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Katowice 2024

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HYDRO(GEO)LOGIA

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Institute of Earth Sciences, University of Silesia in Katowice

BOOK OF ABSTRACTS

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How Air Pollution Can Affect Water Quality

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There is a complex relationship between water quality and air pollution that occurs through several mechanisms:

- **Atmospheric precipitation**: Air pollutants such as dust, heavy metals, and chemical compounds can settle on the ground with precipitation (rain or snow). This phenomenon is known as acid rain, which can alter the chemical composition of surface and groundwater, affecting water quality.
- **Impact on aquatic ecosystems**: Air pollution can cause the acidification of water bodies, affecting living organisms, particularly fish and other aquatic life, which are part of ecosystems that filter water. The death of these organisms can disrupt the natural water purification processes.
- **Direct water contamination**: Some air pollutants can directly enter water bodies through atmospheric deposition. For example, mercury released into the atmosphere through industrial activities can be transported by air masses and settle in water bodies, making the water unsafe for consumption.
- **Climate change**: Air pollution contributes to climate change, which in turn affects rainfall patterns, temperatures, and even the quantity and quality of water in rivers and reservoirs. This can lead to droughts or floods, impacting the availability and quality of drinking water.
- **Secondary pollution**: Some air pollutants can interact with other substances in water, creating new, sometimes more toxic compounds. For example, nitrogen oxides can react with organic compounds in water to form nitrates, which are harmful to human health.

Addressing these issues requires a comprehensive approach that takes into account the influence of various ecological factors. This work focuses on the study of individual air aerosol particles using scanning electron microscopy. Samples were collected at various locations in the Katowice conurbation using both a mobile laboratory placed in the basket of a manned hot-air balloon and a ground laboratory located in a vehicle. The presence of particles such as Zn, Pb, Hg, Fe oxides, and others in the aerosol samples raises concerns about the quality of air, water, and the health and well-being of the habitants.

Advanced HPTLC Approach for Comprehensive and Accurate Analysis of Parabens and Triclocarban in Wastewater

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High-performance thin-layer chromatography (HPTLC) offers enhanced detection and quantification capabilities compared to traditional TLC, facilitating the development of accurate methods for identifying and quantifying various compounds. Despite multiple studies, there remains a significant gap in analysing multiple compounds in wastewater. This study addresses this gap by developing and validating an HPTLC method for the rapid and accurate detection of parabens and Triclocarban (TCC) in wastewater, compounds of environmental concern due to their widespread use and potential health impacts.

Stock solutions of parabens and TCC were prepared at a 1 mg/mL concentration in methanol. The HPTLC system (CAMAG, Germany) utilized precise sample application with a semiautomated CAMAG Linomat 5, a 100 µL syringe, and aluminum-backed silica gel 60 F254 plates. A twin trough chamber facilitated TLC plate development, followed by visualization and documentation with a UV cabinet and visualizer 3. Quantitative analysis was conducted using a CAMAG TLC Scanner-4 integrated with winCATS software.

Validation included linearity, specificity, and system precision-repeatability, in accordance with ICH Q2(R1) guidelines. The presence of parabens and TCC in samples was confirmed by matching Rf values with standard controls. Linearity was evaluated using calibration curves at different concentration levels (100–600 ng/spot), plotting sample amount (ng) against peak area using Microsoft Excel 365. Specificity was established by comparing the spots' Rf values and UV spectra of the standards and test samples. System precision was evaluated by analysing seven different spots within the calibrated range. This validated HPTLC method provides a reliable analytical technique for detecting and quantifying parabens and TCC in wastewater.

