation depend, such as lifetime, rate of degradation and price. Lithium batteries have a long history and currently play the most important role in the electric car industry. However, they are also used in devices such as mobile phones, laptops and other electronic devices. Renewable energy sources and lithium batteries play a significant role in the modern energy system today.

Keywords: renewable energy sources; lithium batteries; energy storage; electric vehicles.

CONTRIBUTION OF HEAT PUMPS TO ENERGY EFFICIENCY AND SUSTAINABLE DEVELOPMENT

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Abstract: Around the world, the growing need for consumption directs attention to the application of heat pumps that use non-conventional, i.e. renewable energy sources. Thanks to high energy efficiency, heat pumps are an economical and environmentally friendly solution for heating and cooling, enabling significant primary energy savings and reduction of fossil fuel consumption. Their application contributes to the improvement of energy efficiency of the system and sustainable development in the energy sector, as well as in industry, public facilities, residential buildings and the utility sector. In this way, conditions are created for long-term sustainability, more rational use of available resources and alignment with modern requirements in the field of energy efficiency and environmental protection.

Keywords: heat pumps, energy efficiency, sustainable development, renewable energy sources.

pH-DEPENDENT PHENOL REMOVAL FROM AQUEOUS SOLUTIONS USING A SUSTAINABLE CARBON ADSORBENT DERIVED FROM FOOD WASTE

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Abstract: Phenol is recognized as one of the priority organic pollutants in aquatic environments due to its high toxicity and widespread industrial use. In this study, the adsorption performance of a carbon adsorbent produced by carbonization of a mixture of banana, potato, and carrot peels was evaluated for phenol removal from aqueous solutions. The effects of the initial solution pH and phenol concentration on the adsorption process were investigated. The adsorbent exhibited high phenol removal efficiency over a wide pH range (2–12), with the highest performance observed under slightly acidic to neutral conditions, while only minor variations were detected under strongly acidic and alkaline conditions. The maximum adsorption capacity reached approximately 190 mg g⁻¹. The equilibrium data were analyzed using the Langmuir, Freundlich, and Temkin adsorption isotherm models. Among the applied models, the Langmuir isotherm provided the best fit to the experimental data, indicating predominantly monolayer adsorption on a relatively homogeneous surface. The obtained results demonstrate that the synthesized carbon adsorbent represents an efficient, low-cost, and sustainable material for the removal of phenol from contaminated water.

Keywords: Phenol, adsorption, biocarbon, Langmuir isotherm, water purification.

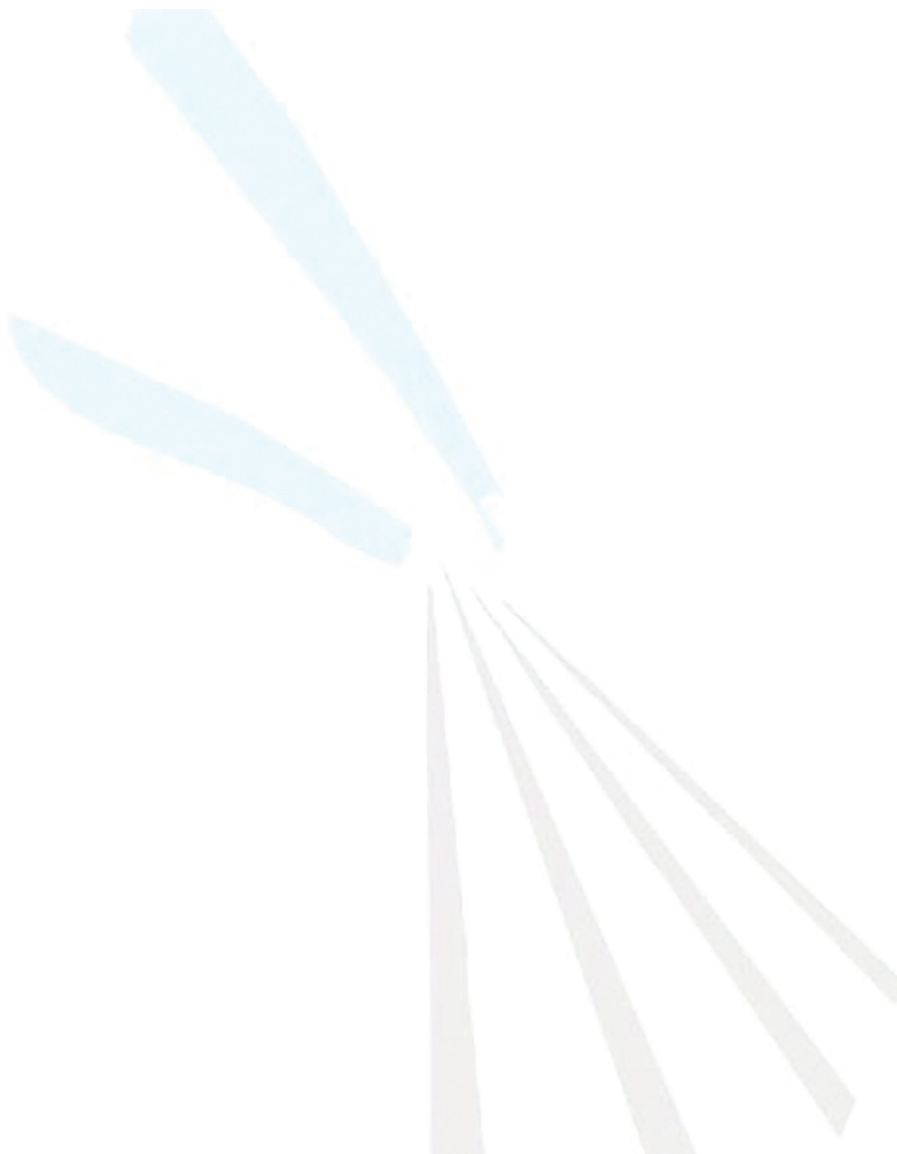
CHARACTERIZATION OF CARBON ADSORBENT OBTAINED BY CARBONIZATION OF ORGANIC HOUSEHOLD WASTE FOR USE IN WATER TREATMENT

