Over the last few decades, there has been a continuous increase in anthropogenic pollution in the aquatic environment, which most often occur in the form of complex mixtures. Therefore, there is a need for continuous monitoring of these chemicals in the aquatic environment, as many of these substances can pose a threat to human health and ecosystems. Sampling and analysis of such a wide range of both organic and inorganic chemicals is a constant challenge for environmental analytics.

Current methods of monitoring the aquatic environment are based on the collection of water samples, their extraction in the laboratory and final analysis. Unfortunately, most micropollutants such as pharmaceuticals, hormones, bisphenol A, occur in natural waters in trace or ultra-trace amounts, which involves the need to collect large amounts of water. Additionally, this approach only allows the determination of analyte concentrations in the environment at the time of sampling. However, concentrations of pollutants in water change over time through episodic events (leaks, runoff of storm water) that can be neglected using the spot sampling. The solution to these problems is the use of passive techniques to monitor micropollutants in water ecosystems. Devices of this type consist of a receiving phase (sorbent, solvent), in which the analytes are stopped, and membrane, i.e. the limiting phase, which allows the selective transport of chemical compounds. Nonetheless, it should be emphasized that the reliability of passive probes is closely related to the accurate calibration.

In the literature, there are several ways to calibrate passive sampling devices (PSDs) in the laboratory, among others static method and flow-through method. These experiments are carried out in order to determine the sampling rates (R_s) of analytes by a dosimeter, which are characteristic for a given chemical compound. The obtained R_s values are then used to determine the time-weighted average (TWA) concentration of monitored chemicals in the environment. Importantly, environmental conditions such as water agitation, sample pH, salinity, or concentration of dissolved organic matter (DOM) can significantly affect R_s. Frequently, POCIS (Polar Organic Chemical Integrative Sampler) type dosimeters are used for the isolation of water-soluble substances. In these probes, the retaining medium is a sorbent, most often Oasis HLB (a polymer with a unique hydrophilic-lipophilic balance). However, interest in carbon nanotubes (CNTs) has recently been growing due to their high sorption potential and extensive surface area, which contributes to their use as sorbents. It has been proven that CNTs can serve as a sorption material for the isolation of both hydrophilic and hydrophobic compounds. Commercially available POCIS can be used to monitor only compounds with $0 \leq \log K_{ow} \leq 5$, while the use of MWCNTs provides a promising opportunity to increase the monitoring range of analytes with $\log K_{ow} > 5$ (e.g. clomipramine) and with $\log K_{ow} < 0$ (e.g. methotrexate).

For this reason, the aim of the project was to evaluate the possibility of using multi-walled carbon nanotubes (MWCNTs) as the receiving phase in passive samplers for the isolation of selected mixtures of chemical pollutants containing, among others: sulfonamides, β-blockers, hormones, phenols, non-steroidal anti-inflammatory drugs, cytostatic drugs, nitroimidazoles and tricyclic antidepressants. The key objective of the present research will be to determine the sampling rates using both static and flow-through calibrations and determination of environmental factors such as: salinity, pH of water, DOM concentration and water agitation on the R_s of target compounds. In addition, the influence of the MWCNTs type as a sorbent on the efficiency of analytes uptake will be examined. During the research, various types of solvents and solvent mixtures will be tested as eluents to obtain the most effective elution of analytes adsorbed on the surface of MWCNTs. Commercially available POCIS containing Oasis HLB as a sorbent will also undergo static calibration to determine R_s of target compounds.

The implementation of the research tasks proposed in this project will not only expand the state of knowledge about the sorption properties and usability of CNTs in passive techniques but also provide many useful calibration data, which are still scarce in the literature. Many comparative studies have shown that CNTs were more effective or as effective as other commonly used sorption materials in active extraction methods. For this reason, conducting innovative research on the use of CNTs in passive probes may contribute to the use of MWCNTs-PSDs in routine monitoring of the aquatic environment. It should be highlighted that the range of chemical compounds that can be monitored using commercially available PSDs is limited. Therefore, the research concerning possible applications of alternative sorption materials in passive techniques that would enable the simultaneous monitoring of both highly hydrophilic and hydrophobic compounds are necessary. The developed passive samplers can be a promising alternative to the widely available POCIS, due to the fact that CNTs have a high sorption potential using a smaller sorbent mass than the commonly used one and MWCNTs-PSDS can allowing the monitoring of a much wider range of chemical compounds.