DISC2023

3rd DIFENEW International Student Conference

ABSTRACT BOOK

3rd DIFENEW INTERNATIONAL STUDENT CONFERENCE

DISC2023

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University of Novi Sad

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Faculty of Technical Sciences, University of Novi Sad, Serbia

Institute of Analytical Chemistry, Faculty of Chemical and Food Technology
Slovak University of Technology in Bratislava, Slovakia

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PREFACE

We are delighted to announce the release of the Abstract Book, showcasing a wealth of outstanding research contributions presented at the 3rd DIFENEW International Student Conference (DISC2023). This conference represents a collaborative effort of two esteemed institutions, the Department of Environmental Engineering and Occupational Safety and Health from the Faculty of Technical Sciences, University of Novi Sad, Serbia, and the Institute of Analytical Chemistry from the Faculty of Chemical and Food Technology, Slovak University of Technology in Bratislava, Slovakia. This significant event is a part of the dissemination activities associated with the Serbian-Slovak bilateral cooperation project titled "Microplastics Impact on the Occurrence of Plasticizers in Surface Water and Effects on Human Health (PLASTICINE) generously supported by the Ministry of Education, Science, and Technological Development of Serbia and the Slovak Research and Development Agency.

At DISC2023, we aim to provide a dynamic platform for participants to engage in the exchange of research interests, innovative ideas, and valuable experiences across a spectrum of vital fields, including Environmental Engineering and Sustainable Development, Occupational Safety and Health, Sustainable Project Management, Civil Engineering and Education 2.0.

We extend our heartfelt gratitude to all authors, co-authors, and their mentors, whose contributions have been instrumental in shaping this conference. We also want to express our appreciation to the dedicated members of the Scientific and Organizing Committees for their unwavering commitment and hard work.

Furthermore, I would like to extend my heartfelt appreciation to the entire organizing team for their outstanding efforts in making this event possible. I am especially grateful to Dr. Maja Sremački, Dr. Nevena Živančev, Dr. Miljan Šunjević and MSc. Tijana Adamov for their exceptional dedication and leadership in orchestrating the entire event. Your contributions have been invaluable, and I am truly thankful for your hard work and commitment.

Looking forward to DISC2024, which will take place in the city of Novi Sad in December 2024, we extend our best wishes to all participants for a year filled with success and enriching experiences.

Warm regards,

Dr. Maja Petrović

Associate Professor

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CIVIL ENGINEERING

DIGITAL TOOLS FOR SUSTAINABLE DESIGN

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Abstract: According to the data provided by the European Commission Directive 2018/844, the construction industry contributes significantly both to the total emission of carbon dioxide and to the consumption of primary energy. Specifically, building facilities are accountable for almost one-third of all CO_2 emissions. Green building certification systems contribute to the creation of a more sustainable built environment, providing guidelines and recommendations for the construction of new or renovation of existing buildings and urban areas. Such systems, due to their organization and way of formulating directives, are susceptible to parameterization, which gives space for their automation in a digital environment. The scientific community has recognized the lack of computer tools that would facilitate the application of sustainable building design principles during the design, construction, and operation of construction facilities. Green building certification systems can be introduced into regular design and construction processes by designing new digital tools intended for professionals in the architecture, engineering, construction, and operation sector. The method described in this paper confirms the standpoint of various certification systems that the design of sustainable buildings does not necessarily have to be more complex and expensive than those that only meet the mandatory requirements of legislation. From a broader point of view, the result of the application of such methods would be the reduction of energy consumption and negative impact on nature, but also the creation of a healthier and more pleasant environment for users of the built and urban environment.

Keywords: *Sustainability; Automation; AECO; Green Building Certification Systems.*

THE INFLUENCE OF SUPPLEMENTARY CEMENTITIOUS MATERIALS ON SOME PROPERTIES OF STRUCTURAL CONCRETES

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Abstract: Cement is the primary contributor to greenhouse gas (GHG) emissions from concrete production, accounting for 8-10% of total anthropogenic GHG emissions. Presently, the global annual cement production exceeds four billion tons, and there are projections indicating it may surpass five billion by the end of this decade. With these in mind, urgent measures should be taken to mitigate the adverse environmental effects and curb climate change caused by the cement industry. The implementation of strategies that promote and encourage green and sustainable alternatives and innovations is highly recommended. Among others, the most promising strategy is the application of supplementary cementitious materials (SCMs) to substitute clinker. This approach enables a significant reduction of the clinker content in cement, thereby diminishing its negative environmental and economic impacts. Despite regulations permitting the use of various SCMs, even up to 95% in certain Portland composite cement (e.g., CEM III/C stipulates only 5-19% clinker), their practical application remains limited. More precisely, the average clinker content in cement hovers around 77%, indicating that only 23% of clinker is currently being replaced by suitable SCMs. In addition to the undeniable environmental benefits, reducing clinker content has the potential to impair the mechanical and, notably, durability-related properties of concrete. These properties are crucial for practical applications in reinforced concrete structures. The paper presents contemporary achievements, advantages, and limitations in applying supplementary cementitious materials (SCMs) in concrete. The discussion encompasses the fundamental characterization of SCMs, as well as their mechanical and durability properties. Drawing insights from available literature indicates the significant potential and competitiveness of concrete when incorporating SCMs like ground-granulated blast furnace slag (GGBFS), fly ash (FA), limestone (LS), and metakaolin (MK). It appears that combining different SCMs could yield optimal concrete performance.

Keywords: *Cement; Concrete; Supplementary Cementitious Materials; Environment; Sustainability.*

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GREEN CONCRETE TO ACHIEVE A MORE SUSTAINABLE ENVIRONMENT

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Abstract: Cement production is responsible for approximately 7-10% of the world's total carbon dioxide (CO_2) emissions, and this figure is projected to rise to 12-23% by 2050. With annual global concrete production currently standing at a staggering 12 billion tons and continuing to grow, addressing the environmental impact of this industry is paramount. The root of the problem lies in the fact that cement production is both energy-intensive and a major source of CO_2 emissions. While concrete is often considered a more sustainable and CO_2-efficient material due to its ability to incorporate waste materials, the cement component accounts for just 10-15% of the total mass of concrete yet contributes to almost 95% of the overall emissions during concrete production. To mitigate this environmental challenge, numerous research studies have been dedicated to finding alternative binders that can replace a portion of cement in concrete formulations with more sustainable materials. Green concrete represents a groundbreaking approach to construction materials, prioritizing sustainability by incorporating waste materials or minimizing environmental footprint. It aligns with the principles of reduction, reuse, and recycling to foster a more environmentally conscious construction industry. The primary objectives of green concrete revolve around three key pillars: reducing CO_2 emissions (reduction of emissions from cement production), conservation of natural resources (limestone, clay, natural river sand, rocks) and waste minimization. Examples of innovative green concrete types include carbon-negative concrete, geopolymer concrete, self-healing concrete, and cool concrete. To produce green concrete and foster a sustainable environment, several recommendations are paramount: replacing and reducing cement content in concrete with environmentally friendly alternatives like fly ash, slag, microsilica, pozzolanic materials, ash derived from household waste incineration, and biofuel ash and/or by using recycled aggregates, the volume of waste materials ending up in landfills can be significantly reduced, while conserving natural resources.

Keywords: *Green Concrete; CO_2; Construction; Environmental Footprint; Sustainability.*

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OCCUPATIONAL HEALTH AND SAFETY

CURRENT STATE OF PSYCHOSOCIAL RISK MANAGEMENT IN THE WORKPLACE ENVIRONMENT: OPPORTUNITIES AND CHALLENGES

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Abstract: In recent years, a significant number of changes and events in the world of work have been recognised that change the workforce, the environment, work equipment, and the way work is designed and organised, with significant implications for the health and well-being of workers. Psychosocial Risk Management (PSRM) applies the risk management framework to address psychosocial risks (PSRs) in the workplace. PSRs stem from organisational and work-related concerns such as workload, working hours, culture, interpersonal relationships, career development, and many others. Transitioning from assessing to managing PSRs in the workplace is a challenging task for organisations. The implementation of the PSRM protocol, however, enables organisations to detect and alleviate potential hazards, ultimately safeguarding the physical and mental well-being of employees. Progress in policies and strategies on PSRs has reached international and national levels, stimulating the development of models, approaches, and practical tools for managing PSRs in occupational organisations. Standard ISO 45003:2021 provides guidelines for managing these risks within an occupational health and safety management system based on ISO 45001:2018. Numerous studies conducted on macro- and micro-organisations have demonstrated the success rate and favourable effects of deploying PSRM systems. Positive motivators for PSRM include the ease of access to PSR assessment resources, the availability of external expert support, and the observable benefits of PSR assessment executions. Most frequently, workers' ignorance, organisations' lack of resources to implement management systems, their fear of excessive authority interference, the stigmatisation of mental health, and their ignorance of the necessity of PSRM systems are obstacles to their implementation. As previously mentioned, the application of occupational health and safety (OHS) management tools has been proven to be a powerful approach to evaluating the hazards connected to occupational stress. The benefits and drawbacks of PSRM systems are discussed in this research study.

Keywords: *Well-being; Psychosocial Risk Assessment; Management Tools; OHS Strategy; International Standards.*

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OCCUPATIONAL EXPOSURES TO AIRBORNE PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

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Abstract: Per- and polyfluoroalkyl substances (PFAS) are a group of synthetically made chemicals which are used in many industrial processes. Due to absence of data in the scientific literature this review was only focused on a few occupations such as ski waxing, firefighting, education/office buildings, a textile manufacturing plant, and retail textile stores. The concentrations in dust and air are measured for perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorooctanesulfonic acid (PFOS), perfluorohexanoic acid (PFHxA), perfluorotetradecanoic acid (PFTetDA), perfluorododecanoic acid (PFDoDA), and perfluorodecanoic acid (PFDA). Ski waxing consistently exhibited elevated levels of both air and dust concentrations of PFAS, reaching up to 10 µg/m^3 in the air and 10 mg/g in the dust. In particular, the average concentrations of PFOS in ski waxing dust were comparable to those found in other occupations. However, the levels of PFOA were two orders of magnitude higher than in other occupations and the levels of other measured PFAS were approximately four orders of magnitude higher than reported values for other professional exposures. In textile manufacturing, the air concentrations ranged from 0.0001 to 0.01 µg/m^3 and dust concentrations were in range from 0.0001 to 0.01 mg/g. Notably, during specific processes such as textile scouring, drying, and heat setting, PFTetDA levels peaked at 10 µg/m^3, indicating elevated releases during these manufacturing stages. Further research is needed to assess the risk of PFAS exposure in the reviewed occupations and to identify other jobs that may be at risk. The findings of this review highlight the importance of conducting further research to expand understanding of occupational exposure to PFAS and the associated levels of exposure. Additional research is necessary to identify other occupations that may be at risk of PFAS exposure. Conducting quantitative exposure assessments and recognizing at-risk occupations, products containing PFAS, and the causes of PFAS exposures will assist in developing recommendations for implementing safety measures to protect workers from potential health issues.

Keywords: *Air; Dust; Industry; PFOS; PFOA.*

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AN OVERVIEW OF EXPOSURE TO SILICA DUST IN INDUSTRIAL SECTOR

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Abstract: Professional and long-term exposure to high concentrations of silicon dioxide is one of the most common causes of lung disease. Industrial workers who inhale silicon dioxide particles have an increased risk of developing serious lung diseases that can lead to disability and even death. The investigation claimed that exposure to silicon dioxide dust can cause the development of chronic bronchitis, diseases of the small airways, cancer, etc. The World Health Organization (WHO) and the International Labor Organization (ILO), based on joint assessments and the data they have, show that there is a connection between occupational exposure to silicon dioxide and the development of silicosis. In the assessment of the occupational impact of silicon dioxide, working-age persons (≥ 15 years) were included. 65 studies were performed, involving > 2.3 million measurements collected in 22 countries. Most of the studies were done in construction, manufacturing, and mining. Based on the measurements carried out, for occupational exposure to silicon dioxide 42 studies presented a medium exposure level in the range 0.006–16.9 mg/m^3, 29 studies geometric mean (not determined -1.65 mg/m^3) and two studies per median (range 0.075–1.3 mg/m^3). The average silica dust levels often exceed the safety limits for workers' health (0.05 mg/m^3). Industrial sectors such as construction, manufacturing, pottery and ceramic works, cement industry and mining are sectors where workers are mainly exposed to respirable crystalline silicon dioxide dust. The parameters used for the estimation models are a systematic review and meta-analysis of studies on the prevalence and level of occupational exposure to this dust. Estimates of prevalence and levels will serve as input data to estimate the number of deaths and life expectancy attributable to the occupation, for the preparation of the joint WHO/ILO assessment. Based on the obtained data, it can be concluded that the factors for the development of silicosis can be attributed 100% to professional exposure to silicon dioxide.

Keywords: *Silicon Dioxide; Occupational Exposure, Professional Diseases.*

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This research (paper) has been supported by the Ministry of Science, Technological Development and Innovation through project no. 451-03-47/2023- 01/200156 “Innovative scientific and artistic research from the FTS (activity) domain”.

ASSESSMENT OF SAFETY KNOWLEDGE, PRACTICES AND ATTITUDE AMONG LABORATORY TECHNOLOGISTS IN THE UNIVERSITY OF IBADAN

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Abstract: The workers in laboratories generally are faced with many occupational risks at work which compromises health and safety if adequate preventive measures are not taken. These hazards can be physical, chemical, biological, ergonomic, and psychosocial. Poor laboratory safety practices can cause laboratory accidents and severe injuries. This study aimed to assess the level of knowledge, practice, and attitude to laboratory safety among the study participants in different laboratory categories. It is quantitative research that utilises a descriptive cross-sectional design and proportionate sampling techniques. A total of 248 respondents were allocated proportionately. The questionnaire was administered to laboratory technologists, observational checklist was used to assess safety practices. The mean age of the respondents was age 57.7 ± 18.6 and 65.5% of the respondents were males while the remaining 34.5% were females. The majority of the respondents (49.6%) were between the age range of 31- 40 years. The majority (97.8%) of the respondents had tertiary education. While (45.1%) had working experience of ten years and above. The result reveals that more than half of the respondents 154 (68.1%) had poor knowledge about laboratory safety hazards, while the majority 136 (60.2%) of the respondents had a positive attitude towards laboratory safety practices, Also, most of the respondents 138 (61.1%) had good practice towards laboratory safety. The statistical analysis showed a significant association between age and level of knowledge, attitude, and practice ($P<0.05$). The information derived from the study showed poor knowledge about laboratory safety, a positive attitude and good safety practices across the four categories of the laboratory. There should be periodic safety training and re-training for all the laboratory workers to refresh the safety culture in them.

Keywords: *Knowledge; Attitude and Practice; Laboratory Safety; University of Ibadan.*

TRICLOSAN IN ANTIBACTERIAL PRODUCTS ON THE SERBIAN MARKET – HEALTH RISKS AND REGULATORY IMPLICATIONS

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Abstract: Triclosan (TCS) is a synthetic antimicrobial agent used in various personal care products (PCPs), such as toothpaste, mouthwashes, soaps, disinfectants, and anti-acne preparations. Given the potential endocrine-disruptive effects, the use of TCS in certain FDA-regulated antiseptic products has been banned since 2016. However, in healthcare settings, TCS is still in use, putting healthcare workers at an increased risk of exposure, especially following the COVID-19 outbreak and stringent hygiene protocols. On the contrary, the European Commission restricted its use as a biocide but is still allowing its application in PCPs. The aim of this research was to examine the presence of TCS in PCPs available on the Serbian market by analysing product declarations. The sampling of PCPs was conducted in drugstores and pharmacy chains, including their online stores. The 184 PCPs in the Serbian market met the selection criteria. Based on the obtained results, 9 out of 184 products (4.9%) contained TCS. The TCS-containing products included toothpaste, mouthwashes, hand disinfectants, and anti-acne products. The number of PCPs with TCS declared on the Serbian market is lower in comparison with bigger markets, such as the US, where at least 479 OTC FDA-labelled products contain TCS. Despite the decreased use of TCS globally, TCS remains a high-production volume chemical. Based on the international biomonitoring data, TCS urinary concentrations were in the range of 2.6 – 12468 nM, probably due to its bioaccumulation potential. Furthermore, high urinary TCS concentrations were associated with infertility, diabetes, thyroid impairment, and other endocrine-related disorders. The awareness within the scientific community and regulatory bodies regarding the negative effects of TCS has influenced its presence on the market. However, while the FDA has prohibited the use of TCS in certain products, it can be still found in some PCPs, emphasising the need for continued scrutiny and harmonised regulations to mitigate associated health risks.