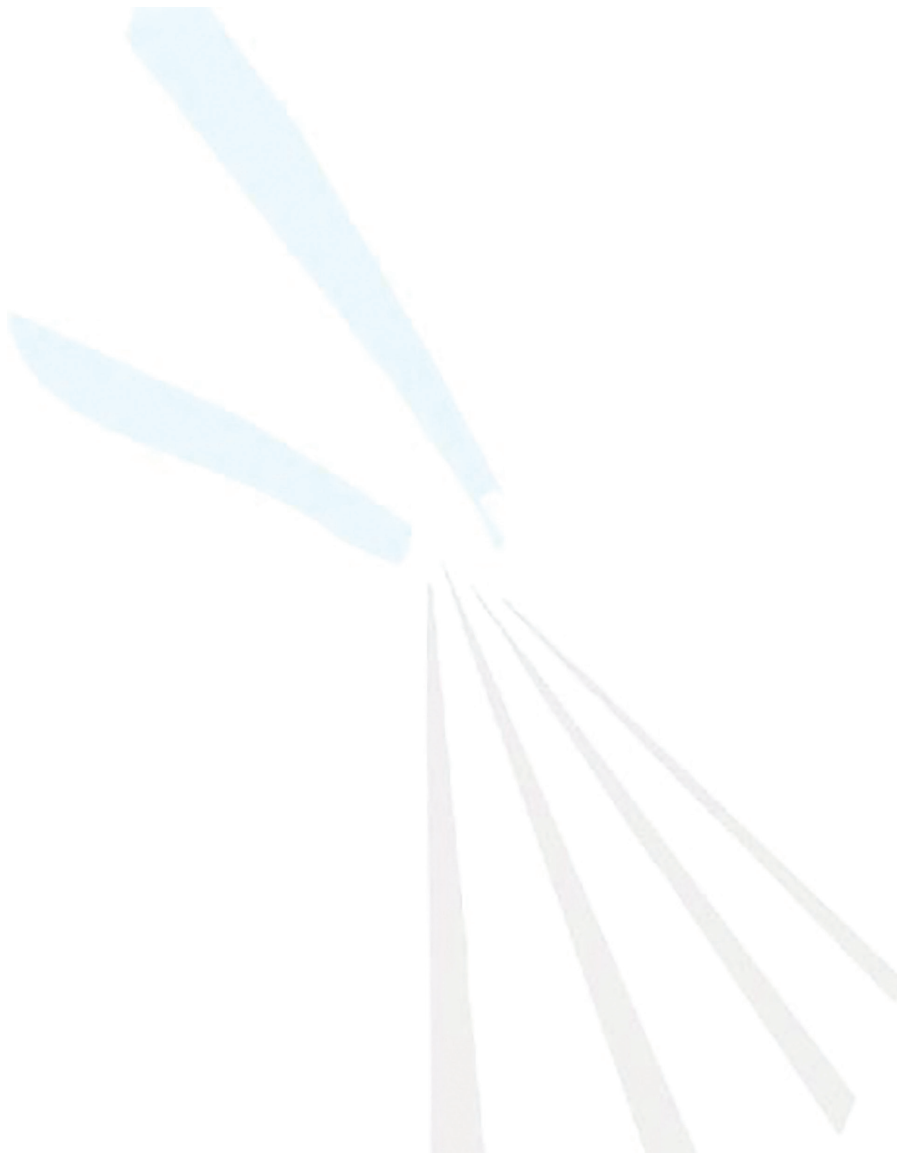
Radmila Lišanin, Marija Stojmenović, Jelena Gulicovski, Jovana Bukumira, Milan Kragović

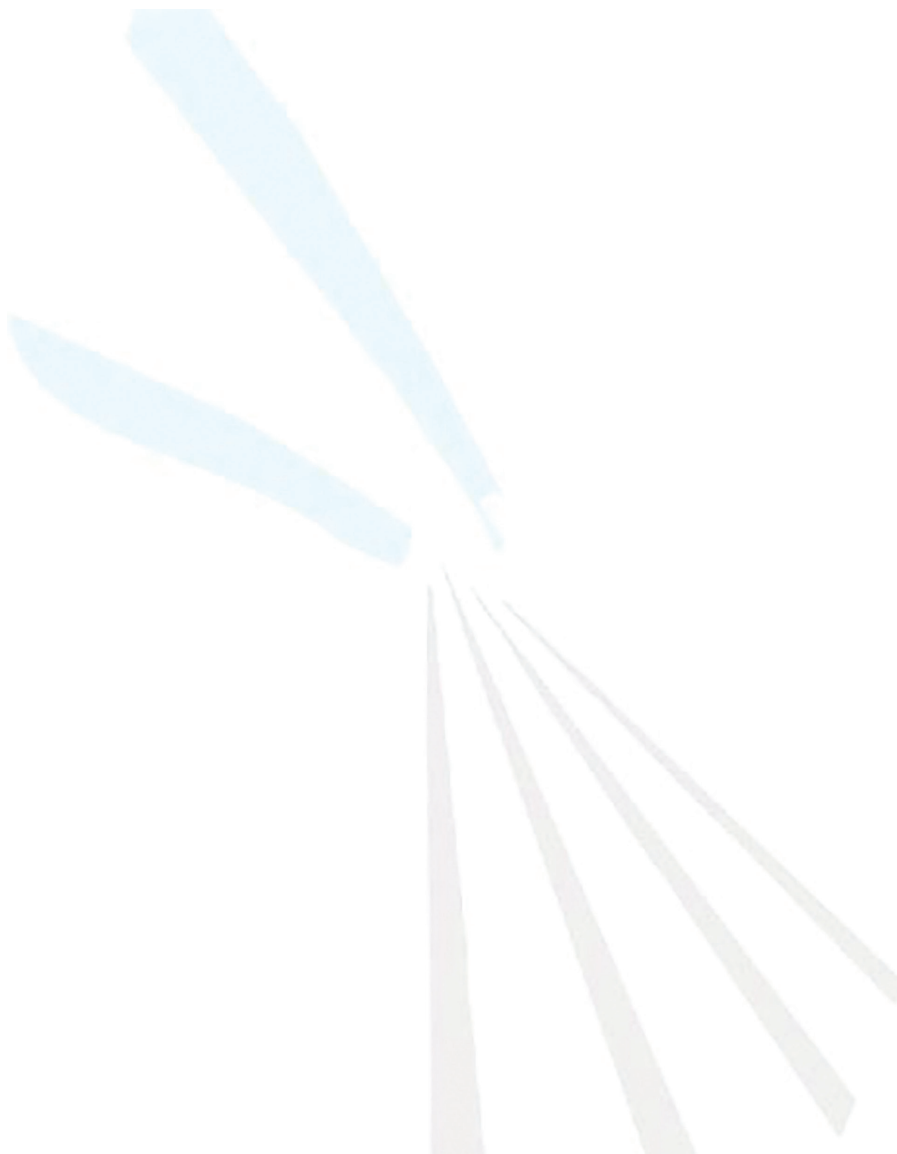
*“Vinča” Institute of Nuclear Sciences, National Institute of the Republic of Serbia,
University of Belgrade, Belgrade, Serbia*

