Currently, among various physical methods microwave irradiation gains more attention. Numerous studies has confirmed the effectiveness in breaking the complex lignocellulose structure, thus improving biomass availability for microbial action in biological processes. This technique presents several advantages, such as high specificity for selective heating and rapid processing. As compared to other pre-treatment methods, microwave irradiation generates fewer inhibitors of biological processes and indicates significant flexibility due to the ease of combining with other methods. However, there are still few installations operating on a technical scale. This is mainly due to the large investment costs.

The work presents optimisation studies pertaining to the microwave pre-treatment of orange wastes for improving biodegradability. Microwave pre-treatment was conducted using an Advanced Microwave Digestion System provided by ETHOS EASY equipped with two 950 W magnetrons for a total of 1900 W. The adopted operational parameters were as follows: temperature of T = 50°C, input power of P = 900 W. The following time intervals were evaluated: 0, 3, 5, 10, 20 and 30 min, which corresponded to the following energy use of 37.7, 62.8, 125.6, 251.2, and 376.7 MJ/kg, respectively.

The obtained results indicated that use of microwave pre-treatment led to destruction of organic matter expressed as COD (chemical oxygen demand), TS (total solids) and TOC (total organic carbon). With regard to COD, this parameter was reduced by 10-15%, TS by 8-12%. In the case of TOC, a minor effect was observed. Simultaneously, solubilisation was noted, the increases of sCOD (soluble chemical oxygen demand) and DOC were observed. The sCOD parameter was enhanced by 14-33%, whereas DOC by 8-18%. Additionally, the biodegradability index expressed as the DOC/TOC ratio was also improved by 8 – 17%, as a result of microwave pre-treatment. Among all the cases considered, the most favourable effect was recorded for a time of 5 minutes. Therein, the highest improvement in biodegradability was achieved with the lowest energy consumption.

POLLUTION OF STORMWATER FROM URBAN AREAS: RESEARCH, MONITORING, AND NEW MEASUREMENT METHODS

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Water is a key element of life on Earth. As a good solvent, it provides organisms with essential nutrients and minerals. Although 2.5% of the Earth's water resources consist of freshwater, only about 1% is suitable for consumption. Therefore, the rational management of water resources is of great importance—particularly in urban environments, where limited resources or uneven temporal distribution make a well-organized water and wastewater management system essential.The water and sewage system is one of the pillars of environmental management in cities. It includes, among others, water supply and sewage networks, wastewater treatment plants, water treatment stations, retention tanks, and installations for the drainage and retention of stormwater.

These components directly affect the condition of aquatic environments, and their improper functioning-such as failures or leaks-can lead to contamination of available water resources. Stormwater drainage systems form an important part of urban infrastructure, responsible for removing rainwater and meltwater. Their main task is to ensure the safe and rapid removal of water from the surfaces of urban catchments, thus preventing local flooding and urban inundation. These waters flow from roofs, roads, squares, sidewalks, parking lots, and industrial areas, carrying pollutants usually present as suspended solids, as well as heavy metals, petroleum compounds, and nutrients. Although stormwater drainage systems are not intended for the discharge of domestic wastewater, they are an important source of pollutants entering rivers, lakes, and retention reservoirs. Rainwater washes various organic substances and pathogens from urban surfaces.

Therefore, monitoring the quality of stormwater is becoming increasingly important-both from an environmental protection perspective and in terms of compliance with water legislation. Regular testing of stormwater quality makes it possible to identify pollution sources, assess the efficiency of treatment devices (e.g., sedimentation tanks, separators), and adjust stormwater management strategies. Monitoring is also essential for the protection of surface and groundwater and for preventing eutrophication. Currently, a variety of analytical techniques are used in research-ranging from classical gravimetric and spectrophotometric methods to advanced instrumental analyses. The most commonly used include measurements of total suspended solids, determination of heavy metals (AAS, ICP), and photometric and conductometric analyses for nutrients, pH, and conductivity.

Although these methods are highly accurate, stormwater monitoring is challenging due to the irregularity of precipitation and the dynamic nature of the "first flush," in which pollutant concentrations are the highest. For this reason, new automated solutions for remote monitoring of stormwater quality are being sought. A promising direction involves so-called **electronic senses**-such as the *"electronic tongue"* and *"electronic eye."* Their advantages include the absence of chemical reagents and the ability to perform real-time measurements at low operational costs compared to traditional laboratory methods. Preliminary research was conducted on the campus of Lublin University of Technology, where the stormwater drainage system has a total length of 2,501.70 meters. Rainwater is discharged into the Bystrzyca River through pipes with diameters ranging from 0.16 m to 0.5 m. The network includes 144 inspection manholes and 73 storm inlets. Samples for analysis were collected from six points: three inlets (W14, W43, W51) and three manholes (D41, D79, D82), located near campus roads and parking areas. The obtained results will serve as reference data for the development of laboratory prototypes of an electronic tongue, enabling the detection of water pollution indicators based on signal analysis from multisensor arrays.

APPLICATION OF IMMOBILIZED MICROORGANISMS FOR RESTORATION OF BIOLOGICAL WASTEWATER TREATMENT

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Modern technologies for biological wastewater treatment are based on the use of microorganisms capable of biochemical decomposition of organic substances and nitrogen compounds. Activated sludge systems remain the most common, but they have several significant limitations, including the sensitivity of microbial communities to hydraulic and temperature fluctuations, instability to toxic impurities and the need for continuous energy supply. These disadvantages are especially critical for small treatment plants operating in seasonal or intermittent mode, when long shutdowns lead to loss of biological activity and the need to re-form the biocenosis after start-up, which can take from 2 to 4 weeks, requiring significant costs to provide the biological process with "fresh" activated sludge or restore the efficiency of activated sludge by long-term feeding [1].