Keywords: *Triclosan; Endocrine Disruptors; Personal Care Products; Market Analysis.*

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OCCUPATIONAL STRESS, BURNOUT, AND THE ASSOCIATED EFFECTS OF PSYCHOSOCIAL HAZARDS IN THE WORKPLACE: A BRIEF OVERVIEW

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Abstract: In today's fast-paced and demanding work environment, occupational stress and burnout have become prevalent concerns. This overview aims to shed light on the concept of psychosocial hazards in the workplace and their impact on employee well-being. Occupational stress refers to the physical, mental, and emotional strain experienced by individuals in their working environment. Factors such as high workloads, tight deadlines, and poor work-life balance contribute to increased stress levels. Prolonged exposure to occupational stress can lead to burnout, chronic exhaustion, cynicism, and reduced professional efficacy. Psychosocial hazards encompass various workplace conditions that can negatively affect employees' psychological health and well-being. These hazards include work-related stressors such as excessive job demands, role ambiguity, lack of support, and interpersonal conflicts. Additionally, organisational factors like poor leadership, inadequate communication, and limited opportunities for growth can contribute to the development of psychosocial hazards. The effects of psychosocial hazards in the workplace are far-reaching. They can lead to increased absenteeism, decreased job satisfaction, higher turnover rates, and compromised mental and physical health. Employees exposed to high levels of occupational stress and burnout are more susceptible to anxiety, depression, cardiovascular diseases, and musculoskeletal disorders. The negative impact extends beyond the individual to affect team dynamics, overall productivity, and organisational performance. Organisations can implement strategies such as promoting work-life balance, providing adequate resources and support, fostering positive interpersonal relationships, and offering stress management programs. Encouraging open communication, involving employees in decision-making processes, and promoting a culture of respect and fairness can help mitigate the negative effects of psychosocial hazards. Occupational stress, burnout, and psychosocial hazards in the workplace are significant challenges that organisations and individuals must address. By understanding the causes and outcomes of these hazards, organisations can take proactive measures to create a supportive work environment that promotes employee well-being, productivity, and overall organisational success.

Keywords: *Burnout; Stress; Hazards; Safety; Workplace.*

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ADDRESSING OSH CHALLENGES IN THE CIRCULAR ECONOMY

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Abstract: This paper explores the critical issue of Occupational Safety and Health (OSH) within the context of the circular economy, a sustainable and environmentally responsible model aimed at reducing waste and promoting resource efficiency. As the circular economy becomes more popular, it presents unique issues concerning the safety and well-being of workers. This study focuses on understanding and managing OSH in circular economy practices, looking at the specific dangers and risks that come with handling, recycling, and reusing materials, and products. It also suggests new ways and guidelines to improve OSH standards in industries that follow circular economy principles. OSH challenges in the circular economy are complex and can change depending on the industry or type of work. Common issues include being around harmful materials, dealing with physical and ergonomic challenges, being exposed to noise and vibrations, not having enough training, dealing with stress, and the complexity of not having standard rules and complicated supply chains. By solving these issues, a safer and more sustainable future could be created. This aligns with the Sustainable Development Goals (SDGs) and the Green Agenda, as it promotes safe and sustainable work environments, reduces waste, and ensures responsible consumption and production.

Keywords: *Occupational Safety and Health; Circular Economy; Sustainability; Green Agenda.*

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WATER AS A GREEN SOLVENT FOR THE EXTRACTION OF POLYPHENOLS FROM SAGE

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Abstract: Sage (*Salvia officinalis* L.), a common member of the family Lamiaceae has been used as traditional herbal medicine against many diseases. It is reported that the plant has a variety of pharmacological effects, including anti-inflammatory, antibacterial, antiviral, hypoglycaemic, fungistatic, anticancer, antioxidative and antimutagenic effects. These effects are mainly due to the presence of phenolic compounds such as carnosic, rosmarinic, caffeic, salvianolic acids and flavonoids (luteolin-7-*O*-glucoside, quercetin and rutin). It is known that polyphenols are extracted with polar solvents, commonly with methanol, ethanol and their mixtures with water. Hence water is a polar solvent, it also can be considered as a potentially green solvent since it is non-toxic to health and the environment. In this study, we determined the total phenolic content (TPC) and total flavonoid content (TFC) in lyophilised extracts prepared with water extraction of sage leaves. The TPC of sage extracts (0.5 mg/mL, 0.25 mg/mL and 0.125 mg/mL) was determined using a colorimetric assay, with Folin–Ciocalteu reagent. TPC was expressed as mg of gallic acid equivalents (GAE) per g of dried extract (de). The TFC of sage extracts (1.75 mg/mL, 1.25 mg/mL and 0.75 mg/mL) was measured by the spectrophotometric method, based on the formation of a flavonoid-aluminium complex. TFC was expressed as mg of quercetin equivalents (QE) per g of dried extract (de). The results were presented as a mean value ± standard deviation (SD) of triplicate measurements. Our findings showed that TPC is in the range from 155 ± 5.55 to 166 ± 2.95 mg GAE/g de. TFC was in range from 31.7 ± 3.61 to 46.6 ± 2.54 mg QE/g de. Compared with published results where extractions of polyphenols from sage were carried out with methanol as an effective and toxic solvent, results obtained in our study demonstrated a high extraction yield of polyphenols from sage using water as a polar and non-toxic solvent.

Keywords: *Sage; Green Extraction; Total Phenolic Content; Total Flavonoid Content; Polyphenols.*

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EFFECT OF *IN VITRO* LONG-TERM LOW-LEVEL EXPOSURE TO DIBUTYL PHTHALATE ON GENE EXPRESSION PROFILE IN HUMAN ENDOTHELIAL CELLS

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Abstract: Exposure to dibutyl phthalate (DBP) has been associated with reproductive, cardiovascular, and metabolic disorders, as shown by *in vivo*, *in vitro*, and epidemiological studies. Most of the *in vitro* studies focused primarily on the consequences of short-term DBP exposure; however, these studies are unlikely to reflect the consequences of low-dose, repeated, prolonged exposures that are common in humans. We examined the effect of long-term low-level exposure to DBP on gene expression profile in human endothelial cells. EA.hy926 cells were repeatedly exposed to either vehicle or three human exposure-relevant concentrations of DBP (1, 10, and 100 nM) for 12 weeks, after which the total mRNA was collected and analysed using DNBSEQ platform. Differentially expressed genes (DEGs) were considered when FC≥[1] and FDR≤0.001. Three concentrations of DBP affected a unique set of DEGs: 1 nM=28 DEGs (19 up, 9 down), 10 nM=58 DEGs (38 up, 20 down), 100 nM=34 DEGs (19 up, 15 down). Some genes were affected by specific concentrations of DBP: 9/28 genes in 1 nM group, 35/58 genes in 10 nM group, and 15/34 genes in 100 nM group, whereas only seven genes, including *IL24* and *SULT1A4*, were shared between the three concentrations of DBP. The most enriched biological processes were IRE1-mediated unfolded protein response and NMDA selective glutamate receptor signalling in 1 nM group, epithelial to mesenchymal transition and apoptotic process in 10 nM group, and cellular response to corticotropin-releasing hormone stimulus and positive regulation of apoptotic cell clearance in 100 nM group. The most enriched KEGG pathways were fatty acid metabolism in 1 nM group, cytokine-cytokine receptor interaction and adherens junctions in 10 nM group, and Fc epsilon RI signalling pathway and chemical carcinogenesis-DNA adducts in 100 nM group. These results demonstrate that long-term low-level DBP exposure causes concentration-specific changes in gene expression profile in EA.hy926 cells.

Keywords: *Dibutyl Phthalate; Endothelial Cells; Long-Term In Vitro Exposure; Global Gene Expression.*

Acknowledgement

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CORRELATION BETWEEN WORK-RELATED PSYCHOSOCIAL RISK FACTORS AND MUSCULOSKELETAL DISORDERS IN SELECTED WORKPLACES: A SHORT REVIEW

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Abstract: Sustaining employees' capability for safe work for as long as possible is one of the fundamental objectives of occupational safety and health (OSH), and psychosocial aspects have become important in fostering a healthy work environment. Work-related psychosocial risks (PSRs) are increasingly linked to the development of musculoskeletal disorders (MSDs) and are often a precursor to their development. MSDs are not solely caused by physical demands within the workplace but are also related to psychosocial work conditions. The association between the mentioned risk factors and the occurrence of MSDs poses a considerable challenge in the field of OSH. High work demands and low rewards are associated with increased PSRs, which in turn can lead to the development of MSDs. This short review focuses on the relationship between MSDs and PSRs in a specific occupational field. The teaching profession is one occupation with a growing rate of MSDs. Contributing risk factors include a high workload, a lack of support from colleagues, time pressures, low job control, and depression. Accumulated psychosocial factors heighten the risk for future MSDs due to prolonged exposure. The resulting physical issues can also lead to psychological stress, as teachers may experience pain, discomfort, and reduced job satisfaction. The psychosocial stress of managing many occupational tasks, such as caring for children simultaneously, coupled with parental interactions, exacerbates the situation. Occupational stress is of crucial importance as it is closely related to psychosocial factors that contribute to MSDs, which can further undermine the mental and physical health of teachers. Research has led to a conclusion on how to handle this intricate interaction. Further organisational measures need to be implemented, such as contemporary ergonomic solutions, workplace stress management, and promoting a healthy working environment, to enhance employee well-being in this occupational area.

Keywords: *Musculoskeletal Disorders; Psychosocial Risk Factors; Occupational Stress; Occupational Safety and Health; Teaching Profession.*

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STEREOLOGICAL ANALYSIS OF RAT OVARIUM AFTER SUBACUTE DIBUTYL-PHTHALATE TREATMENT

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Abstract: Dibutyl-phthalate (DBP) is widely used in various common consumer products, including plastics, cosmetics, children's toys, and medical devices. It is easily released into the environment, due to its limited chemical bonding with polymer products, resulting in unavoidable human exposure to DBP in daily life. Indeed, DBP has been detected in the follicular fluid of humans. The aim of this study was to examine the effects of subacute DBP treatment on rat ovaries using stereological methods. The following stereological parameters were determined: relative volume densities of the corpus luteum, ovarian stroma, and follicular parenchyma, as well as the relative volume densities of the fundamental phases of the ovarian stroma (blood vessels and ovarian interstitium). Female Wistar rats were randomly divided into 4 groups (n=6): Group 1 was the control; Groups 2, 3 and 4 received DBP at three distinct doses (100, 500, and 5000 mg DBP/kg diet), and were treated for 28 days. Bouin-fixed paraffin-embedded ovaries were cut into 5-µm section. The slides were stained with hematoxylin and eosin. Measurements were performed on the newCAST stereological software package (VIS-Visiopharm Integrator System, version 3.2.7.0; Visiopharm; Denmark). The results revealed that the relative volume densities of the fundamental phases of the ovarian stroma remained unaffected by DBP treatment when compared to the control group. However, exposure to 500 mg DBP/kg diet resulted in a significant increase in the relative volume densities of the corpus luteum, with a remarkable decrease in the relative volume densities of the follicular parenchym. Our results indicate that subchronic treatment with DBP at a dose of 500 mg/kg could lead to an accelerated rate of ovarian ageing.

Keywords: *Dibutyl Phthalate; Ovary; Rat; Stereology.*

Acknowledgement

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EFFECT OF SUBACUTE DIBUTYL PHTHALATE TREATMENT ON THE EXPRESSION OF AROMATASE IN RAT OVARY

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Abstract: Phthalate esters are present in a diverse range of consumer and food packaging products. Their widespread use across various commercial products leads to significant exposure for humans and the environment. Dibutyl phthalate (DBP) is one of the most utilised phthalates, and it has been classified as an endocrine-disrupting chemical. The objectives of this study were to investigate aromatase expression following DBP exposure. Female Wistar rats were allocated to 4 groups, and subacutely (28 days) treated with DBP added to the diet in concentrations: 0, 100, 500, and 5000 mg DBP/kg diet, which corresponds to 8.58, 41.34 and 447.33 mg/kg BW/day. Total RNA was extracted from the ovaries, transcribed into cDNA, and expression analysis was performed using quantitative RT-PCR. Results indicated that all applied doses of DBP could down-regulate the levels of aromatase expression, especially in the group treated with the highest dose of DBP. However, statistical analysis revealed that there is no significant difference in the levels of expression between control and DBP-treated rats. From these data, we can infer that, under these experimental conditions, subacute DBP treatment has no significant effect on aromatase expression.

Keywords: *Dibutyl phthalate; Aromatase; Ovary; Rat.*

Acknowledgement

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NOVEL APPROACH TO ASBESTOS EXPOSURE PROTECTION

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Abstract: In the current worldwide disaster management situation, a new and concerning issue is becoming more evident, namely, waste management. The areas affected by the disaster are often partially or completely collapsed and inaccessible. Various types of natural disasters pose distinct risks of exposure. The primary objective of this paper is to delineate the extant status of asbestos and the associated waste management practices subsequent to the disasters in Serbia. Subsequently, an innovative paradigm for asbestos management, focusing on exposure mitigation during natural disasters, will be expounded. This entails an integration of geographical maps. Beyond this, the overarching purpose of this endeavour is to enhance awareness pertaining to the comprehensive governance of asbestos and its waste, particularly in post-disaster scenarios. The current state of protection against elemental disasters in the territory of Serbia is characterised by the incompleteness and unavailability of information regarding the risks of potential elemental disasters, as well as the consequences they may induce, with insufficient public participation. The imperative to develop a long-term strategy for the prevention and mitigation of the consequences of emergencies represents a fundamentally new task in emergency management systems in Serbia. The articulation of an asbestos waste management plan during disasters is imperative, encompassing facets such as identification procedures, safety protocols for both the populace and labour force and the regulated disposition of waste in designated landfills.

Keywords: *Asbestos; Protection; Management.*

EDUCATION 2.0

EMPOWERING PROJECT MANAGEMENT EDUCATION: THE 5-DOOR APPROACH AND GEN Z ENGAGEMENT

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Abstract: Post-millennials, commonly known as Generation Z or digital natives, play a significant role in influencing contemporary educational strategies. With a preference for visual, interactive, and concise learning experiences, Gen Z students present a distinctive challenge and opportunity for higher education. This generation, having grown up amid continuous technological advancements, showcases a unique learning style, placing value on flexibility, instant results, and visual engagement. Challenges for higher education teachers arise in adapting to these preferences, requiring innovative approaches to engage Gen Z students effectively. Recognizing these challenges, teachers from the University of Novi Sad, Faculty of Technical Sciences, have enhanced the International Development Projects course within the Engineering Management study program, Project Management study module. This initiative introduces the 5-Door Approach to eLearning, a very suitable approach to accommodate the diverse learning preferences of Gen Z students and teaching project management discipline. Supported by the Jean Monnet program of the European Union within the project "Enhancing PM² Skills and Competencies for EU Funded Projects," this course aligns with the overarching goal of adapting educational strategies to meet the needs of Generation Z, ensuring that project management education remains relevant and effective in a rapidly evolving technological landscape. The multifaceted model 5-Door Approach for e-learning, inspired by Kolb's Learning Styles theory and incorporating insights from Thiagi's 4-Door Approach, offering participants various entry points to their learning journey. The doors include The Library for accessing course content resources, The Café for interactive activities, The Playground for playful games, The Forest for reflection activities, and Assessment for gauging knowledge and skills acquired. This paper explores the innovative strategy in project management education seamlessly aligns with Generation Z's unique learning styles, bridges traditional and contemporary educational approaches, making it particularly suitable for understanding the complex project management discipline.

Keywords: *5-Door Approach; Project Management; Generation Z; e-Learning.*

TOWARDS A SCIENCE VIRTUAL REVOLUTION: MODERNIZING HIGHER EDUCATION THROUGH THE PROFESSOR EMERITUS ASSOCIATION

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Abstract: The research explores the intersection of the fourth scientific virtual revolution and the modernization of higher education processes in contemporary societies. Focusing on the Professor Emeritus Association's (PEA) objectives and programs, the project is designed to support the transdisciplinary development of education and science. Leveraging virtual platforms, smart technologies, neural networks, and expert systems, the initiative aims to propel the virtual scientific revolution in parallel with the digitization of university education. The strategic plan encompasses networking the PEA with domestic and international institutions, facilitating the exchange of experiences, knowledge, and achievements. Activities include professor exchanges, collaborative workshops, and partnerships with scientific institutes to enhance research infrastructure. The significance implies the creation of university collaboration at national and international levels, vital for the ongoing modernization and transdisciplinarity in higher education. By integrating virtual and digital technologies, the project contributes to the ongoing modernization and transdisciplinarity in the realm of higher education, ensuring the relevance of educational programs in both real and virtual spheres.