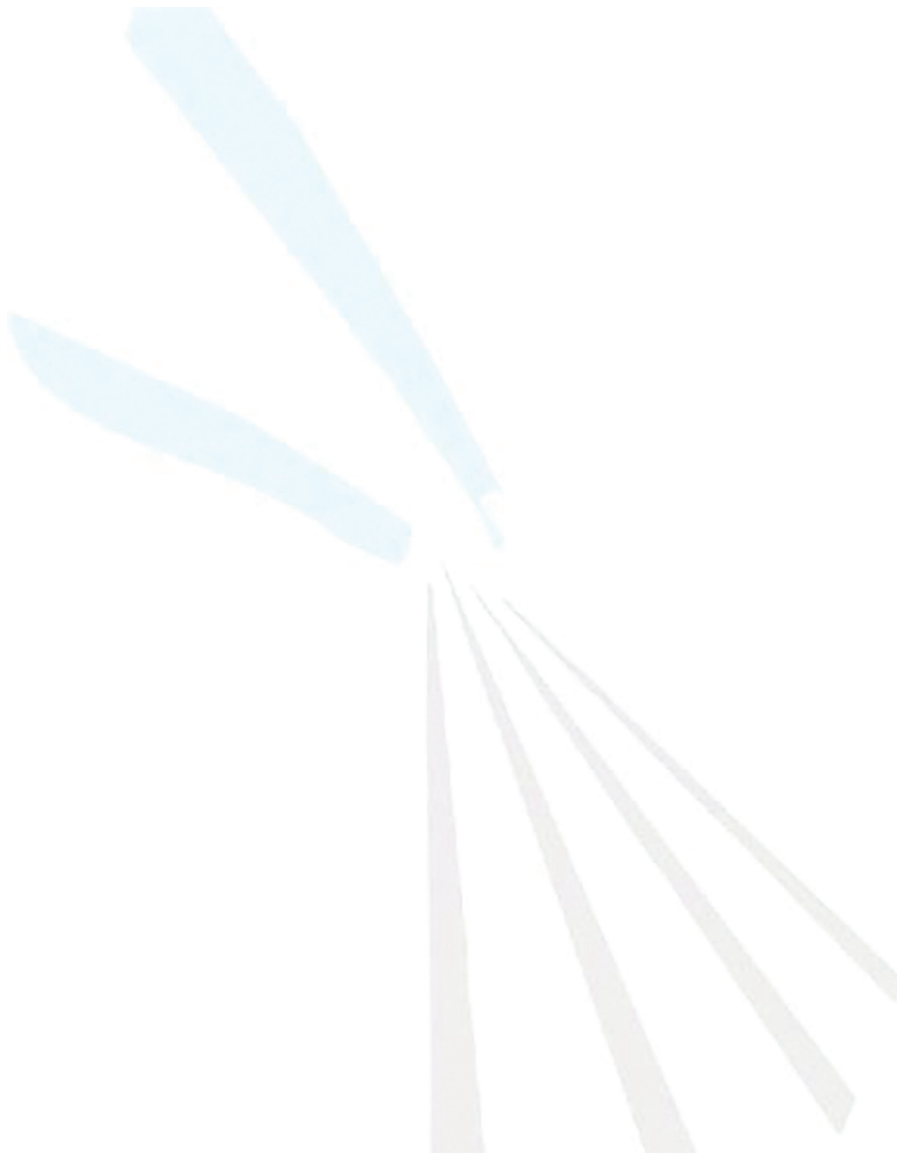
Abstract: Organic waste from households represents a significant unused resource that can be valorized into functional materials for environmental protection. This paper presents the synthesis of a carbon adsorbent obtained by carbonizing a mixture of banana, potato and carrot peels in a mass ratio of 1:1:1. After carbonization at 800 °C in a nitrogen atmosphere, a detailed characterization of the material was performed by determining the point of zero charge (pHpzc), FTIR spectroscopy, scanning electron microscopy (SEM) and BET analysis of the specific surface area. The obtained results show that carbonization leads to complete structural changes of the biomass, where oxygen functional groups are removed and an aromatic carbon structure is formed. SEM analysis confirms the development of a pronounced porous and fibrous morphology, while BET analysis shows a developed micro-mesoporous structure with a specific surface area of 483 m²/g. The determined pHpzc value was 10.55, which indicates a predominantly basic character of the adsorbent surface. The obtained characteristics indicate that the carbonized material has a large number of active sites suitable for the adsorption of organic pollutants. The results confirm that household waste can be successfully transformed into a high-value adsorbent, thereby simultaneously contributing to the development of a circular economy and sustainable technologies for water purification.

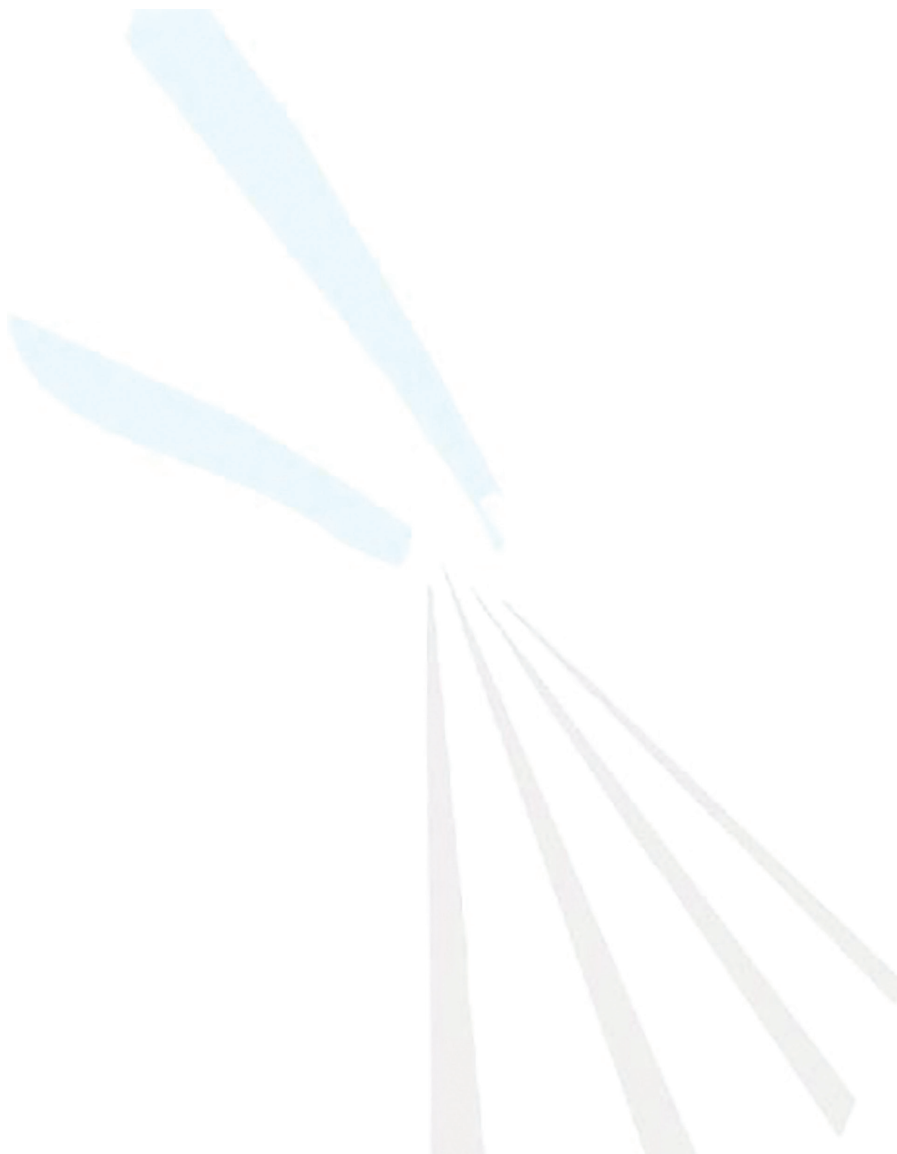
Keywords: Organic waste, carbonization, biocarbon, characterization, BET, FTIR, SEM.