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Groundwater monitoring results in the region of the municipal landfill in Chorzów (Poland)

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This research looked on the spatiotemporal variation of water pollution in the vicinity of a municipal solid waste landfill in Chorzow, southern Poland. Electrolytic conductivity, sulfates, chlorides, nitrates, ammonium ion, and boron assays were carried out for this reason. The study area's groundwater monitoring data served as the foundation for the calculation of the Nemerow Pollution Index (NPI) and Landfill Water Pollution Index (LWPI). The outcomes showed that each piezometer had extremely high pollution. The piezometer at the landfill's groundwater outflow has a LWPI index value greater than 320; values greater than five signify a high risk to groundwater. The NPI index achieved a score of over 44, indicating significant risk as well. The two indices' structure makes it possible to evaluate the degree of groundwater hazard in locations where pollution sources are present. However, the NPI index indicates the impact of parameters other than major ions to total water pollution. In waste management, the use of indexes to evaluate the quality of groundwater surrounding pollution sources is particularly beneficial since it makes it possible to gauge the level of hazard to water, which in turn can aid in the implementation of further preventive measures.

Hydrogen as an Energy Carrier: A Pathway to Sustainable Energy Transition. A Review

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The rising global energy demand and the need to reduce greenhouse gas emissions have spurred the search for sustainable energy alternatives. Hydrogen, with its versatility and clean energy potential, has emerged as a key energy carrier in the transition from fossil fuels to renewables. This study explores hydrogen's role in a decarbonized energy future, examining its production, storage, and applications in sectors like power generation, industry, and transportation. Hydrogen can be produced in various ways, with renewable-powered electrolysis offering a "green hydrogen" option, which emits zero carbon. One of hydrogen's key advantages is its capacity to store energy over long periods, addressing the intermittency of renewable sources like wind and solar. Additionally, its flexibility in generating electricity or heat makes it valuable for stabilizing energy grids. The paper also investigates the geological aspects of hydrogen storage, focusing on subsurface reservoirs, salt caverns, and depleted hydrocarbon fields. It evaluates the feasibility and environmental safety of these storage methods, alongside the technological and policy challenges in scaling hydrogen infrastructure, highlighting its potential to reduce carbon emissions.

Keywords: Hydrogen, energy carrier, renewable energy, decarbonization, hydrogen storage, sustainability, energy transition.

Flood of September 2024 in Poland

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Floods are one of the most destructive natural disasters that can occur in Central Europe. The damage associated with significant floods is enormous and disrupts every branch of the economy and every aspect of human life, even without being directly affected by it. The last such flood in Central Europe was the flood of September 2024, which affected a large part of Central Europe, many residents and many hydrological institutions compare it to the flood of July 1997, which particularly affected the countries of the former Eastern Bloc, including Poland the most. What are the conditions needed for the formation of such floods? What types of floods do we have? How can we protect ourselves against them to minimize losses? Is it possible to prevent future floods? What can we do to better warn against natural disasters?

Artificial intelligence methods in water systems research – a literature review

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The paper discusses various artificial intelligence (AI) methods used in water systems research, including artificial neural networks (ANN), adaptive neuro-fuzzy inference systems (ANFIS), genetic programming (GP), and support vector machines (SVM). The characteristics of each method are analyzed, and the most effective ways to apply them are presented. These techniques have proven particularly useful for predicting changes in surface and groundwater quality, forecasting sewage network failures, evaluating water treatment methods, monitoring climate changes, detecting droughts, and addressing environmental challenges in agriculture. Research shows that AI methods are becoming increasingly important in water systems analysis, with over 60,000 environmental publications now referencing their use.

Application of selected groundwater quality indices in anthropogenically transformed areas

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To accurately assess the impact of waste landfills on groundwater quality, it is essential to develop and use tools that comprehensively account for water composition and the hydrochemical background. The article provides a comparative analysis of selected water quality indices used globally to evaluate environmental risks resulting from pollution. It discusses indicators such as the Water Quality Index, Landfill Water Pollution Index, Nemerow Pollution Index, Backman Index, Canadian Water Quality Index, Horizontal Ratio, Enrichment Factor, and Fuzzy Water Quality Index. The focus is on the values of these indices, their application in municipal and industrial waste landfills, and the limitations of their use. A literature review shows that some indices, such as the Landfill Water Pollution Index and Nemerow Pollution Index, are widely used due to their reliability. These methods support effective water resource management, complement groundwater quality monitoring, and serve as valuable decision-making tools in water protection.

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