Keywords: *Virtual Revolution; Education 2.0; Modern Education.*

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SUSTAINABLE PROJECT MANAGEMENT

CULTURE ARCHIPELAGO OF BUDVA: DECENTRALIZATION OF THE TOURIST OFFER WITH THE HELP OF CULTURAL STATIONS

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Abstract: An analysis of the planning documents and geographical characteristics of the city of Budva established that it is divided into three natural zones on the one hand and into 14 cadastral municipalities on the other. The current conception of the tourist offer indicates that primacy is given to one belt - the coast. Because of this, approximately 95% of the municipality of Budva remained undeveloped and unused. Furthermore, this type of centralization progressed in such a way that all significant cultural and tourist events are concentrated in one part of the promenade that is in the immediate vicinity of the old town of Budva, including the square in front of the old town, but not the old town itself. The aim of this paper is to provide a solution for this phenomenon in the form of decentralization of cultural content according to the model of an archipelago - a formation of a large number of islands that have separate characteristics but cooperate with each other and ultimately depend on the main centre from which the contents are branched off and thus given different roles. Through empirical and theoretical research one can come to the conclusion that this model of decentralization is possible with the help of the creation of "cultural hubs" which, strategically placed, can, with the help of various contents, improve cooperation between cadastral municipalities, develop neglected parts of Budva, and increase and expand the tourist and cultural offer of the Municipality of Budva. The goal of this research is to give sustainable solution of architectural, cultural and tourist development of municipality of Budva, by using all resources it has to offer opposed to the current situation.

Keywords: *Centralisation; Tourist Offer; Sustainability; Archipelago; Budva.*

BETTER PROJECT MANAGEMENT IN FLEXIBLE WORKING ENVIRONMENT

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Abstract: During the COVID-19 pandemic, it was essential to ensure the environment and the techniques for remote work, which was strongly advised for health reasons. After the pandemic was officially over, the companies understood that many workers were better off in that working mode, while some of them enjoyed coming back to the offices - it was connected to many personal factors, among which motivation was one the crucial ones for employees, and the trust and control were crucial for employers. Some employees felt cut off from the corporate culture, thus feeling like "gig workers" and craved to come back to their offices, while some of them felt uncomfortable coming back from the serenity of their homes and "digital nomadism". The reactions of companies varied from country to country, and surprisingly, Americans tend to be the most flexible - approximately 60 % of their companies allow home-office work, and 20 % of the office seats will remain empty in 2024. The Canadians are a bit less flexible with 15 % of empty seats, and the Western Europeans tend to be least flexible with only 8 %. This paper tries to find the answer to what are the psychological parameters of employers and employees that can yield the best results and what kind of project and HR management should be used in the post-pandemic environment.

Keywords: *Remote Work; Flexible Environment; Motivation; Project Management; HR Management*.

AI TOOLS IN SUPPORT OF SUSTAINABLE PROJECT MANAGEMENT: PROS AND CONS

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Abstract: In an era when environmental issues and sustainable development are taking centre stage globally, the use of Artificial Intelligence (AI) systems to aid in Sustainable Project Management (SPM) has received considerable attention. The AI solutions today are diverse and are used in everyday life, from grammar and plagiarism detection tools to ChatGPT. The most important benefits of using AI tools while Project proposal writing are efficiency and accuracy, data processing, predictive analytics, optimisation of resources, and remote monitoring. AI systems can quickly analyse vast datasets to identify patterns, anomalies, and trends that might be challenging for humans, and help predict environmental changes (natural disasters and climate fluctuations). By analysing historical and real-time data, AI systems can provide early warnings and predictive models to enhance alertness and response strategies in SPM. Some of the most controversial points of AI use in this sector (cons) are – data privacy and security, initial costs, technical expertise, ethical concerns (misuse, predatory use), data manipulation and environmental impacts. AI tools require access to vast amounts of data. Protecting the privacy and security of sensitive environmental data is a major concern. Acquiring the necessary technology, training personnel, and adapting existing systems can require substantial financial investments, so smaller organisations or developing countries may find it challenging to adopt these technologies, which can lead to widening the equality and equity gap. Furthermore, the energy consumption and environmental footprint of AI technologies can be significant. Large data centres and high-performance computing systems used for AI may contribute to increased carbon emissions. The integration of AI tools in support of SPM offers a promising path toward more effective and sustainable environmental solutions, with supervision and adequately set guidelines. Project managers must balance the advantages of AI with its potential drawbacks while keeping ethical, security, and environmental considerations at the forefront.

Keywords: *AI tools; Sustainable Project Management; Environmental Impacts; Benefits and Disadvantages.*

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Environmental Engineering and Sustainable Development

A COMPREHENSIVE EXPLORATION OF CUTTING-EDGE APPROACHES FOR EVALUATING INORGANIC POLLUTION RISKS IN LANDFILL LEACHATE

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Abstract: The Leachate Pollution Index (LPI) serves as a monitoring tool to evaluate the potential for leachate contamination. It aims to assist managers and landfill operators in planning appropriate remedial measures to reduce the landfill's pollution footprint and contribute to the preservation of environmental quality. The LPI is developed using the Rand Corporation Delphi Technique, whereby each parameter is assigned weights based on its significance. The paper highlights the concern of numerous researchers who have concluded that the traditional and time-consuming Delphi Technique is inadequate in handling innate vagueness in the decision-making process. Moreover, the conventional approach utilised in the LPI's development failed to precisely reflect the experts' viewpoints. To address these limitations, an integration of the Delphi method and fuzzy set theory was performed, leading to the creation of the enhanced Fuzzy Delphi Method and the revised Leachate Pollution Index (r-LPI). This index has demonstrated greater precision and robustness when evaluating the pollution potential of landfill leachate through the integration of a fuzzy technique with a novel hybrid multi-criteria decision-making method. An alternative method for assigning relative weights to pollutants has been computed using the fuzzy analytic hierarchy process. This approach was found to provide a more comprehensive prediction of leachate pollution compared to the traditional Delphi method. It involves expert opinions and facilitates the prioritisation of criteria based on their importance. The drawback of the r-LPI is that it assesses the pollution potential of leachate solely based on the concentration of pollutants, rather than taking its volume into account. Moreover, using the LPI as a benchmark may also result in a distorted interpretation of the extent of leachate pollution. The review underscores the imperative to improve LPI assessment amid challenges posed by socio-economic trends, technological advancements, and the emergence of novel pollutants.

Keywords: *Leachate Pollution Index; r-LPI; Delphi Method; Fuzzy Technique; Fuzzy Analytical Hierarchy Process.*

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SUSTAINABLE REMEDIATION OF CONTAMINATED ENVIRONMENTS BY PLANT-BASED NANOMATERIALS

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Abstract: In the latest technological and scientific revolution, nanotechnology has gained considerable attention across diverse industries and academic disciplines, with a particular emphasis on environmental remediation. The pursuit of advanced nanotechnology necessitates the development of controlled, straightforward, cost-effective, and safe methods for synthesizing nanomaterials. Conventional nanomaterial production techniques, such as chemical synthesis, pose risks due to the utilization of toxic chemicals and the generation of environmentally harmful byproducts. Some nanoparticles are inadvertently produced during washing processes, posing a potential threat to soil, water, and air ecosystems, thereby endangering plants, animals, and bacteria. Conversely, evidence suggests that utilizing plants for nanomaterial synthesis is not only economically viable but also environmentally sustainable. Plant-based nanoparticles exhibit lower toxicity compared to various alternatives, making them appealing candidates to mitigate the extensive harm inflicted on the microbiome by existing methodologies. In the field of environmental remediation, the employment of plant-based nanoparticles has demonstrated numerous advantages and applications. Therefore, this chapter aims to assess the current state of knowledge regarding products derived from plant-based nanoparticles for environmental cleanup, with a comprehensive exploration of the widespread utilization of plant-nanoparticle interactions in environmental remediation.

Keywords: *Nanotechnology; Environmental Remediation; Nanomaterial Synthesis; Plant-Based Nanoparticles; Public Health.*

SOLID WASTE MANAGEMENT CHALLENGES IN TRANSITION COUNTRIES

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Abstract: Solid waste management has been a challenge for over a decade, due to increasing amounts caused by rapid population growth. Many municipalities, especially in transition countries, face problems of large amounts of municipal solid waste, where existing collection systems and technologies are insufficient, resulting in a large part of waste remaining uncollected or ending up on illegal landfills, creating a risk to the environment. They need tools which can systematically analyse the collected data, and then assess all aspects of the system, including both technical and non-technical ones. This paper provides an overview of the state of municipal solid waste management in Novi Sad (Serbia) as a case study of country in transition. The methodology integrates literature data with material flow analysis (MFA) to analyse and evaluate the current scenario. Additionally, recommendations for future actions to improve current waste management system in Novi Sad (Serbia) are defined.

Keywords: *Municipal Solid Waste, Waste Management, MFA, Transition Country.*

CRITICAL REVIEW OF ELECTRICAL AND ELECTRONIC WASTE LEGISLATION IN SERBIA

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Abstract: Waste electrical and electronic equipment (e-waste) contains hazardous components that may have a negative impact on the environment and human health if not properly managed. In regard to this, legislation concerning e-waste management is one of the major contributors toward the sustainable management of this waste stream. In this work, an overview of the institutional and legal framework in the field of e-waste management in Serbia in the context of harmonising national environmental law with European Directives, as an EU candidate country, is provided. Comparing the relevant legislation between Serbia and the EU, certain differences and shortcomings regarding the current state and compliance with the EU have been detected, such as a lack of legal framework for the establishment of collective schemes in accordance with the „producer responsibility" principle and essential provisions of Directive 2012/19/EU (Articles 5, 12, 13) relating to obligations of separate collection and financing of collection, treatment, reuse and sustainable disposal of this waste. Further, within this work, the key stakeholders towards e-waste management who are responsible for implementing the e-waste policies, from producers and consumers of electronic equipment to government, collectors, municipalities and recyclers are identified. Lastly, a management system was proposed that would increase collection rates, enable transparent monitoring of the waste flows, improve financial mechanisms for waste management, support socially and environmentally sound treatment standards throughout the supply chain and define the responsibilities of the stakeholders within the system so that regulation can evolve with industry.

Keywords: *E-waste legislation; WEEE Directive; Management; Sustainability.*

CADMIUM DOPED SBA-15 HYBRID CATALYST FOR IMIDACLOPRID REMOVAL

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Abstract: To produce sufficient quantities of crops for the ever-growing demand, chemical substances known as pesticides are used to control pests, insects, weeds, and fungi. Today, neonicotinoids, predominantly imidacloprid, are widely used as insecticides owing to their systemic effect and significant water solubility. However, due to its properties, a considerable amount of imidacloprid is released into soil, air and water. The persistent presence of imidacloprid in water systems has prompted the exploration of efficient removal methods, primarily heterogeneous photocatalysis, and the development of advanced materials for pesticide mineralisation. Among the advanced materials garnering considerable attention are mesoporous silica materials. These materials stand as a pivotal class of nanostructured supports in heterogeneous photocatalysis. Specifically, SBA-15, enjoys broad applicability in photocatalysis owing to its thicker walls, distinct morphology, chemical resistance, and porosity, resulting in heightened thermal and mechanical stability. An expanding strategy for enhancing the photoactivity of semiconductors is the synthesis of composite materials by combining existing photoactive materials such as ZnO, WO_3, TiO_2, CdS etc. with mesoporous materials or zeolites. This study investigates the application of heterogeneous photocatalysis for imidacloprid removal, employing hybrid materials of cadmium-doped SBA-15 as catalysts. The synthesis involved the preparation of composite CdO/SBA-15 and CdS/SBA-15 catalysts with varying loadings and employing diverse post-synthesis procedures such as washing with water, ethanol, and calcination. Characterisation of the synthesised catalysts was conducted using X-ray diffraction (XRD), infrared spectroscopy (FTIR), and UV/Visible spectroscopy. Subsequently, these catalysts underwent testing in a batch reactor under diverse conditions, including variations in pH, initial concentration, light sources, and the presence of scavengers, to assess their efficacy in imidacloprid removal. The analysis revealed that the composite catalysts possess a narrow bandgap, with the most favourable outcomes (achieving a 98.33% conversion after 60 minutes) obtained for the non-calcined 10% CdO/SBA-15 catalyst treated with water post-synthesis, employing benzoquinone as the scavenger.

Keywords: *SBA-15; Semiconductor; Photocatalysis; Imidacloprid.*

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EXAMINING LEVELS OF POLYCYCLIC MUSKS IN AQUATIC SEDIMENTS BY MULTI–RATIO EQUILIBRIUM PASSIVE SAMPLING

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Abstract: Polycyclic musks (PCMs) are widely used in daily chemical products, so their mass production and wide use enable them to enter the environment in various ways. Their lipophilicity and persistence have led to accumulation and toxicological effects in aquatic systems, especially in sediment and biota, and their long-term low-dose presence in the environment will result in serious ecological risks. To provide contaminant concentrations for three polycyclic musks: tonalide, galaxolide and cashmeran on a defined basis, surface layer riverbed sediment samples collected at ten locations along the Danube stretch in the territory of Serbia, were ex-situ (in the laboratory) equilibrated with silicone passive samplers of constant accumulative properties, using the multi-ratio equilibrium passive sampling (MR–EPS) approach. Contaminant's equilibrium concentrations in passive samplers are mutually comparable in time and space and are better measure for bioavailability than total sediment concentrations. The methodology included four tested mass ratios of sediments and silicone rubber, which was used as a passive sampler. Equilibrations of passive samplers with sediment at largely different sampler–sediment mass ratios, allow the construction of a part of a (de)sorption isotherm, which yields the Cw in the pore water at a low sampler-sediment ratio (minor depletion of the sediment phase) and the accessible or releasable concentration in the sediment C_{AOC} at high sampler-sediment ratio (maximum depletion of the sediment phase). The detected concentration levels of polycyclic musks were very low (< 2 ng/L). At site Belegiš (upstream of Belgrade), musk showed some higher $C_{W,0}$ levels but these can only be considered indicative. For musk cashmeran, $\log K_{AOC}$ deviated from the unity line but not significantly, considering its large variability (s = 0.4 log unit). The highly significant linear isotherms for musks obtained by the MR–EPS confirmed the partition-driven nature of their exchange between water and sediment for the investigated sediments.

Keywords: *Polycyclic Musks; Passive Sampling; Sediment; Danube.*

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ECO-FRIENDLY LIGNIN-MAGNETITE NANOCOMPOSITE SYNTHESIS AND APPLICATION FOR MICROPLASTIC REMOVAL

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Abstract: Plastics make human life easier in many ways and are cheaper alternatives to other materials used in industry, so plastic production amounts are increasing every year. Most popular plastic products, such as disposable dishes, bags, and device packaging, are supplied to the market. However, the environment is faced with pollution caused by the use of large quantities of plastic products. Only a relatively small amount of plastic is recycled or made into bioplastic. One type of plastic is microplastic, whose particle size is smaller than 5 mm. In the environment, these particles cause ecological and health protection problems, such as organism metabolism disorders and oxidative stress. Microplastic particles are also found in the human body in small concentrations. Most often, they enter through food chains, directly from the atmosphere or drinking water [1]. Therefore, it is important to find new microplastic removal technologies. One strategy for water treatment is to apply lignin-based nanocomposites. This biopolymer is mostly found in plants and is extracted from biomass. According to eco-friendly, planet-safe, and nontoxic technologies, in this work, lignin is extracted from softwood sawdust using an alkaline extraction method. For the nanocomposite, synthesis we used magnetic iron oxide nanoparticles (Fe_3O_4) and lignin solution. The sorption was investigated by sorbing 300 µm low-density polyethylene particles in the selected time interval from 2 min to 240 min. The efficiency and kinetic studies show that the synthesised lignin-magnetite nanocomposite has sorption capabilities for sorbing low-density polyethylene particles.