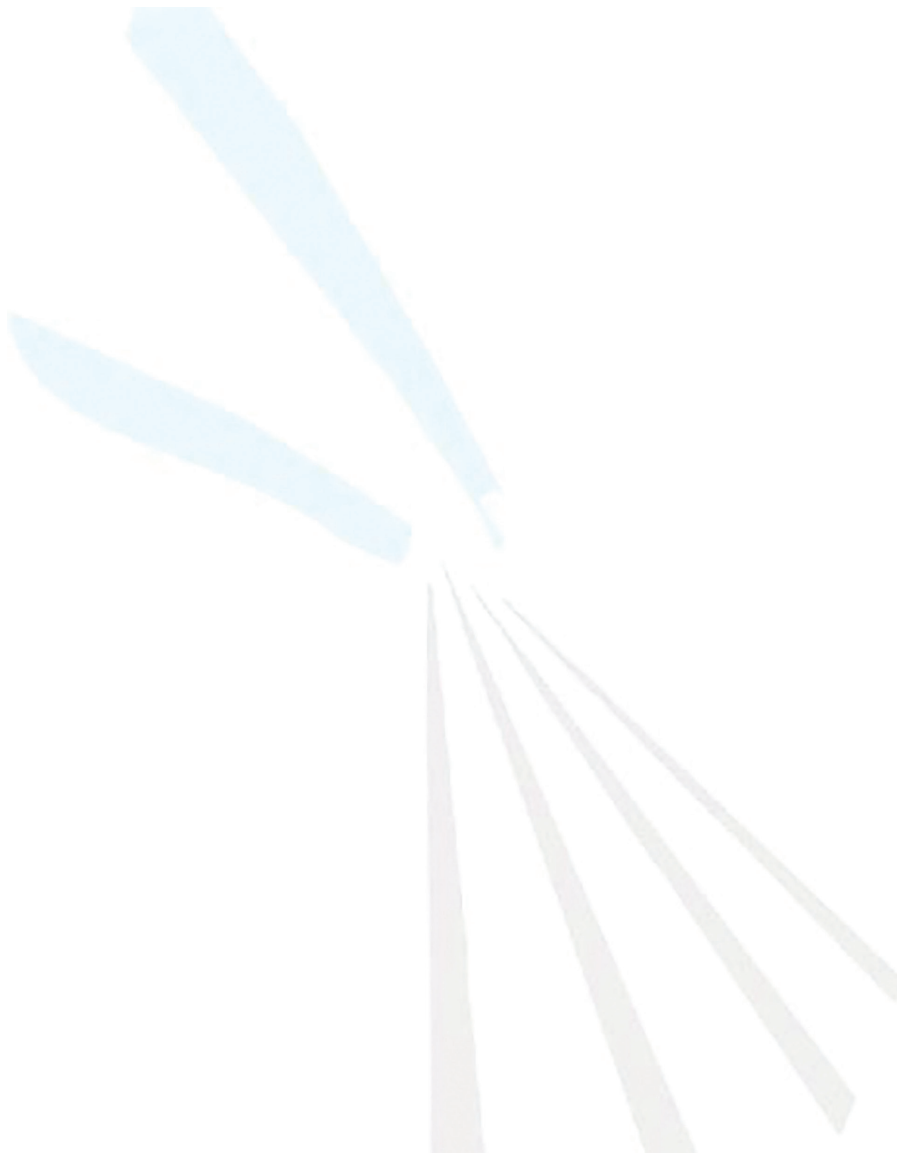


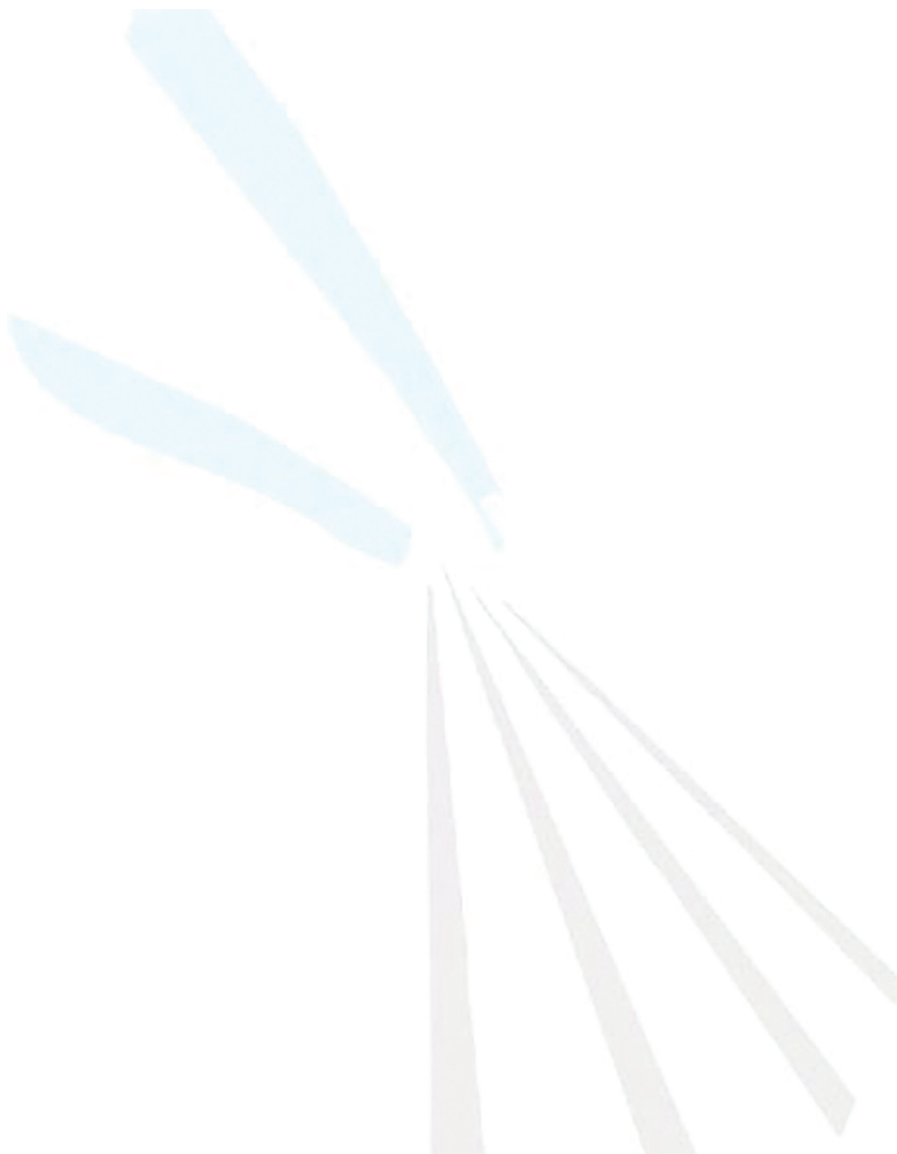


