

Pharmaceuticals are currently a key component of human daily life. Various drugs are used by people as prescribed medicines or drugs available over the counter. They are often overused, mostly in households but also in industries such as agriculture or aquaculture. It is important to note that these compounds are frequently only partially metabolized by the targeted organisms which leads to their release into natural aquatic systems, including sources of drinking water, or sewage systems from where they reach water bodies such as lakes, reservoirs, rivers, and seas and become micropollutants. This problem is especially intensified in urban areas with high population density, causing a high inflow of pharmaceuticals into wastewater treatment plants and urban water reservoirs. It has been shown that their presence impacts microorganisms, fish, plants, and potentially humans.

In the progress of research on this topic, more scientists and international organizations like UNESCO underline the need for reducing the release of pharmaceuticals into the environment and novel solutions aimed at removing them from contaminated water bodies. To tackle this challenge, in this project, we propose to develop a passive remediation system in the form of floating islands. These islands will be composed of biopolymer and highly reactive adsorbents (zeolites and biochar) that will immobilize pharmaceuticals commonly identified in various urban water reservoirs. Additionally, these floating islands will be biomodified with bacteria capable of degrading pharmaceuticals, ensuring efficient and sustainable long-term operation of the system. Developed systems (including these biomodified ones) will be tested using microcosms, i.e. systems imitating natural ecosystems, but performed under controlled laboratory conditions as well as the real urban water reservoir. These enable not only validating their operational capacity but also, by application of the high-throughput metagenomic techniques, assessing their biosafety and environmental impact.

Passive remediation systems such as floating islands are an example of nature-based solutions. Their complexity in scientific and technological aspects requires solutions beyond a single discipline. Therefore, in this project, we emphasize interdisciplinary reliance on the tight cooperation between geologists, chemists, and material scientists from AGH University in Krakow and microbiologists from the University of Warsaw.