Keywords: *Lignin; Secondary Wood Raw Materials; Magnetic Iron Nanoparticles; Nanocomposite; Microplastic Particles; Sorption Efficiency.*

ANALYSIS OF THE IMPACT OF TRAFFIC ON THE INTERNATIONAL HIGHWAY A-1 ON AIR QUALITY IN THE REGION OF THE CITY OF NIS

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Abstract: In the last decades, road traffic has been a dominant source of pollution both in urban areas and outside urban areas where the frequency of traffic is extremely high. The construction of a large number of highways and bypasses around the cities has shifted and reduced the level of traffic in urban areas, and thus the direct impact of traffic on air quality in populated areas. However, this reduction did not affect the air quality in general in their surroundings. The extremely high frequency of different categories of traffic moving at high speeds on highways and bypasses represents a significant source of pollution that is transported over long distances under the influence of natural air currents. The most important pollutants produced by burning fossil fuels are SO_2, CO, suspended particles PM_{10} and $PM_{2.5}$, NOx, VOC, and others. In this work, a simulation of the spread of suspended particles PM10 and PM 2.5 and NOx generated in traffic on the international highway A-1 in the direction Belgrade - Niš, in the vicinity of the City of Niš, was carried out. Special attention is paid to the level of pollutants in the area of the "NAIS" toll booth. On this point, vehicles slow down and stop for a certain period of time, which significantly increases the negative impact of traffic, and the impact on health on a large number of people working in the toll booth. Employees at toll booths are directly exposed to the named pollutants for several hours every day, which directly endangers their health. ADMS Roads software was used to create the simulation. This software enables numerical modelling of the spread of pollution from traffic and industrial sources or a combination of those two sources. The program has found wide application in monitoring and controlling the impact of road traffic in large urban areas such as London and Beijing.

Keywords: *Air Quality; Pollution Modeling; ADMS Roads; Traffic.*

Acknowledgement

This work was supported by Technical faculty "Mihajlo Pupin" Zrenjanin, Project number MIS-ETC 1425. During the realisation of the project "ENVIROBANAT", Technical faculty "Mihajlo Pupin" acquired a program package for simulating the distribution of pollutants. ADMS ROADS from package was used in the preparation of this paper.

REMOVAL OF SELECTED PHARMACEUTICAL RESIDUES FROM WASTEWATER BY ADSORPTION ON BIOMASS DERIVED ACTIVATED CARBON

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Abstract: Presence of pharmaceutical residues in wastewater discharges into rivers disrupts aquatic ecosystems and ultimately affects human health. The risk of exposure to pharmaceutical residues becomes greater because these molecules are not easily degraded during conventional sewage treatment. The aim of this study was to test the application of activated carbon from biomass for removing paracetamol, trimethoprim and nevirapine residues from wastewater. Liquid chromatography tandem mass spectrometry was used for target analysis. Powdered rice husks were carbonated at different temperatures in the range of 300 – 600 °C then activated using phosphoric acid. Biochar carbonated at 500 °C was found to offer the best adsorption properties. Adsorption of the three pharmaceutical drugs was found to increase with increase in contact time and adsorbent dosage, decrease with increase in initial drug concentration while pH did not have a significant effect on the adsorption rate. The optimum contact time for the three pharmaceutical drugs was 30 minutes (with agitation) while the optimum adsorbent dosage was found to be dependent on the concentration of the pharmaceuticals. Adsorption isotherms for the three pharmaceutical drugs fitted well in both Langmuir and Freundlich models. Kinetic studies found the adsorption to fit well in the pseudo-second order model with R^2 values approaching unity. This indicated that chemisorption was favoured over physisorption. These investigations show that, chemically activated rice husk biochar is an effective, low-cost adsorbent for use in removal of pharmaceutical residues from wastewater.

Key words: *Pharmaceutical Residues; Wastewater; Activated Carbon; Adsorption Isotherms.*

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THE IMPACT OF WASTEWATER TREATMENT PLANT LOCATION ON THE ECOSYSTEM

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Abstract: In civil engineering projects, choosing the right location is crucial, especially when it comes to designing wastewater treatment plants (WWTPs). Numerous studies have highlighted that the choice of location for WWTP facilities is contingent upon a multitude of factors, each of which carries associated risks during and after construction. The evaluation of these factors varies from one location to another and from project to project. An ecosystem represents a geographical region where plants, animals, and various organisms operate as an integrated unit, encompassing not only the biological elements but also the encompassing weather patterns and landscapes. In the context of WWTP placement, several critical factors come into play, including hydrology, land utilisation, dominant wind patterns, prevalent waterborne diseases, and the quality of the receiving water body. The two primary ecological risks commonly associated with WWTP placement are (1) the potential for detrimental impacts on the local ecosystem, and (2) the risk of inadequate distance or positioning concerning nearby settlements. The first risk pertains to the potential for mislocating the treatment facility in a manner that could result in harm to the surrounding ecosystem. The second risk involves the possibility of adversely affecting the local population and impeding connectivity to nearby towns in case such a need arises. In the event of accidents, malfunctions, or miscalculations, there exists a potential risk of altering the organic and nutrient composition within the water body. This, in turn, may result in the depletion of local flora and fauna populations, and in the worst-case scenario, lead to local extinctions. Furthermore, the selection of WWTP locations is linked to socio-economic factors, which can, in turn, shape public opinion negatively. To enhance the scope of this research, an in-depth analysis of specific facility locations and their impact on the ecosystem could provide valuable insights.

Keywords: *Civil Engineering; Wastewater Treatment; Ecosystem; Risk Assessment.*

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ADSORPTION PROCESS OF AZO PRINTING DYE ON ACTIVATED CARBON: ENHANCED REMOVAL EFFICIENCY AFTER FENTON TREATMENT

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Abstract: As an advanced technology, mainly attributed to nonselective oxidative degradation by reactive hydroxyl radicals, the Fenton process has been widely used for the removal of various organic pollutants: synthetic dyes, antibiotics, pesticides, phenol, and aromatic hydrocarbons. However, the main challenges to overcome within the Fenton process are the narrow acidic pH range (2.5 - 3.5), sludge formation in neutral pH medium and high toxicity of treated effluent due to the generation of contaminating by-products, unknown organic compositions and coexisting inorganic ions in wastewaters. Therefore, this research discusses the possible use of commercially available activated carbon to increase the overall reaction efficiency and inhibit previously established negative environmental impacts of Fenton oxidation. In our previous research, Fenton treatment of Yellow printing wastewater resulted with 78% removal efficiency and 41% of total organic carbon (TOC) reduction. However, treated sample was characterized as highly toxic since the toxicity inhibition of *Vibrio Fischeri* bacteria was 58%. Therefore, the adsorption treatment efficiency was monitored through the assessment of decolorization efficiency (dye removal), mineralization degree (TOC reduction) and toxicity inhibition. A high efficiency of the adsorption treatment was obtained in terms of reduced toxicity, which was up to 50%, and at the same time followed with TOC reduction of 81%. It is assumed that after the adsorption treatment applied, the proportion of degradation products formed in the Fenton process, which were initially responsible for the high toxicity of printing wastewater, decreased due to their binding to the surface of the activated carbon. However, the lowest efficiency of the adsorption treatment was achieved within dye removal from the treated wastewater (5%). Since the initial Fenton treatment gave satisfactory results in decolorization efficiency, the adsorption treatment certainly played the most important role in increasing mineralization and reducing toxicity, even at neutral pH.

Keywords: *Adsorption; Azo Dye; Activated Carbon; Printing Wastewater; Fenton Treatment.*

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ANALYSIS OF WATER INDICATORS IN BOSNIA AND HERZEGOVINA IN THE CONTEXT OF WATER PROTECTION

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Abstract: The paper analyses the effects of the application of water indicators in the world, the EU, and the Federation of Bosnia and Herzegovina to support the reduction of the degradation of water resources. Water monitoring is the basis for assessing the state of water, and the possibility of a valid and accurate assessment of the state of water bodies depends significantly on the efficiency of its implementation. One of the tools of Integral Water Resources Managment (IWRM) – the River Basin Management Plan (RBMP) - significantly contributes to increasing the efficiency of water monitoring. BIH has an obligation to apply the principles of the WFD and, thus, the IWRM, both based on the federal water law and as a country aspiring to become a member of the EU. Different sets of water indicators help to assess the state of water and the progress in achieving environmental goals, i.e., "good water status" as outlined by the Water Framework Directive (WFD). A mutual comparison was also made based on the analysis of the state of water bodies in the preparation of the II cycle of the RBMP for FBIH, Slovenia, and Austria. A comparison of the degree of application of IWRM in these countries was also made. The analysis of existing water indicators for FBIH showed that there is insufficient data for the development of water indicators in FBIH, that a set of water indicators for FBIH has not been established, and that it is necessary to improve the efficiency of water monitoring in FBIH and reporting according to EEA/EIONET and other international conventions.

Keywords: *Water Indicator; WFD; IWRM.*

APPLICATION OF DATA-BASED MODELS FOR CONDITION MONITORING OF ROTATING MACHINERY USING VIBRATION SIGNALS

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Abstract: Maintenance of rotating machinery is the essential part and the core of every production process and directly affects its productivity and quality. Therefore, automation of the diagnostics phase of rotating machinery, i.e. monitoring of its condition and identification of possible faults is crucial for a well-organised production plant. This paper proposes a methodology for transforming raw vibration signals into adequate inputs for machine learning classification algorithms in order to identify present faults in rotating machinery. First, optimal sampling frequency is determined, and appropriate filtering of raw data is performed. Next, Time Synchronous Averaging (TSA) of the filtered signals is conducted and the obtained TSA signals are used for estimation of the level of importance of ten time-domain statistical functions. The level of importance of the statistical parameters is evaluated using two proposed methods. The first method tests the ability of the parameters to distinguish a faulty from a healthy condition. The second method tests the ability of the parameters to differentiate ten different fault conditions. Results from both methods show that Peak Value, Root Mean Square (RMS) and Standard Deviation are the most influential time-domain statistical parameters for the analysed study case. Furthermore, frequency-domain features which include RMS frequency (RMSF), frequency centre (FC), and root variance frequency (RVF) are extracted from the TSA signals. The study continues with the use of Neighbourhood Component Analysis (NCA) to calculate the weight factors of the features in terms of recognising the present rotating machinery faults. Only the ones with the highest level of importance have been used as input for the classification algorithms. MATLAB has been used for training and testing various classification algorithms. K-nearest neighbours' classifier (KNN) and Support vector machines (SVM) showed the highest accuracy in distinguishing ten different fault conditions.

Keywords: *Time-Domain Analysis; Frequency-Domain Analysis; Vibration Signals; Rotating Machinery; Classification Algorithms.*

EFFECT OF SUBACUTE DIBUTYL PHTHALATE TREATMENT ON THE OXIDATIVE STRESS BIOMARKERS IN RAT LIVER

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Abstract: Dibutyl phthalate (DBP) is a chemical additive prevalent in plastic products, cosmetics, dyes, and varnishes. It has been established as possessing endocrine-disrupting properties and reproductive toxicity in laboratory animals. However, the hepatic implications of DBP exposure are scarce in the existing literature. The aim of our study was to determine whether DBP treatment disturbs redox balance by altering glutathione (GSH), protein thiol levels and malonaldehyde (MDA) levels in rat liver. A 28-day study was conducted on 24 female *Wistar* allocated into four groups (n=7) and treated with DBP mixed in diet in various concentrations (0, 100, 500 and 5000 mg DBP/kg diet). After the study period, animals were sacrificed by decapitation and liver samples were collected. The level of GSH and protein thiol levels were determined spectrophotometrically, while the lipid peroxidation was accessed by TBARS assay. Levels of GSH showed a dose-dependent decrease compared to control, although significant reduction was detected only for the highest dose group, whereas levels of MDA and thiol groups did not significantly differ between the liver of control and DBP-treated rats. Our study shows that DBP can potentially disturb redox balance in rat liver by alteration of GSH levels.

Keywords: *Dibutyl Phthalate; Glutathione; Thiol Groups; Lipid Peroxidation.*

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EFFECT OF SUBACUTE DIBUTYL PHTHALATE TREATMENT ON THE TRANSCRIPTION OF CYTOCHROME P450 7A1 IN RAT LIVER

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Abstract: Dibutyl phthalate (DBP) is a commonly used chemical additive with known endocrine-disrupting properties. Despite its wide use, limited research engaged in its specific effects on hepatic gene expression, particularly on cytochrome P450 7A1 (*Cyp7a1)*, a gene that encodes a key enzyme involved in bile acid synthesis. The aim of our study was to investigate the potential effects of DBP on the transcription of *Cyp7a1* in rat liver. A total of 24 female *Wistar* rats were treated with DBP in various concentrations (0, 100, 500, 5000 mg DBP/kg diet) over the course of 28 days. After the exposure period, liver samples were collected for RNA isolation. The level of *Cyp7a1* transcription was accessed using RT-qPCR. Although relative mRNA expression of *Cyp7a1* was upregulated across all groups compared to the control, the difference in expression was not statistically significant. Our study shows that DBP does not affect the expression of *Cyp7a1* in the liver.

Keywords: *Dibutyl Phthalate; Liver; Bile Acid.*

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EFFECT OF SOLID/LIQUID RATIO ON Hg(II) SORPTION EFFICIENCY OF NATURAL AND MODIFIED ZEOLITE

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Abstract: Remediation of mercury-contaminated soil is extremely important in order to reduce the emission of mercury to more remote areas. One such example is the Idrija mercury mine area in Slovenia. Investigations have revealed that mercury is leached from the soil under the influence of rainwater and reaches even the Gulf of Trieste through the Idrijca and Soča rivers. Therefore, soil remediation is desirable in order to reduce the spread of pollution. Namely, the remediation of mercury-contaminated soil is quite a challenging task, whether it is carried out in situ or ex situ. Various biological, chemical, and physical remediation techniques have been applied, and each of them has advantages and limitations. For example, physical techniques are expensive because they require a lot of manpower, biological techniques are quite time-consuming, while chemical techniques are often environmentally unacceptable if performed in situ. Therefore, nowadays investigations are focused on finding environmentally acceptable and relatively short-term remediation techniques. One of them could be sorption using environmentally friendly sorbents. For these purposes, ecologically acceptable natural zeolite (NZ) from the Zlatokop deposit in Vranjska Banja, Serbia, as well as its modified form (MZ), were used as sorbents. Two-step modification of NZ was performed with 1 mol/L $Fe(NO_3)_3 \times 9H_2O$ for 2 hours at 100 °C, and then with 1 mol/L $Na_2S \times 9H_2O$ for 4 hours at 150 °C. Furthermore, it is well known that the efficiency of the sorption process depends on a number of parameters such as pH, concentration, contact time, and especially on the mass of the applied sorbent, i.e., on the solid/liquid ratio (S/L). Therefore, the aim of this paper was to examine the influence of the S/L ratio of NZ and MZ for different initial mercury concentrations in the range 1.1-11.9 mmol/L at a predetermined optimal pH≈2 (1.90 < pH < 1.98). Batch experiments were carried out at room temperature, at 220 rpm and for 24 h with S/L for NZ in the range 2-30 g/L and for MZ in the range 2-14 g/L. For all initial mercury concentrations (1.1, 4.1, 7.8 and 11.9 mmol/L), an optimal S/L ratio for NZ was 30 g/L, while for MZ it depended on the initial Hg(II) concentration and was equal to 6-14 g/L, respectively. At the specified S/L ratio for NZ, the sorption efficiency was in the range of 66.3%-98.0%, while for the specified S/L ratios for MZ, the efficiency was in the range 96.9%-99.8%. The results indicate that a 5 times lower S/L ratio is required using MZ than NZ to achieve the same sorption efficiency, which is especially pronounced for lower initial mercury concentrations. Finally, a significantly lower consumption of MZ justifies the modification procedure and promises the eventual possibility of its application.