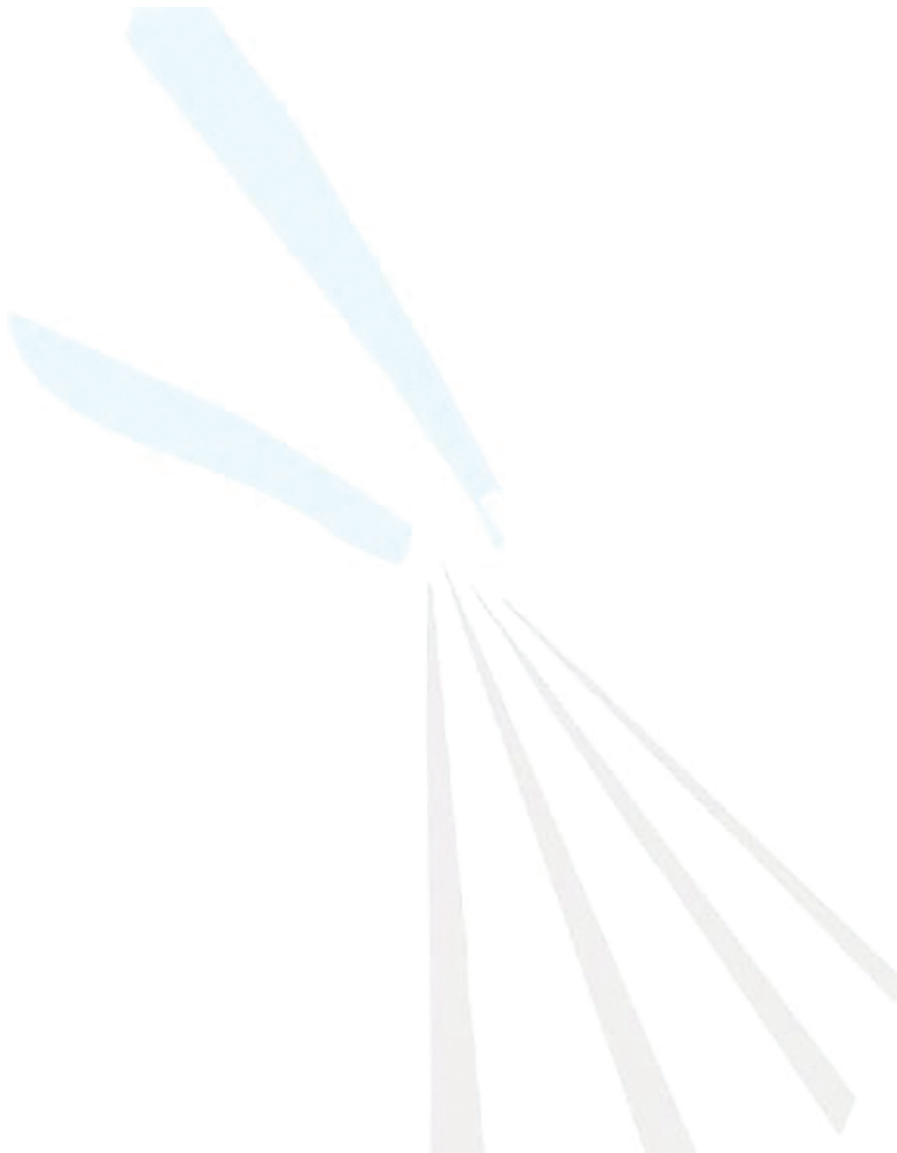


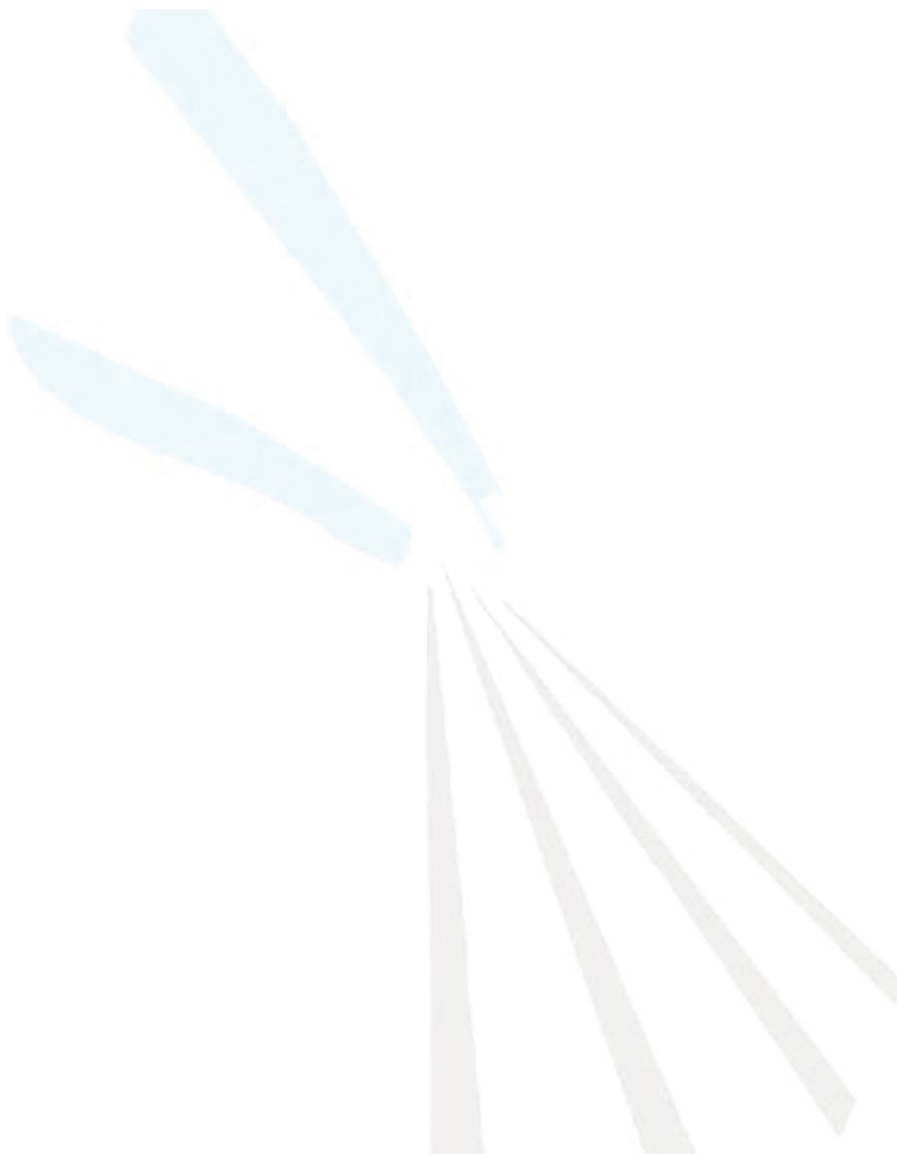


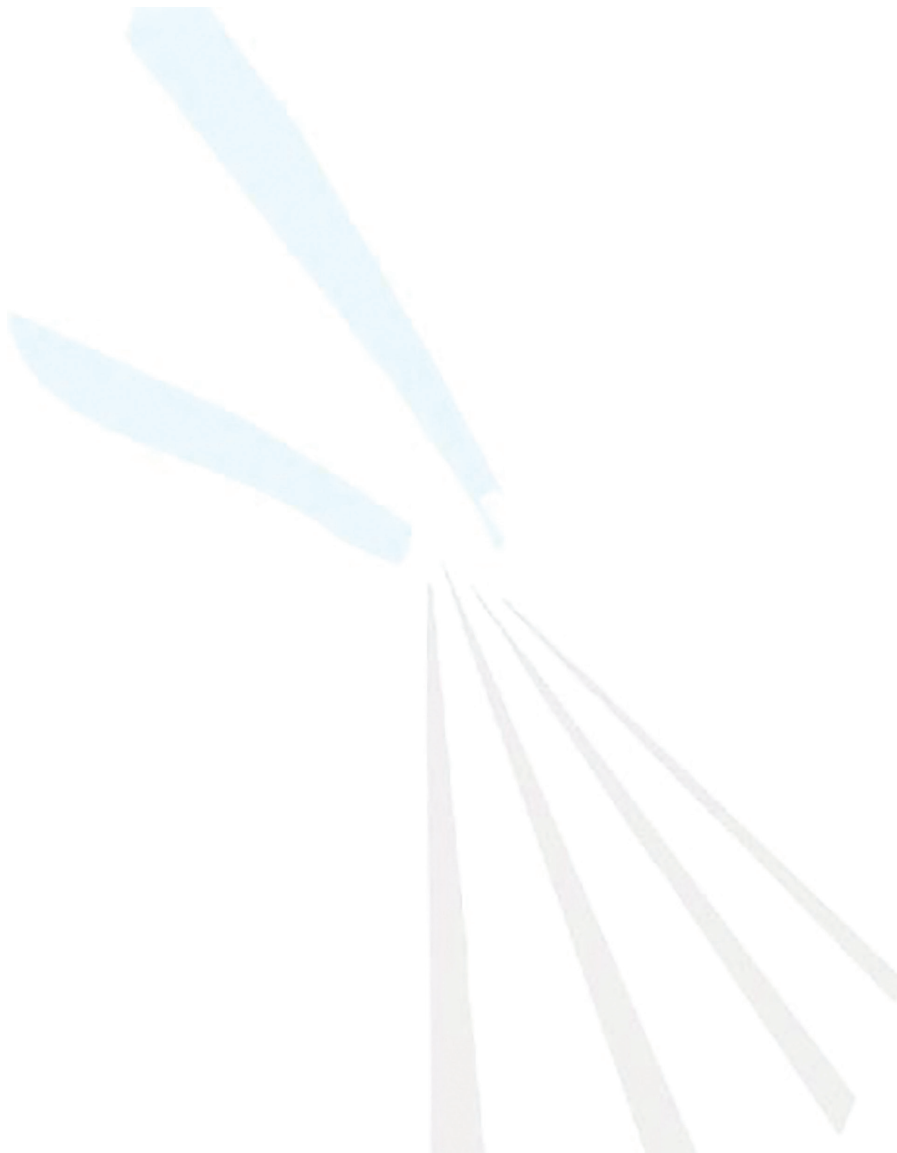