Keywords: *Natural Zeolite; Modified Zeolite; Chemical Modification; Solid/Liquid Ratio; Mercury.*

SURFACE WATER POLLUTION SOURCE IDENTIFICATION AND QUANTIFICATION: LITERATURE REVIEW

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Abstract: Surface waters are important natural resources and are widely used for different purposes in human life such as agriculture, industry, municipal services and so on. Using surface water at a high rate led to increasing of their pollution and scarcity. This pollution is mainly human-made and, in some cases, anthropogenic. Recognizing this problem currently, water pollution source identification and quantification is an active research area. The main objective of this review is to identify different pollution factors of surface water, approaches and methods used by different researchers for the identification and quantification of these pollution sources. There are different pollution factors in surface water such as heavy metals, microplastics, nutrients like Nitrogen and phosphorus, waterborne pathogenic microbes, and petroleum hydrocarbons. Different pollution identification and quantification methods were used in different literature based on the objectives and scopes of the studies. This includes Inverse Methods, Bayesian Inference, an Innovative Biosensor Network, Differential Evolution (DE) optimization algorithm, a Combining Differential Evolution Algorithm (DEA) and Metropolis-Hastings Markov Chain Monte Carlo (MH–MCMC), Field Observation and Laboratory Analysis, and Multivariate Receptor Model.

Keywords: *Surface Waters; Pollution Sources; Identification; Quantification.*

CONCENTRATIONS AND SOURCE APPORTIONMENT OF OCPS AND PCBS IN SEDIMENTS OF LAKE VICTORIA, EAST AFRICA

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Abstract: Lake Victoria is the second largest lake in the world with a catchment area of 193,000 sq. km. Several anthropogenic activities take place around the lake which may emit pollutants, yet lake sediments act as their sink. This study determined the levels and sources of organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs) in 41 sediments. Extraction, clean-up, and analysis was done using Soxhlet method, fractionation column and GC-MS/MS, respectively. Concentrations of 13 OCPs ranged from non-detectable (n.d.) levels to 376 µg kg^{-1} dry weight (d.w.). *p,p*'-DDD was the most dominant OCP residue contributing 88.2, 82.9 and 72.9% to the ∑DDTs for Uganda, Kenya and Tanzania, respectively. The ratio of *p,p*'-DDE to *p,p*'-DDT was >1 in all sediments suggesting past DDT usage around the lake basin. α-Endosulfan was the most dominant Endosulfan isomer in all sediments which was attributed to its high percentage (70%) in technical Endosulfan formulation. PCB concentrations ranged from n.d. to 3.30 µg kg^{-1} d.w. CB 198 was the most dominant PCB congener, followed by CB 184. The dominancy of CB 198 was attributed to the hydrophobicity of highly chlorinated PCBs in the aquatic environment, water partition coefficient (K_{ow}) value and sorption to organic matter in sediments. Principal component analysis (PCA) extracted four components accounting for > 68% of the total variance that indicated degradation, past OCPs usage in agriculture and public health. PCB congeners were a result of volatilization, degradation of higher congeners, improper waste disposal of old transformers, plasticizers, and capacitors. Lindane, *p,p*'-DDD and *p,p*'-DDT were above the probable effect levels (PEL) hence, they were likely to cause an adverse effect on aquatic organisms in the lake. All PCBs were below the TEL and PEL levels in the sediments.

Keywords: *Organochlorine Pesticides; Polychlorinated Biphenyls; Concentrations; Sources; Lake Victoria.*

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UNLOCKING THE POTENTIAL: GAS CHROMATOGRAPHY (GC) IN THE ANALYSIS OF COMPLEX PESTICIDE MIXTURES AND COMPREHENSIVE FLOW-MODULATED GC×GC AS A POTENTIAL SOLUTION FOR OVERALL PCB ANALYSIS

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Abstract: The pharmaceutical, food, and agricultural industries are increasingly releasing various compounds into the environment, categorized as persistent and emerging pollutants. These substances, resistant to degradation and capable of long-distance migration, significantly impact ecosystems and living organisms. Addressing environmental pollution urgently requires continuous innovation in analytical methods, especially for assessing water pollutants such as pesticides and polychlorinated biphenyls (PCB). In response to this need, a GC-MS method was developed for analyzing 194 pesticides across different organic compound classes: carbamate, triazine, pyrethroid, pyridine, organophosphorus, benzimidazole, organochlorine, pyrrole, quinone, morpholine, dinitroaniline, phenylpyrazole, pyrimidine, phenylpyrrole, pyridazinone, carboxamide, dicarboximide, aniline, oxadiazole. The method employs a 30 m HP-5 stationary phase with a helium carrier gas flow rate of 1 ml/min. Despite the complexity of the compound mixture, co-elutions were addressed by implementing a lower temperature ramp, starting at 30°C (10 min) and increasing at a rate of 2°C/min until reaching 300°C (10 min). Successful results were obtained through both the scanning method and the development of the Selected Ion Monitoring (SIM) method, featuring characteristic *m*/*z* qualitative and quantitative ions. PCB compounds, constituting a complex mixture of 209 congeners within a single class, present identification challenges in real samples using conventional GC methods due to their high similarity and retention characteristics. In this study, a comprehensive two-dimensional gas chromatography method was employed with 30 m IL-60 stationary phase in the first and 5 m BPX 50 in the second dimension. Serial coupling of two columns with different polarities facilitated enhanced separation of complex mixtures. Optimization of carrier gas flow rates in the primary and secondary columns, along with modulation period, was crucial for peak resolution and capacity. Optimal parameters included a modulation period of 4 s, a flow rate of 0.7 ml/min in the first, and a flow rate of 23 ml/min in the second dimension.

Keywords: *Polychlorinated Biphenyls; Pesticides; Gas Chromatography; Comprehensive Two-Dimensional Gas Chromatography; Method Optimization.*

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ENHANCING PM POLLUTION MODELLING: INSIGHTS FROM COMPARATIVE ITERATION ANALYSIS

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Abstract: The comprehensive study delves into the intricate dynamics of particulate matter (PM) pollution spread, leveraging agent-based modelling (ABM) in conjunction with the SIR model. Our investigation focuses on the implementation of four distinct iteration strategies – linear, random, parallel, and concurring – within a computational model representing an unobstructed area subjected to diverse congestion scenarios. The results of comparative iteration analysis reveal the profound impact of different iteration procedures on PM pollution simulation outcomes. Synchronized strategies, emphasizing particular environmental assessment before agent action, exhibit a more conservative approach to PM spreading. The conservatism ascends from the agent's ability to proactively survey the environment, resulting in fewer contacts with PM particles. The significance of the research is defined in its contribution to the field of environmental health risk management. By highlighting the pivotal role of iteration procedures in shaping PM pollution models, findings provide valuable insights for policymakers, researchers, and environmental health professionals. Understanding the intricacies of how different iteration strategies influence simulation outcomes is crucial for crafting realistic predictions and effective countermeasures against PM pollution. The research explores different understanding of PM pollution dynamics through a nuanced study of iteration strategies. Serving as a foundation for future studies in environmental modelling and risk assessment, the research fosters a holistic approach to addressing the challenges posed by PM pollution in the contemporary world.

Keywords: *PM Pollution;* Agent-Based Modelling*;* SIR Model*.*

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EFFECT OF TEMPERATURE FOR CHLORPYRIFOS ADSORPTION ONTO CARBON MATERIAL DERIVED FROM SPENT COFFEE GROUNDS

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Abstract: Pesticides are extensively used in agriculture to enhance crop yield and combat pests and pose a significant threat to ecosystems and human health when their residues accumulate in soil and water. Conventional methods of pesticide removal are often costly or introduce secondary pollutants. The increasing worry about pesticides harming the environment has led to more research on their removal. Various biowaste materials have been investigated for remediation of these contaminants. Among investigated materials, spent coffee grounds, a widely available waste product, offer a promising solution. Coffee consumption is a daily ritual, generating substantial quantities of spent coffee grounds as residual waste. Harnessing the adsorption potential of spent coffee grounds for pesticide removal addresses an environmental challenge and aligns with waste management principles and a circular economy. The carbon material, obtained through a controlled carbonisation process of spent coffee grounds at 900 °C, showed high adsorption potential for chlorpyrifos. The Langmuir and Freundlich models were employed to analyse the adsorption process, revealing favourable adsorption behaviour at different temperatures. Thermodynamic parameters indicated the spontaneous and feasible nature of the adsorption process, with temperature being an important factor for the adsorption of chlorpyrifos on the investigated material.

Keywords: *Chlorpyrifos; Spent coffee grounds; Carbon materials; Adsorption; Thermodynamics.*

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REMOTE SENSING OF RIVERINE MICROPLASTIC UTILISING SATELLITE SENSORS, NEURAL NETWORKS, AND SUSPENDED SEDIMENT DATA: A CASE STUDY OF THE LOWLAND TISZA RIVER

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Abstract: The implementation of remote sensing has revolutionised various sectors of environmental monitoring; however, its utilisation in assessing concentrations of riverine microplastics (MPC) remains a relatively unexplored domain. This study aimed to assess the potential of satellite sensors in estimating MPC directly and indirectly through suspended sediment concentration (SSC) as a proxy. The developed models were based on intensive spatiotemporal SSC and MPC measurements (26 sites and 198 samples) on the lowland Tisza River (Carpathian Basin), utilising various optical and synthetic aperture radar (SAR) sensors, along with an artificial neural network (ANN) algorithm. The results highlighted the significant influence of hydrology on suspended sediment and microplastic transport, as during low stages the SSC varied between 11 and 64 g/m^3, while the MPC between 2 and 57 item/m^3. On the contrary, during high stages and flood waves, these values increased (SSC: 13-302 g/m^3; MPC: 12-126 item/m^3). The direct models showed limited accuracy in estimating MPC (R^2=0–0.2) due to technical restrictions of current sensors and low MPC levels in rivers. However, the proxy models exhibited promising results. Nevertheless, the accuracy of these models was contingent on hydrological conditions, with the lowest accuracy during low stages (R^2=0.2, RMSE=13 items/m^3, and MAE=9 items/m^3) and the highest during flood waves (R^2=0.9, RMSE=8 items/m^3, and MAE=11 items/m^3). Conversely, SAR-based models provided the least accurate estimations. Significantly, the findings of this study are a step forward automatic quantification of riverine MPC. Therefore, further studies, encompassing denser SSC/MPC measurements and additional water quality parameters, are imperative to overcome the current study's limitations and enhance estimation accuracy.

Keywords: *Plastic transport, Hydrology; Dams; Machine learning.*

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EXTRACTION OF COBALT AND LITHIUM USING GREEN AQUEOUS BIPHASIC SYSTEMS BASED ON IONIC LIQUIDS

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Abstract: Lithium-ion batteries have become an integral part of the modern world: they power most of the portable devices we surround ourselves with every day. Almost all commercial lithium-ion batteries use graphite as the anode and metal oxides (cobalt, nickel, or manganese) or iron phosphate as the cathode material. However, compared to sodium, for example, the first alkali metal in the periodic table, lithium is far less abundant in the earth's crust. The situation is similar with elements needed for electrodes, such as cobalt, nickel, copper and even phosphorus, which are contained in cathodes and electrolytes. One of the solutions to reduce the negative aspects of global lithium demand is certainly recycling, which would contribute significantly to reducing the environmental impact. In the case of cobalt, copper and nickel, 90% of the material can currently be reused, while the proportion of lithium that can be recovered through recycling is around 65%. The work aims to investigate, develop, and optimise a separation method based on aqueous biphasic systems with non-toxic green solvents - ionic liquids and salt - for the extraction and separation of lithium and cobalt metals with the aim of their reuse. Two ionic liquids with the same cation and different anions (Acetate and Glycolate) with ammonium sulphate were used to build aqueous biphasic systems. The metal concentrations were determined using the ICP OES method and the extraction parameters (extraction efficiency) were calculated on this basis. Acetate and glycolate are relatively similar anions, with the glycolate anion containing a hydroxyl group. The results showed a higher efficiency of cobalt extraction (73.8%) when the system contains an ionic liquid with glycolate anion, while the efficiency extraction of lithium (72.8%) is higher when the system contains an acetate anion.

Keywords: *Lithium-ion batteries; Metals; Ionic Liquids; Aqueous Biphasic Systems.*

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ANION INFLUENCE IN PHOSPHONIUM-BASED IONIC LIQUIDS ON THE FORMATION OF THE AQUEOUS BIPHASIC SYSTEMS

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Abstract: Aqueous biphasic systems based on Ionic Liquids (IL-ABS) have gained considerable attention as extraction media for metal extraction and separation due to their improved adaptability in terms of specific interactions and environmentally friendly properties. In this regard, the creation of functionalised and task-specific ionic liquids has become essential for the production of effective and selective ABS. Phosphonium-based ionic liquids (ILs) have proven to be promising candidates for various applications due to their unique properties such as non-volatility, low toxicity, combination possibilities with different anions and thermoresponsiveness. This work focuses on the synthesis and characterisation of two novel hydrophilic phosphonium-based ILs with anions derived from natural acids that are well-known complexing agents, including acetate and glycolate. The aim of the work is to investigate the liquid-liquid equilibria of a ternary aqueous two-phase system by determining the phase diagrams at different temperatures. Ammonium sulphate was chosen as the second ABS component due to its acidic pH, low cost and wide availability as a salting-out agent. The phase diagrams were determined using the proven cloud point method at 25°C and 35°C, while the compound lines were determined analytically to gain insight into the exact composition of the phases. These parameters are very important in order to select the operating conditions for a possible application in metal recovery. The results obtained from the phase diagrams show that the formation of ABS is favoured in the following order of anions: Acetate < Glycolate. Glycolate-based phosphonium ILs showed a higher ability to form ABS, while the acetate IL is the most hydrophobic, resulting in a lower to salt out ammonium sulphate. These results indicate that the choice of anionic species in the development of phosphonium-based ionic liquids plays a crucial role in the formation of ABS as well as in their future application.

Keywords: *Ionic Liquids; Aqueous Biphasic Systems.*

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SUSTAINABLE SOLUTIONS FOR FASHION'S WASTE CRISIS

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Abstract: In a world marked by rapid changes, driven by global consumerism, cost-effective labour, and technology, the fashion industry faces a pressing issue, "fast fashion". This paper explores practical and sustainable solutions to the fashion waste crisis. The key actors include consumers, who play a pivotal role in shaping demand, fashion brands, which have considerable influence over production and supply chains, and policymakers, who have the power to enact regulatory frameworks. One of the solutions revolves around the promotion of a circular economy. Take-back programs and recycling initiatives can be instrumental in this regard. Another crucial avenue involves a strategic shift towards sustainable materials. By investing in the development and utilisation of eco-friendly materials like organic cotton, recycled fabrics, and innovative textiles derived from renewable resources such as bamboo and hemp, the fashion industry can significantly reduce its environmental footprint. The "slow fashion" movement emerges as a compelling solution, urging consumers to prioritise quality over quantity. Simultaneously, endorsing local and ethical manufacturing practices aligns with eco-conscious values while reducing carbon emissions associated with long-distance transportation and ensuring fair labour conditions for workers. Raising awareness among consumers about the environmental and social consequences of fast fashion remains crucial. Governments can enforce sustainability standards by implementing regulations, including restrictions on harmful materials and chemicals, incentives for recycling, and support for sustainable practices. Industry stakeholders, including fashion brands, non-governmental organisations, and consumers, must unite their efforts to forge a sustainable future for fashion. Embracing innovative technologies like 3D printing and on-demand manufacturing can mitigate overproduction and reduce waste. The growth of second-hand markets and clothing rental services offers a practical solution to extend the lifespan of garments. Furthermore, designers can make a significant impact by creating garments that are designed for disassembly, facilitating recycling, and minimising landfill waste.

Keywords: *Sustainable Development; Fast Fashion; Circular Economy; Waste.*

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SBSE–TD–GC–MS/MS FOR DETERMINATION OF FIPRONIL AND ITS THREE DEGRADATES IN WATER SAMPLES

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Abstract: Fipronil (FIP) is an insecticide and veterinary pharmaceutical that has been included among the Watch List substances for European Union monitoring. A method was developed to determine FIP pesticide and its three main degradates (fipronil desulfinyl, fipronil sulfide, fipronil sulfone) in water for screening and monitoring purposes based on the requirement of the EU Watch List (Decision 2022/1307) developed under the Water Framework Directive. The method uses solvent-free stir bar sorptive extraction (SBSE) combined with thermal desorption–gas chromatography–tandem mass spectrometry (TD–GC–MS/MS) optimised for the analysis of 100 mL samples. Water samples are stirred with a polydimethylsiloxane (PDMS)-coated sorptive stir bar for 16 hours, followed by TD and GC analysis of the trapped analytes from the PDMS phase. The method is simple, non-laborious and green, as it has been evaluated as "an excellent green analysis" according to the so-called analytical Eco-Scale assessment. The limits of quantification for all FIPs determined in tap, MilliQ, lake and artificial seawater ranged from 0.12 to 0.30 ng L^{-1}, meeting the requirement of Decision 2022/1307. The recoveries were between 81.7 and 109% and relative standard deviations in the range of 2.8–14%. Validation of the method confirmed its suitability for screening and monitoring studied analytes in selected matrices.

Keywords: *Fipronil; Water Analysis; SBSE; Thermal Desorption; GC–MS/MS.*

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GREEN SYNTHESIS OF ZERO VALENT IRON NANOPARTICLES USING CAPE GOOSEBERRY FRUITS AND LEAVES EXTRACTS

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Abstract: Zero valent iron nanoparticles are widely used in Europe and America for *in situ* remediation of organic and inorganic contaminants because of their relatively low cost, high reactivity and good adsorption capacity. When chemically synthesized zero valent iron nanoparticles are released into the contaminated media, they tend to undergo agglomeration which affects their mobility and stability. This study explored the green synthesis of zero valent iron nanoparticles using iron (III) chloride as the precursor and extracts from Cape gooseberry fruits and leaves as reducing, capping and stabilizing agents. The synthesized nanoparticles were characterized using Scanning electron microscopy (SEM), Fourier transform infrared (FTIR) spectrophotometer, X-ray diffraction (XRD) and a Zetasizer. The nanoparticles produced from the leaves were spherical, contained 19.7% iron and were in the size range of 30–40 nm while those from the gooseberry fruit extract were square shaped, contained 28.2% iron and in the size range of 100–150 nm. The FTIR spectrum indicated functional groups such as –OH and C-H from the plant extracts responsible for the reduction and capping of iron (III) chloride and iron nanoparticles, respectively. The XRD spectrum of the nanoparticles had a distinct peak at the coordinates 2θ = 32° which corresponds with rambhohedral structure of hematite (α-Fe_2O_3). Based on the characteristics, the gooseberry plant-based nanoparticles have potential for remediation of contaminated soils and water especially if optimal synthesis parameters such as precursor concentration, pH, ratio between plant extract and precursor salt are ascertained.

Keywords: *Nanoremediation; Nanoparticles; Pollution; Green synthesis*

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ASSESSMENT OF POLYBROMINATED DIPHENYL ETHERS IN MARABOU STORK AND FREE-RANGE CHICKEN AROUND KITEEZI DUMPING SITE IN UGANDA

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Abstract: Many bird species rely on dumping sites as reliable sources of food and habitat thus putting them at a risk of exposure to chemicals such as polybrominated diphenyl ethers (PBDEs). This study investigated the levels of 7 PBDEs (BDE 47, 99, 100, 153, 154, 183 and 209) in the muscles of Marabou stork (*Leptoptilos crumenifer*) and free-range chicken (*Gallus gallus domesticus*) preying in the vicinity of Kiteezi dumping site, Uganda. Kiteezi being one of the largest dumping sites in Uganda is a major receiver of e-waste making the site a potential source of PBDEs. A total of 50 Marabou stork and 50 chicken preying around a dumping site in Kiteezi were collected. Extraction was done ultrasonically, clean-up using a multilayer silica gel column and analysis using Gas chromatography coupled with mass spectroscopy. Concentrations of Σ_7PBDEs in marabou stork ranged from 23.3×10^{-3} to 13.2 µg/g lw (median 8.35 ng/g lw), while in chicken from 9.39×10^{-3} to 9.07 µg/g lw (median 7.24 ng/g lw). BDE-209 was the predominant congener (contributed over 90% in both species of the ∑PBDEs). The dominance of the congener could be attributed to the deca-BDE mixture which is still production. The estimated dietary intake (EDI) values from consumption of chicken ranged from <0.100 to 2.20 ng kg^{-1} bw day^{-1} (mean value of 1.3 ng kg^{-1} bw day^{-1}). The Margin of Exposure (MOE) of BDE 47, 99, 153 and 209 were 573333, 8400, 4800 and 17989417. The values were higher than the set MOE value of 2.5 suggesting that the chicken is fit for human consumption.

Keywords: *PBDEs; Leptoptilos Crumenifer; Gallus Gallus Domesticus; Margin of Exposure; Uganda.*

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OCCURRENCE, BIOSORPTION AND PHYTOREMEDIATION OF SELECTED ENDOCRINE DISRUPTING CHEMICALS FROM WASTEWATER USING MORINGA OLEIFERA AND EICCHORNIA CRASSIPES

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Abstract: This study investigated the levels, mass loadings, removal efficiency, and associated ecotoxicological risks of selected endocrine disrupting chemicals (EDCs), namely, dibutyl phthalate (DBP), diethylhexyl phthalate (DEHP), dimethyl phthalate (DMP), linuron (LNR) and progesterone (PGT) in wastewater, sludge, and untreated dry biosolid (UDBS) samples from twelve wastewater treatment plants (WWTPs) in nine major towns in Kenya. Analysis was done using high-performance liquid chromatography coupled with triple quadrupole mass spectrometry (LC-MS/MS). All the wastewater influents had quantifiable levels of EDCs with DBP being the most abundant (37.49%) with a range of 4.33 ± 0.63–19.68 ± 1.24 µg L-1. DEHP was the most abundant in sludge and accounted for 48.2% ranging between 278.67 and 9243.49 ng g-1 dry weight (dw). In the UDBS samples, DEHP was also the most abundant (40%) of the total EDCs detected with levels ranging from 78.77-3938.54 ng g-1 dw. The average removal efficiency per pollutant was as follows: DMP (98.7%) > DEHP (91.7%) > PGT (83.4%) > DBP (77.9%) > LNR (72.2%). The mass loadings were as high as 373.33 g day-1 of DBP in the treatment plants located in densely populated cities. DEHP and PGT had their Risk Quotients (RQs) > 1, posing a high risk to biota. DMP, DBP, and LNR posed medium risks as their RQ values were between 0.1 and 1. EDCs are therefore loaded to environmental compartments through either the effluent or through the UDBS, which are used as fertilizers. Removal of these toxicants was carried out via adsorption using chemically activated fat-free powdered Moringa Oleifera seed biomass (MOSB) which was synthesized, characterized and used as a low-cost biosorbent for the abstraction of PGT and LNR from synthetic wastewater. The process parameters, contact time, pH, concentration of adsorbate, temperature and adsorbent dosage were set and optimized using central composite design (CCD) and response surface methodology (RSM) in design expert software. For biosorption of both PGT and LNR, the proposed model was quadratic. The optimum parameters for PGT adsorption to MOSB were: 86.8 min, 500 µg L-1 adsorbate concentration, 298 K and 0.1 g adsorbent dosage while for LNR were: 154 min, 500 µg L-1 adsorbate concentration, 298K and 0.1 g adsorbent dosage. pH was not a significant factor in the removal of both PGT and LNR. The kinetics, isotherms and thermodynamics were analysed further using OriginPro version 9. The equilibrium data were best described by the Langmuir isotherm for PGT and Sips model for LNR, with a maximum monolayer adsorption capacity of 135.8 µg g-1 and 144.014 µg g-1 respectively. Adsorption kinetics followed pseudo first order (PFO) for PGT and pseudo second order (PSO) for LNR predicting a physisorption and a chemisorption rate determining step respectively. The thermodynamics functions (PGT: $\Delta G < 0$, ΔH = -9.258 kJ mol-1 and ΔS = +44.16 J mol-1 and LNR: $\Delta G < 0$, ΔH = -10.27 kJ mol-1 and ΔS = +41.52 J mol-1) confirmed that the adsorption of PGT and LNR onto MOSB is a spontaneous and exothermic process with randomness and affinity experienced at the surface of the adsorbent. The adsorption mechanism was non-electrostatic and may have involved π-π interactions. The results from this study show that the MOSB is a promising alternative for an ecofriendly, low-cost biosorbent that can effectively remove PGT and LNR from aqueous solutions. Phytoremediation of LNR and PGT using Eichhornia crassipes was also carried out. The uptake was however below the quantification levels.

Keywords: Ecotoxicological Risks*; Phthalates; Removal Efficiency; Adsorption.*

BREAKTHROUGH IN THE UTILISATION OF PHOTOCATALYSIS IN LARGE-SCALE WASTEWATER TREATMENT PLANTS - A STEP FURTHER TOWARDS SUSTAINABILITY OF PROCESS

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Abstract: Numerous scientific investigations have demonstrated the efficacy of the photocatalytic method in eliminating a range of contaminants of emerging concerns, including pesticide, phenolic, and pharmaceutical residues. Most of the studies were carried out with the aim of utilising diverse nanomaterials (NMs) within laboratory conditions (suspended and immobilised systems). The objective of this paper is to outline the crucial factors that need to be considered when evaluating the photocatalytic process's viability and application in actual wastewater treatment facilities. More in-depth research is essential to evaluate the practical application of the various oxidation processes in wastewater treatment facilities. To ascertain whether this approach is sustainable and cost-effective, it is imperative to examine the potential for recovery, regeneration, reusability, and waste stream management for spent nanoparticles. The economic viability of the photocatalytic treatment is considered a crucial step that is necessary towards further process optimisation. Recovery of utilised photocatalysts is essential since their active surface is disabled for re-application due to the photocatalytic intermediates or scavengers. The reusability of photocatalytic material involves conventional washing with distilled water, ethanol, or methanol. Furthermore, the drying course follows the washing step of used NMs. Temperature is a critical factor in this stage as it can lead to agglomeration or alter the morphology of NMs. In addition, there is a possibility of a loss of significant amounts of NMs during the washing process. Other possibilities for the reuse of deactivated NMs include ion exchange/back-washing technique, hydrogen peroxide/UV and heat treatment. The primary disadvantage of photocatalytic treatment is its high energy consumption. However, this issue can be resolved by combining solar radiation with novel NMs, including titanium oxide or modified zinc oxide. Further possibilities for lowering operating expenses which include waste management of utilised suspended NMs can be avoided by recovery operation by the development of a supported photocatalytic system.

Keywords: *Contaminants of Emerging Concern; Economic Visibility; Regeneration; Reusability; Waste Management.*

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TWO-STAGE COST-EFFECTIVE TREATMENT OF ZINC-CONTAMINATED WATER

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Abstract: With the economy development and the growth of the world's population the water consumption increases, causing the reduction in water quality and its availability per capita. Better water management is thus essential for preservation of the natural resources for future generations. Developing the effective water treatment methods and finding economically and environmentally acceptable materials is a priority in wastewater management. In this study, the two-stage treatment of zinc-contaminated waters containing 100 mg Zn/L and 500 mg Zn/L was carried out firstly by chemical precipitation and then by sorption onto biosorbents. The chemical precipitation with neutralization to the pH≈7.5, pH≈8.5 and pH≈9.5 was performed using low-cost precipitating agents – the milk of lime suspensions obtained from the technical-grade lime of different purity (29.6%, 76.8% and 94.3%). The obtained results showed significant dependence of zinc precipitation on water pH. The chemical precipitation with neutralization to the pH≈9.5 with all tested precipitating agents was sufficient as the only treatment stage for highly effective zinc removal (≥ 99.5%) from both wastewaters, meeting the discharge criteria (< 2 mg/L). The chemical precipitation with neutralization to the pH≈7.5 and pH≈8.5 saved chemicals but required an additional treatment stage by sorption on biosorbents (olive pits, cherry pits and sour cherry pits). A residual zinc concentration < 2 mg/L was achieved after the second treatment stage using all biosorbents, but only in effluents after chemical precipitation at the pH≈8.5, while at the pH≈7.5, not even two-stage treatment was sufficient for effective zinc removal. Thus, pH≈7.5 is not recommended for chemical precipitation of zinc. Finally, which approach in treatment of zinc-contaminated water will be used in practice depends on consumption and price of precipitating agents, initial zinc concentration, availability of biosorbents, as well as on costs and methods of disposal of generated waste in form of zinc hydroxide sludge and zinc-saturated biosorbents.

Keywords: *Water treatment; Zinc; Chemical precipitation; Low-cost precipitating agents; Biosorbents.*

URBAN DRAINAGE CHANNELS AS MICROPLASTIC POLLUTION HOTSPOTS INTO LAKE VICTORIA, EAST AFRICA

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Abstract: This study investigated the spatiotemporal distribution, characteristics and sources of microplastics (MPs) in Nakivubo catchment which drains into Lake Victoria, the largest freshwater lake in Africa. Surface water was sampled from thirteen (13) different sites (S1 to S13; n = 117) along Nakivubo catchment during the dry and wet seasons as well as on the onset of the rains in 2022. The samples were digested using hydrogen peroxide, extracted using density separation method and subjected to microscopic and Fourier-transform infrared spectroscopy analyses. The results showed that all the samples had MPs ranging from 1568.59 ± 1473.83 particles/m^3 during the dry season to 2140.39 ± 3670.07 particles/m^3 during the wet season. The mean output of MPs (microplastic fluxes) from Nakivubo catchment into Lake Victoria was found to be approximately 293.96 million particles/day. The highest mean abundance of MPs (5,466.7 ± 6441.70 particles/m^3) was for samples from site S3, which is near market areas, car washing bay and informal settlements. These places are characterized by poor waste management and direct discharge of wastewater into Nakivubo channel. However, the concentration of MPs was relatively lower in wastewater treatment plant effluent (580.56 ± 416.42 particles/m^3) than expected possibly due to removal of MPs by Wastewater treatment processes. Filaments (79.7%) and fragments (17.9%) were the most common form of MPs and majorly originated from domestic effluents and surface runoff, while polyethylene (75.4%) and polyethylene-polypropylene (16.0%) were the major polymer types in the sample, explainable by its low density and wide usage in various consumer products. The abundance of MPs (2140.39 particles/m^3) was highest during the wet season which could be linked to the lower flow rates of water in the catchment and higher residence times. These data support that MPs remobilization maybe occurring during intense rainfall events in the urban drainage channel of Nakivubo.

Keywords: *Microplastics; Spatiotemporal Distribution; Ecological Risks; Source Apportionment; Nakivubo Channel.*

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URINARY ORGANOCHLORINE PESTICIDE LEVELS IN CHILDREN WITH NODDING SYNDROME FROM NORTHERN UGANDA: A SEARCH FOR NS-TRIGGERS

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Abstract: Nodding syndrome (NS) is a mostly East African paediatric epileptiform encephalopathy of unknown aetiology characterised by vertical head nodding that appears during the early stages of the disease. Previous studies have suggested that exposure to pesticides and/or *Onchocerca Volvulus* could have an etiologic role in NS onset in children, but no study has verified this. This study aimed to determine the presence of neurotoxic pesticides such as organochlorine pesticides (OCPs) in the urine of children with NS from the NS hotspot community in Kitgum District, Northern Uganda. Urine samples were collected from children with NS (N=50) and control samples were collected from NS-free children living in the same household (HC) (N=50) and children from NS-free households with no history of head nodding and other seizures including febrile seizures living in the same community (CC) (N=50). Target OCPs were extracted from urine samples by solid-phase extraction and quantitative analysis of the analytes was done using gas chromatography-tandem mass spectrometry (GC-MS/MS) operated in a multiple reaction monitoring (MRM) mode. The levels of ∑OCPs in NS, HC and CC ranged from 0.26 up to 6.15, 7.69 and 4.48 ng/mL, respectively. The levels of ∑OCPs among HC, CC and NS were statistically significantly different ($p < 0.05$, Kruskal-Wallis H test). The contribution of the groups of organochlorines to the ∑OCPs in the investigated samples was in the order; ∑DDTs > ∑HCHs > ∑endosulfan > ∑CHLs > ∑DRINs. Our results suggested that NS onset in children could not be linked to OCP exposure. Future studies could investigate other classes of neurotoxic pesticides in other matrices and characterize their potential markers for NS onset.