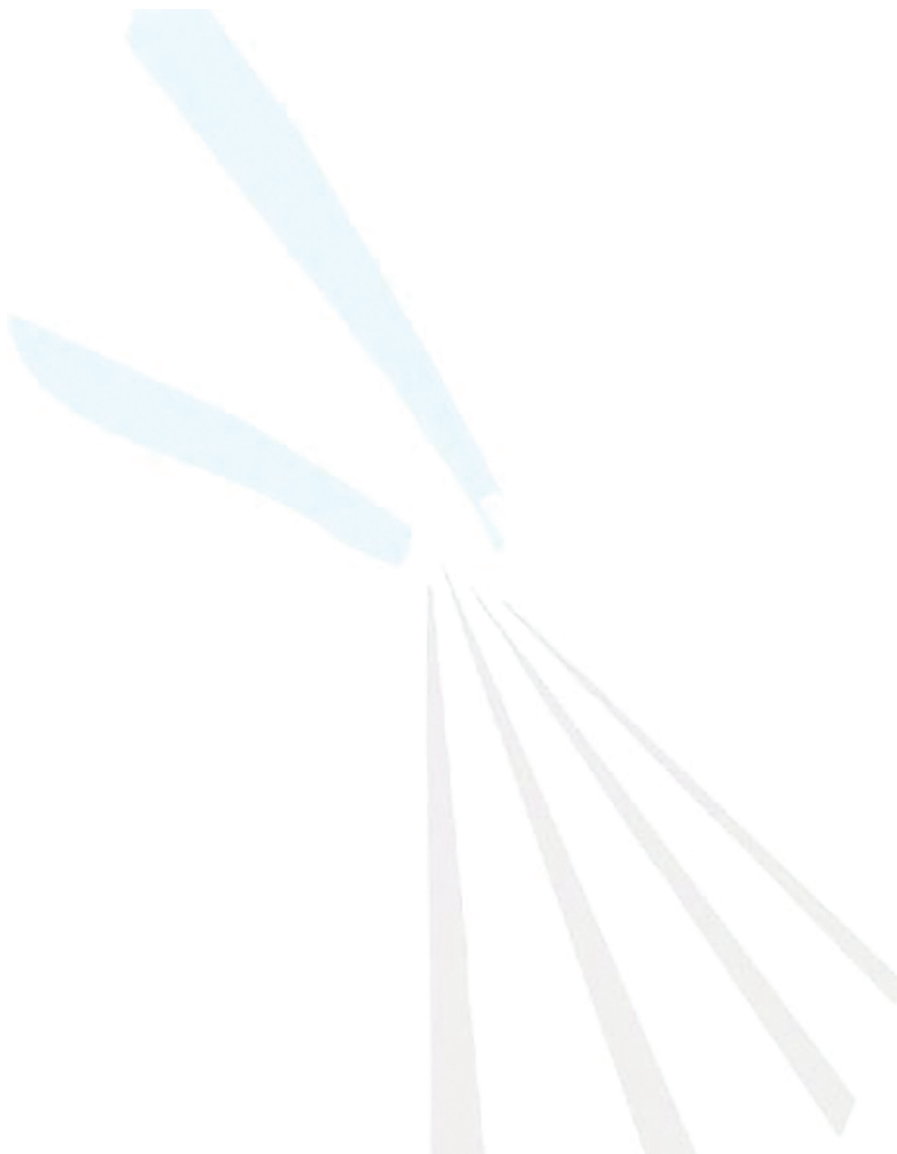


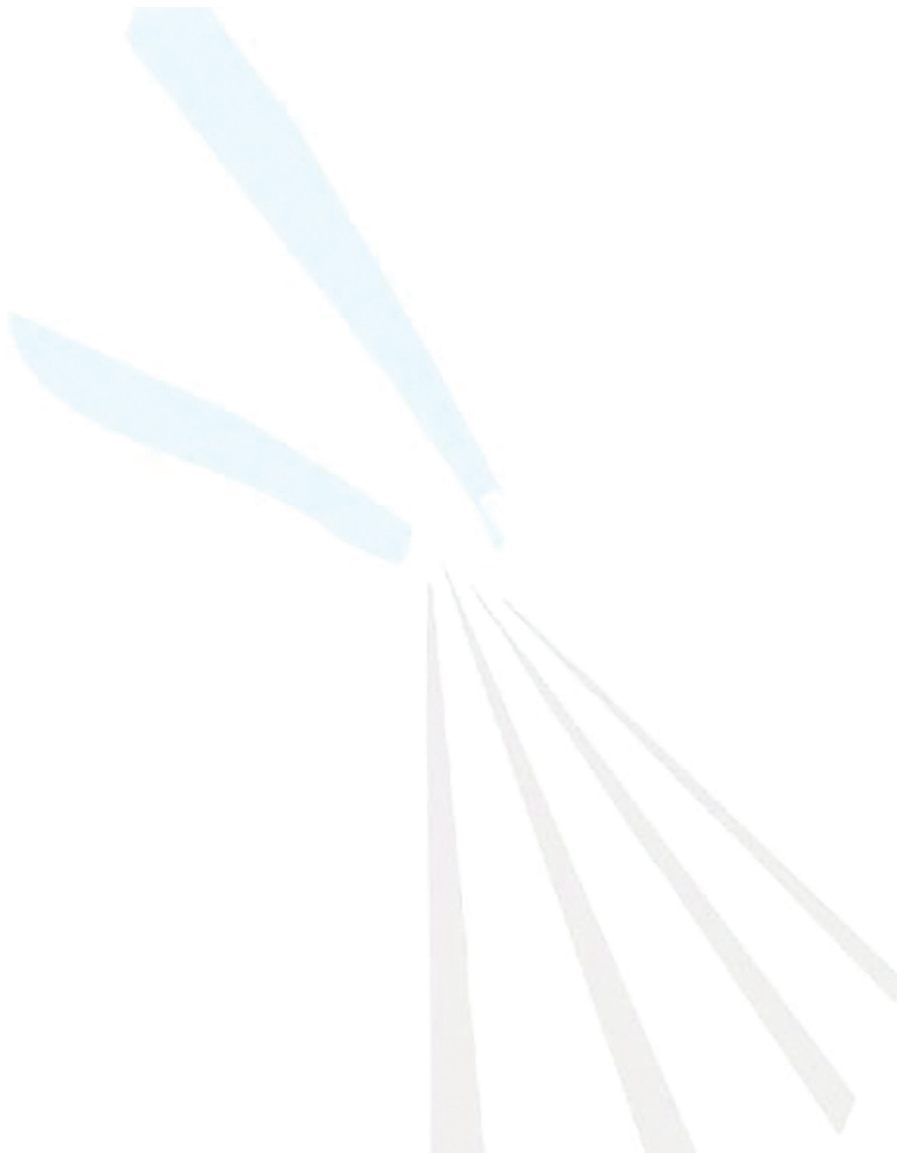