Keywords: *Urine; Children; Nodding Syndrome; Organochlorine Pesticides; Uganda.*

Acknowledgement

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APPLICATION OF ARTIFICIAL INTELLIGENCE IN THE DEVELOPMENT OF AN ACOUSTIC CAMERA FOR NOISE DETECTION AND LOCALIZATION

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Abstract: One of the main pollutants within cities which negatively impacts people's health is environmental noise. The first step to solving noise pollution is its identification through the application of standard methods for assessment, which include short-term measurements, the creation of noise maps and subjective analysis, as well as advanced methods through the application of new modern tools that simplify the process of characterizing the noise. However these measurements are expensive and time consuming so alternatives are needed. With the advent of micro electro-mechanical sensors (MEMS) new possibilities open up for developing new sensor units based on MEMS microphones. Such sensor units would be lower in cost, allowing for wider application and the possibility of continuous measurement and assessment of noise pollution. This research comprises the development of a low cost acoustic camera that combines several micro electro-mechanical sensors and a video camera. Through the combination of MEMS microphones and beamforming techniques the noise source will be localized and the noise levels will be measured with great accuracy and precision. While through the use of a camera information will be gathered on the environmental surroundings where the measurements are carried out. The development of the acoustic camera includes the selection and design of a configuration based on a two-dimensional and three-dimensional structure, the selection of hardware components and the development of a suitable algorithm for generating noise data. Of particular interest to this research will be the modularity of the device, which will determine the optimal structure for measuring and detecting noise in an urban environment. Artificial intelligence will be used in data processing and determining the dominant noise sources which will allow for an autonomous process that minimizes the need for supervision and handling by an expert.

Keywords: *Noise Measurement; Acoustic Camera; Environmental Noise; Artificial Iintelligence.*

RELATIONSHIP BETWEEN MICROPLASTIC MIGRATION AND SOME SOIL PHYSICAL PROPERTIES OF FALLOW GREENHOUSE FARMLANDS: CASE STUDY IN SOUTHEASTERN HUNGARY

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Abstract: Environmental pollution by plastic contaminants is an emerging and one of the hot topics of discussion by researchers and environmentalists in the 21st century. Since their inception, dependency on plastic has made life inevitable because plastic is used in different life endeavours such as agriculture, automobiles, pharmaceuticals, construction, etc. Despite the presence of microplastic in the soil ecosystem, only a few studies reveal the actual relationship between soil physical properties and microplastic migration. Hence, there is a knowledge gap in microplastic migration behaviour in the soil environment. This research aims to evaluate the vertical distribution of microplastic pollution in the sediment profiles. The study was conducted at three sites in Southern Hungary (Szeged, Szentes, and Szarvas), where the usage of plastic greenhouses is very common for cultivating vegetables. The overall mean abundance of microplastics in the sediment profiles is 63.77± 14 pieces/kg, whereas in the surface layer, it was 440 pieces/kg. The analysis of variance shows that the abundance significantly differs in the different study areas, thus the means of the profiles were 85 pieces/kg at Szeged (on the surface: 225 ± 61pieces/kg), 4.5 pieces/kg at Szentes (on the surface: 125± 52 pieces/kg), and 96.3 pieces/kg at Szarvas (on the surface: 866± 102 pieces/kg). The contaminants in the sediment profiles are mainly fibres (72%) and fragments (19%), whereas on the surface their proportions were 44 and 18%. These structures were recovered in different colours, but transparent and red colours dominated the colours accounting for 37% and 23% respectively. So, we can conclude that less microplastic with special forms does migrate to the soil depths. The results show that physical properties such as particle size distribution, porosity, and hydraulic conductivity have minimal influence on migration vertical migration, but soil cracks serve as pathways of microplastic migration.

Keywords: *Microplastics; Profile; Greenhouse; Soil; Pollution.*

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POTENTIAL OF PHOSPHOGYPSUM FOR SEDIMENT SOLIDIFICATION

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Abstract: In the face of escalating industrialization and the unchecked release of untreated wastewater into surface waters, environmental pollution has emerged as an omnipresent challenge. Polluted sediment poses a significant threat, gradually releasing potentially toxic metals into aquatic ecosystems, eventually impacting humans through the food chain. Phosphogypsum, a byproduct of phosphoric acid production crucial for phosphate fertilizers, holds promise as a material for solidifying polluted sediment. Despite its potential, only 15% of global phosphogypsum production is recycled, while the remainder is untreated and consigned to landfills. Stabilization/Solidification (S/S) emerges as a widely employed technique for managing contaminated sediments, with leaching tests serving to evaluate the performance of solidified sediment forms for controlled utilization. This study focuses on the Begej canal sediment, exploring its characterization pre- and post-treatment with phosphogypsum at varying mass percentages. The research unfolds in two phases: a sediment risk assessment study and the characterization of sediment solidified with phosphogypsum. Characterization involves assessing pseudo-total metal concentrations, sequential extraction, metal bioavailability using hydrochloric acid, and leaching tests. Results from sequential extraction highlight the high risk of zinc, cadmium, and copper in untreated sediment for the aquatic environment. Post-treatment, leached values for these metals decrease, designating zinc and cadmium as low risks, and copper as a medium risk in both mixtures (sediment and 3% or 5% phosphogypsum). Notably, DIN and TCLP tests reveal metal concentrations in all mixtures below toxic waste disposal limit values. This work underscores the potential of phosphogypsum in solidifying polluted sediment, offering a sustainable approach to mitigate environmental risks associated with industrial pollutants.

Keywords: *Sediment; Stabilization; Metals; Phosphogypsum; Leaching Tests.*

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APPLYING WASTEWATER-BASED EPIDEMIOLOGY TO ASSESS THE EXPOSURE TO PESTICIDES OF HUMAN POPULATION AND ENVIRONMENT

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Abstract: This review summarises current academic publications to discuss the techniques, findings, limitations, and future possibilities of using wastewater-based epidemiology to measure pesticide exposure. This review adds to the establishment of a comprehensive paradigm for pesticide management and risk reduction by exposing the relationship between human behaviour, pesticide consumption, and environmental effects. Wastewater-based epidemiology (WBE) has emerged as a novel and reliable method for monitoring human exposure to a wide range of pollutants, including pesticides. This review investigates the use of wastewater-based epidemiology to assess pesticide exposure in human populations and the environment. The WBE methodology via analyses of wastewater samples, gives reliable data on the prevalence, trends, and possible dangers associated with frequently used substances in everyday life, in particular pesticides. The integration of WBE into environmental monitoring and public health evaluations provides useful insights that supplement existing methodologies, increasing our capacity to address pesticide-related concerns. In the context of environmental implications, this review explores the broader consequences of pesticide exposure, considering the potential contamination of aquatic ecosystems through wastewater discharge. The symbiotic relationship between human pesticide usage and ecological disruption becomes evident, emphasising the need for comprehensive monitoring strategies to safeguard both public health and the environment. As the field of WBE advances, challenges related to data interpretation, standardisation, and representation are acknowledged, spurring discussions on refining methodologies and enhancing collaboration across disciplines. The author's previous studies and research on multiple localised sites that required sampling of wastewater and surface water of one of the biggest river systems in Europe has shown that the use of the pesticides that were banned for use from the 70s still affects our ecosystem, moreover, it still actively infiltrated into the surface water through wastewater.

Keywords: *Wastewater-based epidemiology; Pesticides; Exposure to pesticides; Pathways of exposure.*

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PAH DERIVATIVES IN SEDIMENTS AND FISH FROM WHITE NILE NEAR MELUT OIL FIELDS, SOUTH SUDAN: BIOACCUMULATION AND SOURCE APPORTIONMENT

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Abstract: This study aimed at determining the occurrence of PAH derivatives in sediments and fish from White Nile in vicinity of Melut oil fields, South Sudan. Extraction of analytes in sediments and fish was done using ASE and an ultrasonic extraction, respectively. Analysis of the concentrations of PAH derivatives was done using GC-MS/MS. OHPAHs were first converted to trimethylsilyl derivatizes by using BSTFA/TMCS,99-1 prior to gas chromatographic analysis. Total concentrations of PAH derivatives ($\sum_{15}$NPAHs, $\sum_{5}$OPAHs and $\sum_{3}$ OHPAHs) in sediments were 319.28, 312.68, and 184.21 ng g^{-1} dw at site A, 54.05, 34.31 and 30.85 ng g^{-1} dw at B and 53.07, 47.02 and 17.81 ng g^{-1} dw at C. The levels of PAH derivatives did not differ significantly in sediments of different sites, and this is indicative of a common source of pollution. The mean levels of NPAHs, OPAHs and OHPAHs in *Clarias gareepinus* were 215.7, 24.9 and 32.6 ng g-1 ww at site A. They were respectively 340.1, 30.6 and 44.5 ng g-1 ww at B, while those at C were 208.4, 22.3 and 18.6 ng g-1 ww. They were (347.7, 97.2 and 68.2), (392.5, 66.8 and 117.9), and (214.5, 78.2 and 105.2) ng g-1 ww at A, B and C, respectively in *Lates niloticus* and (276.5, 52.7 and 36.3), (241.3, 47.2 and 73.1), and (230.1, 59.3 and 94.7) ng g-1 ww at A, B and C, respectively in *Oreochromis niloticus*. The levels in *O. niloticus* were significantly higher than those of other fish species. The major sources of PAH derivatives were petrogenic in nature, based on diagnostic ratios. This could be attributed to the presence of crude oil reservoirs and oil production activities in the area. BSAFs ranged from 0.03-2138 g OC g-1lipid, showed high bioaccumulation of lower molecular weight PAH derivatives compared to high molecular weight derivatives.

Keywords: *PAH Derivatives; Accelerated Solvent Extraction; Biota-Sediment Accumulation Factors Concentrations Sources; BSAFs; White Nile.*

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CELLULOSE-DERIVED CARBON MATERIALS: A STUDY OF ISOTHERMS IN MALATHION REMOVAL

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Abstract: Pesticides, whether synthetic or natural, are crucial in managing insects, and weeds, and influencing plant growth. However, the widespread use of organophosphates, a highly effective class of chemical pesticides, raises environmental concerns due to their slow biodegradation, resulting in ecosystem and food chain contamination. The inhibitory effect of organophosphates on acetylcholinesterase contributes to various health disorders. Malathion, commonly used for mosquito and insect control in crops and pet care, exhibits gradual decomposition in water and soil, leading to heightened concentrations in discharge areas and potential risks to aquatic organisms and human health. To address the removal of organophosphates, various methods have been explored, with adsorption standing out for its simplicity, cost-effectiveness, and environmental friendliness. Cellulose-derived carbon materials, characterised by porous structures and large surface areas, provide an efficient solution. This study focuses on utilising cellulose-derived carbon materials as an adsorbent for malathion removal, employing SEM, EDX, FTIR, and BET analysis for comprehensive characterisation. The investigation concentrates on malathion adsorption onto cellulose-derived carbon materials, employing four isotherm models: Freundlich, Langmuir, Temkin, and Dubinin-Radushkevich. The experimental data best fit the Freundlich isotherm, indicating a multilayer adsorption mechanism on the heterogeneous surface of carbon materials. The Langmuir isotherm model shows the maximum adsorption capacities for malathion onto materials CDCM3, CDCM6, and CDCM8, respectively, are 38.67 mg g^{-1}, 170.20 mg g^{-1}, and 254.41 mg g^{-1}. The adsorption energy from the Dubinin-Radushkevich isotherm confirms that the adsorption process for malathion removal is physisorption, while the Temkin isotherm suggests an exothermic process. These findings significantly contribute to sustainable strategies for mitigating the environmental impact of organophosphates.

Keywords: *Malathion; Cellulose; Carbon materials; Adsorption.*

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MAXIMISING PESTICIDE EXTRACTION EFFICIENCY WITH IONIC LIQUID-BASED AQUEOUS BIPHASIC SYSTEMS: OPTIMISATION APPROACH

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Abstract: The drastic increase in pesticide usage over recent decades has significantly impacted environmental quality and is a considerable risk to human health and the ecosystem. Notably, organophosphate pesticides (OPs) like malathion, chlorpyrifos, and azinphos-methyl are among those extensively found in various environmental matrices. Their persistence and toxicity underscore the importance of eliminating pesticides from water sources. Ionic liquid-based biphasic aqueous systems (IL-ABS) have proven to be highly efficient in the extraction of pollutants from the environment including pesticides. The optimisation of extraction using such systems is of great importance in environmental remediation and purification processes. Through systematic optimisation, it becomes feasible to enhance the efficiency of IL-ABS in the extraction of pollutants. Optimisation techniques involve a comprehensive assessment of various parameters, such as TLL (tie line length) and mixture composition along the same TL. These parameters significantly impact selectivity and partitioning during extraction. For this purpose, TBPSal (tetrabutylphosphonium salicylate)/$C_6H_5Na_3O_7$ (sodium citrate) based ABS was optimised by varying either salt (different tie lines) or IL (on the same tie line) mass concentration. Longer tie lines led to increased extraction efficiencies by varying $C_6H_5Na_3O_7$ concentrations which influenced the partitioning of OPs, resulting in notable improvements (reaching 100% extraction efficiency). Also, the phase ratio variations notably affected recovery efficiencies. Systems with lower upper phase volumes are operationally and economically advantageous, minimising constituent usage during scale-up extraction processes. In this study, successful optimisation of pesticide extraction was achieved and significant advancements in extraction efficiency were attained. These findings not only confirm the feasibility of pesticide extraction but also underscore the importance of optimisation in such processes.

Keywords: *Pesticide; Extraction; Ionic Liquids; Optimisation.*

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ENHANCED REGENERATION OF ADSORBENT MATERIAL THROUGH INNOVATIVE APPLICATION OF IONIC LIQUIDS

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Abstract: Adsorption is a prevalent method for removing pollutants from the environment due to its efficiency in capturing contaminants from aqueous solutions. However, it comes with limitations such as the saturation of adsorbent materials, reducing their efficacy over time. Regeneration methods developed thus far often demand high temperatures or involve the use of hazardous chemicals, rendering them unfavourable for practical application. Pesticides, being significant pollutants with detrimental effects on both health and ecosystems, are frequently targeted for removal using adsorption techniques. Ionic liquids have emerged as promising compounds due to their advantages as green solvents, displaying thermal stability and non-volatility among other benefits. In this study, a regeneration process was conducted on carbon adsorbent material previously used to adsorb organophosphate pesticides: malathion, chlorpyrifos, and azinfos methyl. In this study series of different ionic liquids were synthesised for this purpose, by altering combinations of cations and anions, which aligns with the fundamental concept of ionic liquids as designer solvents. The results indicated an impressive regeneration efficiency for some types of ionic liquids, achieving up to 100% recovery of the adsorbent material. Ionic liquids such as TBPSal (tetrabutylphosphonium salicylate), bbimSal (1,3-dibutylimidazolium salicylate) and bbimBr (1,3-dibutylimidazolium bromide) proved to be among the most effective. This study underscores the importance of zero-waste and circular methodologies while stressing the pivotal role of adsorption and subsequent regeneration techniques in effectively eliminating pesticides from the environment. Employing eco-friendly chemicals like ionic liquids and accomplishing complete material recovery are fundamental strides toward sustainable approaches for pollutant eradication.

Keywords: *Pesticide; Adsorption; Ionic Liquids.*

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AS^{3+} ASSESSMENT IN THE SOIL AND PARTS OF WHITE PINE AT THE SASTAVCI (BADANJ) SURFACE MINE AND ITS VICINITY

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Abstract: One of the most significant environmental problems of modern society is global contamination with heavy metal cations. Due to many anthropogenic activities such as mining, industry, agriculture, urbanization, communal activities, traffic, transportation, etc., pollution with toxic and dangerous metal cations occurs. Perhaps one of the biggest problems today are abandoned mining areas that represent a major threat to the environment, both for terrestrial and aquatic ecosystems. Mining activities have a great negative impact on the environment, soil characteristics change, and the concentration of toxic metal cations increases. Remediation of heavy metal cations is crucial because of their serious toxic effects on plants, animals, and human health. Plants can spontaneously grow and inhabit surface mines as well as their immediate environment, since heavy metal cations accumulate in tissues. One of the techniques used for remediation is phytoremediation, which is one of the most innovative techniques used today. On the basis of the experimental part, the concentrations of As^{3+} were obtained both on the surface mine itself and in its immediate surroundings, as well as the monitoring and assessment of the distribution of metal cations in the system of roots, branches, needles and product "fruit" system of evergreen species, white pine, in the exploitation of the surface mine lead-zinc ores Sastavci (Badanj).

Keywords: *Surface Mine Sastavci (Badanj); Trace Elements; ICP-MS; Phytoremediation.*

EXAMINATION OF THE SORPTION PROPERTIES OF ULTRASONICALLY TREATED PYROPHYLLITE

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Abstract: Adsorption has proven to be the best water purification process and is considered a very effective method for pollution control in general. Clay is a natural material that occurs on the earth's surface and consists of hydrated aluminosilicates and other metal oxides such as Fe_2O_3, MgO and K_2O. The use of clay as an adsorbent has considerable advantages over many other commercially available adsorbents. Low price, high specific surface area, availability, high ion exchange potential, excellent adsorption properties and non-toxicity are just some of its advantages. One of the most abundant natural clay materials is pyrophyllite. Pyrophyllite ($Al_2[Si_4O_{10}](OH)_2$) has a 2:1 layered structure whose layers are electroneutral, so pyrophyllite contains no cations or water molecules in its interlayers. As a result, it has good physical and chemical properties, making pyrophyllite one of the potential materials for the production of membranes for efficient water filtration. This study focuses on the characterization of natural pyrophyllite ore subjected to ultrasonic treatment at different time intervals. The purpose of ultrasonic treatment is to remove hard phases such as quartz and calcite from the ore and thereby improve its sorption capacity. The treated samples were thoroughly analysed using SEM and XRD techniques. It was found that increasing the duration of the ultrasonic treatment was associated with a reduction in the proportion of hard phases in the sample. The results of the UV-VIS analysis were also presented, in which the sorption properties of pyrophyllite ultrasonically treated for 30 minutes were investigated in comparison to the sorption properties of the raw ore. The sorption of a methylene blue solution after 24 hours in water was investigated and the UV-VIS analysis showed that the efficiency of the ultrasonically treated pyrophyllite was 97%, while the efficiency of the raw ore was 89% over the same period. These results indicate that the pyrophyllite has good sorption properties and could be a potential material for the production of membranes.

Keywords: *Pyrophyllite; Water Pollution; Ceramic Membrane; Water Filtration.*

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IMPORTANCE OF UNDERSTANDING MATERIAL TRANSFORMATION BY WASTE TREATMENT TECHNOLOGIES

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Abstract: The sustainable waste management revolves around three key objectives: protection of human health and the environment, conserving resources, and aftercare-free waste management. These principles emphasize the responsible management of waste, aiming to prevent complications for the well-being of present as well as future generations. Various waste treatment methods and technologies play integral roles in achieving these goals. Anaerobic digestion and composting are used for treatment of separately collected biomass. The residues from these processes can be utilized as compost or used as remediation materials for contaminated sites. Nonetheless, mechanical biological treatment plants can produce refuse derived fuel and stabilized organic fraction. The former is directed to waste-to-energy plants, while the latter can serve as landfill covering, proving the potential efficient use of different waste streams. Concerning landfills, it is crucial not to dispose of waste that is not biologically inert. The commitment to preventing mobilizable hazardous substances in landfills is vital, representing a comprehensive and responsible approach to waste management. Thermal treatments play an important role in destruction hazardous organic compounds efficiently. This technology holds significance as it has the capability to effectively handle hazardous materials. Recycling is acknowledged as a valuable practice, contributing to the conservation of resources, and reducing the need for incineration and landfilling. The understanding of the material transformation by the different combination of the available waste treatment technologies is important, especially for transition countries, such as Serbia, this providing a fundamental knowledge base for the ongoing and future waste management infrastructure development, that must be directed towards achieving waste management goals.

Keywords: *Waste Management Goals; Technologies; Material Transformation.*

Acknowledgement

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DISC-SPE EXTRACTION METHOD AND GC-MS ANALYSIS OF SELECTED PRIORITY SUBSTANCES FROM SURFACE WATER SAMPLES

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Abstract: Since the setting of environmental quality standards (EQS) for the Water Framework Directive (WFD) priority substances in surface waters, there is the requirement for periodic monitoring of these pollutants for certain compounds often on very low concentration levels. Achieving such low limits is analytically difficult and it would not be possible without using a suitable extraction technique. In this work, the use of conventional liquid-liquid extraction (LLE) was compared with solid-phase extraction on an HLB (Hydrophilic-Lipophilic Balanced) sorbent disc (disc-SPE) to extract 1 L of a water sample. The disc-SPE method allows a much larger sample volume to be used, enabling a large preconcentration factor to be obtained and thus achieving the necessary detection limits for the problematic compounds. The selection of compounds suitable for GC-MS analysis was carried out first. Then, three methods were developed and optimised both in scan and SIM mode for the determination of selected substances in groups, namely polyaromatic hydrocarbons (PAHs), chlorinated pesticides and industrial pollutants. For LLE, dichloromethane and hexane were tested as extraction solvents and recoveries of extraction were calculated. The use of hexane provided higher values, in the range from 83% to 120%. For disc-SPE, the selection of suitable solvents for the conditioning and elution step was investigated. The use of hexane and acetone in a 3:1 ratio for the elution of analytes from the sorbent gave good results, especially for the group of chlorinated pesticides. Recoveries in the range of 40-105% were achieved for most of the compounds in this group. The selection of optimal disc-SPE conditions will continue by testing additional solvents, comparing the methods of extract evaporation, and using larger sample volumes (up to 50 L) to achieve the detection and quantification limits required by European legislation.

Keywords: *Priority Substances; Disc Solid-Phase Extraction; Gas Chromatography; Mass Spectrometry.*

Acknowledgement

This work was supported by the Research and Development Agency under projects APVV-21-0178 and SK-SRB-21-0035.

IMPACT OF RAINFALL ON THE METALS LEACHING FROM MICROPLASTICS IN THE ENVIRONMENT

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Abstract: The international community has given significant attention to environmental pollution from microplastics (MPs) and climate change in recent decades. Previous research in water environments has been predominantly concentrated on studying the effects of human-related activities on MPs degradation, with limited knowledge about non-anthropogenic impacts on microplastic distribution. Previous studies have established that rainfall plays a crucial role in the presence of other pollutants and materials. It has been implied that rain or runoff might influence the transfer of different components adsorbed on MPs and the MPs from landfills to different water bodies. The main aim of this paper was to examine the influence of rainfall on the potential metals leaching from MPs in the environment. Based on the preliminary findings, there is a direct correlation between the ability of plastics and MPs to adsorb metals and furthermore impact of rainfall on metals leaching from MPs in the environment. In this study, influence of rainfall on leaching of metals from MPs was investigated. Metal leaching from the MPs in the field was followed during the three weeks. The obtained results imply that, depending on metal type, the amount of metal leaching was deferring. The highest metal leaching concentration from MPs occurred in terms of Al, Fe, Zn and P, where it exhibited the following order: Al ≈ Fe > P ≈ Zn. Since soils presents a medium with a wide range of different environmental conditions, this vector-like and leaching behavior underscores the importance of furthermore investigating leaching possibilities of metals from MPs in different environmental conditions.

Keywords: *Microplastic; Metals; Leaching; Soil; Environment.*

Acknowledgement

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APPLICATION OF ARTIFICIAL INTELLIGENCE IN WASTEWATER TREATMENT: CHALLENGES AND OPPORTUNITIES

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Abstract: The application of Artificial Intelligence (AI) in wastewater treatment presents a transformative potential for environmental management and sustainability. Integration of AI technologies in wastewater treatment processes delineate the current state of wastewater treatment methodologies, emphasizing the limitations in efficiency, resource utilization, and environmental impacts and underscore the necessity for innovation, particularly in the context of increasing industrialization and urbanization, which strain existing treatment infrastructures. The core of the discussion centres on the integration of AI, specifically through machine learning algorithms, data analytics, and predictive modelling, to enhance the effectiveness of wastewater treatment. AI's role in optimizing treatment processes, reducing energy consumption, and improving effluent quality is examined. Key issues such as the need for high-quality, comprehensive data sets, the integration of AI with existing infrastructure, and the training and development of AI models tailored to the specificities of wastewater treatment are addressed. Technical aspects of implementation of AI models, usability of concrete architectures and their advantages and disadvantages are explored. In identifying opportunities, the paper emphasizes AI's potential in monitoring and control, predictive maintenance, and the development of smart, autonomous wastewater treatment systems. It also explores how AI can aid in achieving environmental sustainability goals and compliance with regulatory standards. Finally, a roadmap for future research is presented, advocating for interdisciplinary collaborations between AI researchers, environmental engineers, and policymakers. This approach aims to address the identified challenges and harness AI's full potential in revolutionizing wastewater treatment processes. In conclusion, it is stated that AI, despite its challenges, offers significant opportunities for innovation in wastewater treatment, paving the way for more efficient, sustainable, and intelligent environmental management systems.

Keywords: *Machine Learning; Effluent Quality; Environmental Management; Sustainability.*

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APPLICATION OF ELECTROCOAGULATION IN WASTEWATER TREATMENT

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Abstract: The purpose of this study was to investigate the efficiency of electrocoagulation utilizing various configurations of aluminium and iron electrodes in eliminating chemical (chemical oxygen demand – COD, biochemical oxygen demand – BOD, total suspended solids – TSS, turbidity, total phosphorous) and microbiological characteristics from municipal wastewater. In addition, the obtained effluent was compared with the existing Regulation (EU) 2020/741 on minimum requirements for water reuse when it comes to the potential of its use as a resource in e.g., irrigation of agricultural land. Based on the research findings, one can concluded that the electrocoagulation technique could be used to efficiently remove chemical and microbiological pollutants from municipal wastewater. Multiple electrode configurations (experiment sets: E1-E8) were used throughout the study to find the most effective one. By observing the obtained results and the achieved removal efficiencies, it was concluded that the E8 treatment, in which the bipolar arrangement of electrodes (Al(-)/Al/Al/Al(+)) was applied, was the most effective, given that satisfactory efficiencies were achieved for all physico-chemical (COD= 74%, BOD=79%, TSS=98%, turbidity= 96%, total P= 100%) and microbiological parameters (total coliform, faecal coliforms, *E.coli*, faecal streptococci, *Salmonella sp.* ~ 100%) except for N (6%). Additional analyses, such as electrical conductivity (1,27 mS/cm) and sodium adsorption ratio (SAR= 8,06) revealed that water purified in this way could be used for irrigation of soils with good permeability. Future work will optimize the process by selecting appropriate electrode combinations. Furthermore, the resultant precipitate will be investigated as a possible nutritional resource.

Keywords: *Wastewater Treatment; Electrocoagulation; Nutrients; Wastewater Reuse.*

Acknowledgement

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ESTIMATION OF THE LEACHATE PENETRATION FROM THE SANITARY LANDFILL TO THE GROUND WATERS

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Abstract: The estimation of the leachate water behavior from the sanitary landfill Savina Stena is important for the leachate treatment. The use of the HYDRUS software package allowed us to predict the movement of leachate through the soil, that is, to determine the depth of its penetration, due to potential damage to the protective substrate, for a certain period of time. The simulation was done for water flow. Based on the obtained experimental results, the flow of water was observed through loam, sandy loam and silty loam, that is, the number of materials in the sample is three. The chosen hydraulic model is Van Genuchten - Mualem, the upper boundary condition of the water flow is Constant Pressure Head, while the lower boundary of the flow is set to Free Drainage. In the graphic domain, a soil profile with a depth of 200 cm is presented with the entered parameters, where each element has a size of 1 cm. For 4 hours, the water content was measured at a depth of 70 cm, in 8 hours at a depth of 110 cm, in 12 hours at a depth of 130 cm, while in 16 hours it was at a depth of 160 cm and in 20 hours at a depth of 180 cm. The water content is ultimately equal to the saturated water content (Qs) i.e. 0.43. The obtained results for the soil types, Qs is 0.43 for loam, sandy loam 0.41 and silty loam 0.45, and the average saturated water value is 0.43.

Keywords: *Leachate; Soil; Hydraulic Properties; Hydrus.*

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PROJECT PRESENTATIONS

SmartWaterTwin

Twinning for Smart Water-Thinking and Rethinking Wastewater Management in Circular Economy Frame «

Coordinating institution: Faculty of Sciences, University of Novi Sad
Coordinator at UNS: Djurdja Kerkez, PhD, Associate professor
Program: Twinning Western Balkans HORIZON-WIDERA-2021-ACCESS-02
Duration:2022-2025

Funded by the European Union

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Smart Water Twin HEProject
www.smartwatertwin.pmf.uns.ac.rs
smartwatertwin@pmf.uns.ac.rs

The Western Balkans' water sector is currently facing a variety of challenges worsened by climate change and pollution. The circular economy can help. Indeed, wastewater can serve as an innovative solution contributing to the nexus of water, energy and material recovery. SmartWaterTwin will boost knowledge and research excellence in the area of sustainable wastewater treatment and management by increasing the scientific and technical capacities in Serbia. Eventually, the project will help shift the paradigm from a linear and traditional model towards the future, circular one.

Objective 1
Bridging the scientific knowledge gap and moving towards innovative technology in circular economy context

Objective 2
Establishing a methodological framework for applying circular-economy principles into wastewater sector in Serbia

Objective 3
Twinning for coherent international approach to the circular economy

Objective 4
Enforcing and expanding ECR competencies in advanced wastewater treatment field

BEUSED

» Research reinforcement within environmental aspects: step forward to beneficial use of sediment«

Coordinating institution: Faculty of Sciences, University of Novi Sad
Coordinator at UNS: PhD Dragana Tomašević Pilipović, Associated professor
Programme: Science Found of Republic of Serbia, Program IDEA
Duration:2021 - 2024

Department of CHEMISTRY, BIOCHEMISTRY AND ENVIRONMENTAL PROTECTION

Science Fund of the Republic of Serbia

https://beused.rs

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BEuSED Idea

Introducing alternative technologies and novel tools for a resource-efficient approach based on the potential to use sediments as a resource for newly generated materials.

BEuSED Solution

-Deliver efficient, robust and improved tools, models, and methods to support risk-based monitoring and sediment management decision
- Reinforce the process of chemical immobilization
- Transform remediated sediment into eco-friendly public infrastructure material

Evaluation of phthalates and cadmium as potential biomarkers from the environment in patients with lung cancer

Coordinating institution: Faculty of Medicine
Coordinator at UNS: Prof. Dr. Nataša Milić
Duration: 2021-2025

Project concept

1. To determine whether there is a difference in data related to smoking, dietary habits, daily lifestyle, personal and family medical history and demographic characteristics among patients with small cell lung cancer, non-small cell adenocarcinoma and non-small cell squamous carcinoma (stage IIIB and IV)

2. To examine the exposure of patients with inoperable advanced microcellular and non-microcellular lung cancer (stage IIIB and IV) of both sexes from the territory of AP Vojvodina to phthalates and cadmium as endocrine disruptors based on the content of phthalate metabolites and Cd in morning urine samples

3. To investigate whether there is a difference in exposure to phthalates and cadmium between patients with small cell lung cancer, non-small cell adenocarcinoma and non-small cell squamous cell carcinoma

4. To determine whether there is a difference in exposure to phthalates and cadmium based on data related to smoking, dietary habits, daily lifestyle, personal and family medical history and demographic characteristics, as well as laboratory parameters.

Methodology

- A cross-sectional study that include 180 patients with diagnosed inoperable advanced microcellular and non-microcellular lung cancer (stage IIIB and IV) over the age of 18, both sexes.

- The ten phthalate metabolites: mono-ethyl phthalate (MEP), mono-(2-ethylhexyl) phthalate (MEHP), mono-methyl phthalate (MMP), mono-n-propyl phthalate (MPP), mono-n-butyl phthalate (MBP), mono-iso-allyl phthalate (MiAP), mono-n- allyl phthalate (MnAP), mono-cyclohexyl phthalate (MCHP), mono-benzyl phthalate (MBzP), and mono-n-octyl phthalate (MOP) are quantified using developed GC-MS method.

- ICP-MS is applied to determine the Cd content in morning urine samples.

Results of the project

- ✓ 4 articles published in SCI journals
- ✓ 18 presentations at national and international conferences
- ✓ Developed SPE coupled to GC-MS method for simulations analysis of 10 phthalate metabolites
- ✓ Cd quantified in 61.11% of patients with adenocarcinoma with levels several times above ToxGuide recommended levels.

РЕПУБЛИКА СРБИЈА
АУТОНОМНА ПОКРАЈИНА ВОЈВОДИНА
ПОКРАЈИНСКИ СЕКРЕТАРИЈАТ ЗА ВИСОКО ОБРАЗОВАЊЕ
И НАУЧНОИСТРАЖИВАЧКУ ДЕЛАТНОСТ

Jean Monnet ENROL Project

»Challenges and opportunities for implementation of regulations on environment, occupational health and safety and labour relations based on the best European practices«

Coordinating institution: University of Novi Sad
Coordinator at UNS: PhD Maja Petrović, Associate Professor
Programme: Jean Monnet Actions - Modules
Duration: 2022 – 2025

Co-funded by the European Union

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