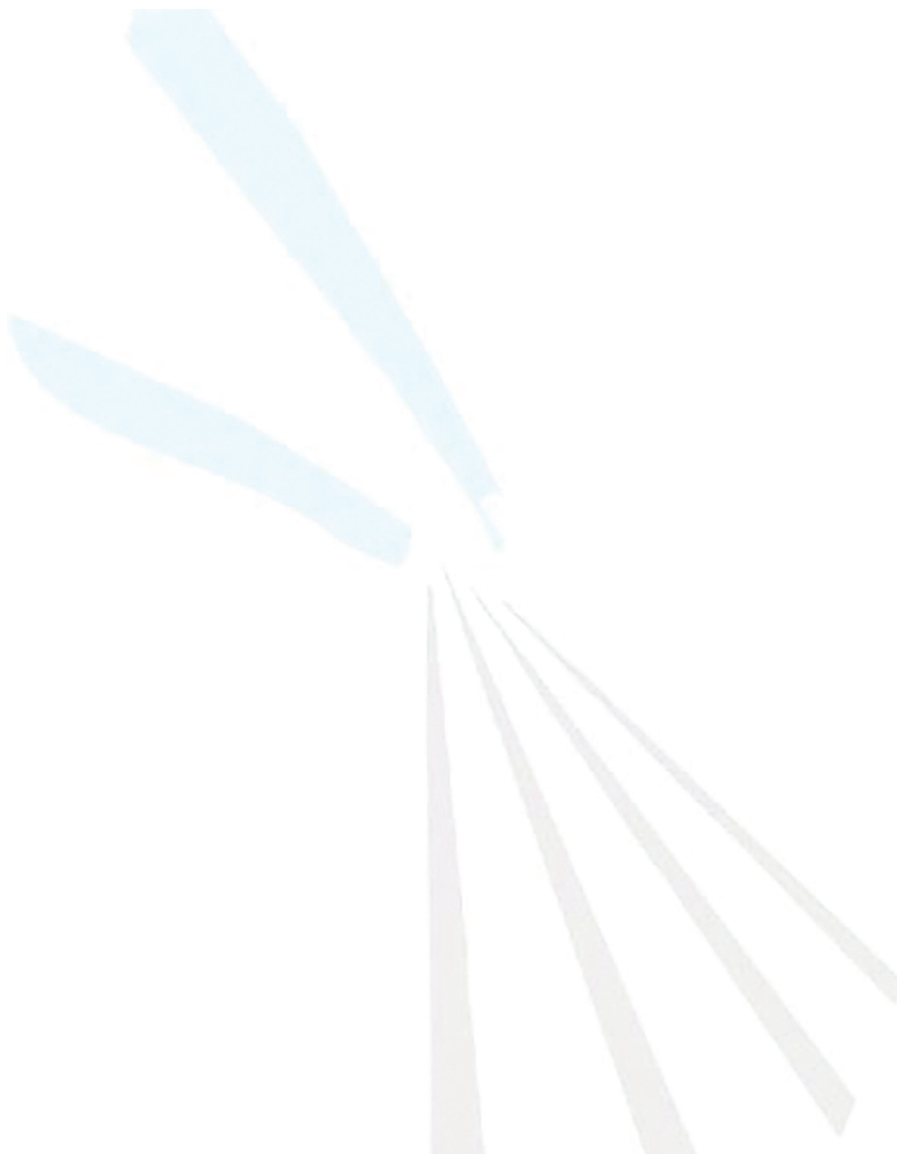


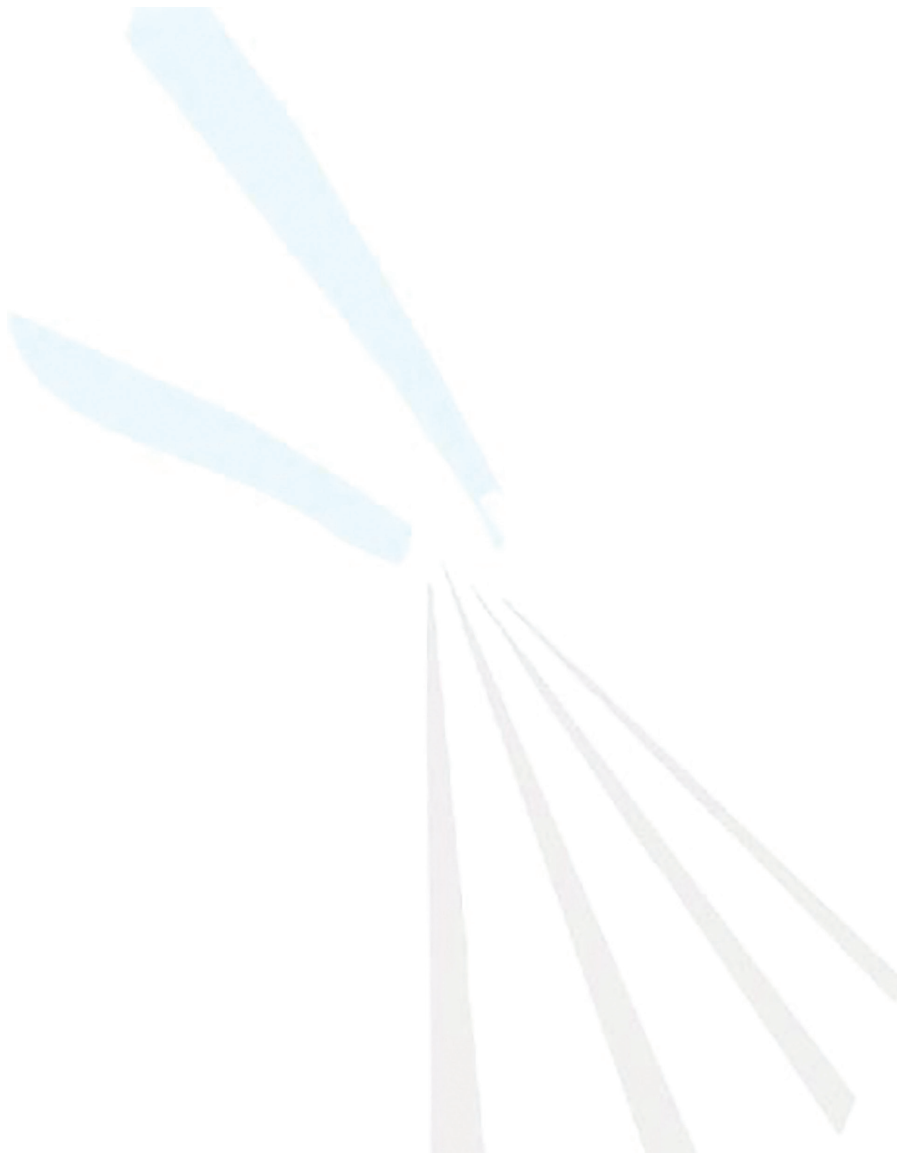


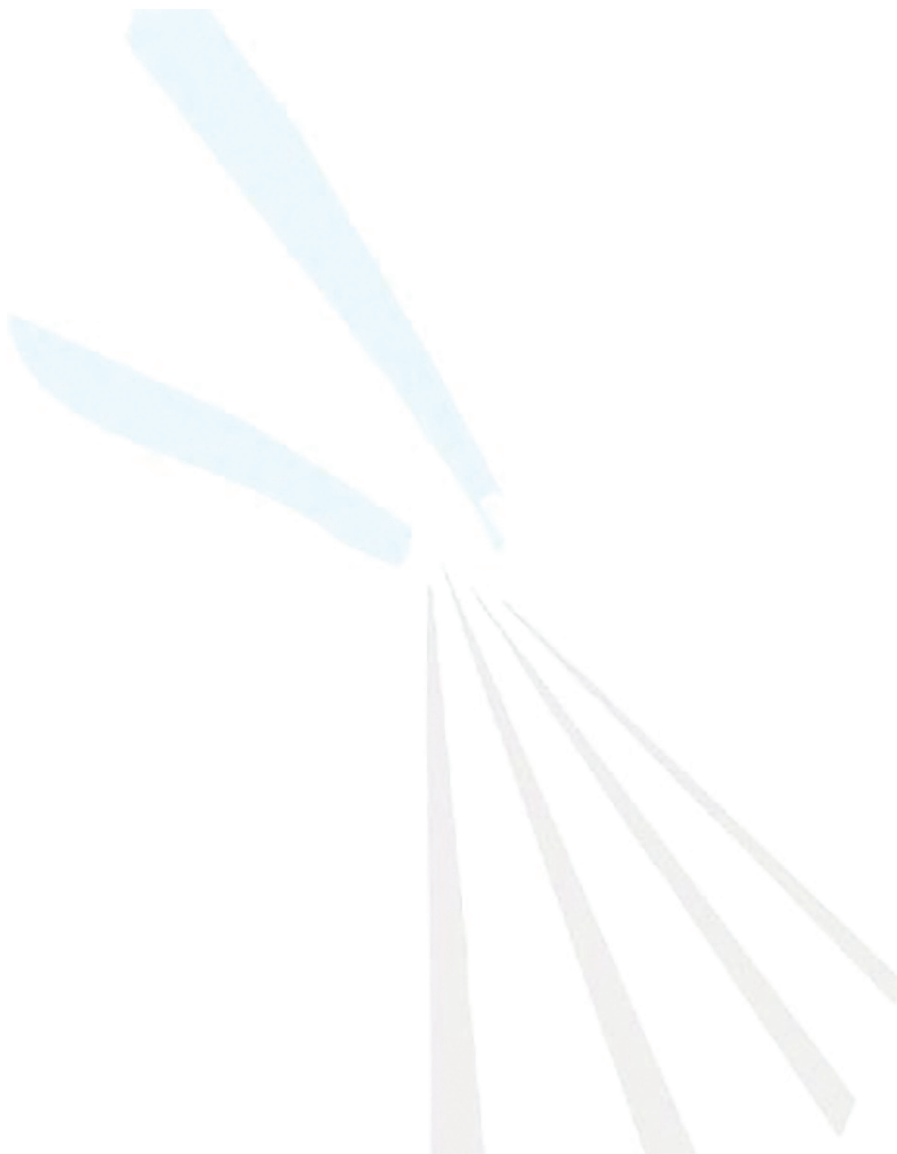












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