University of Zurich[UZH]

eawag aquatic research

Department of Chemistry

Master Thesis

Analysing abiotic transformation of micropollutants across different sediment-water test systems

To date, it remains impossible to fully prevent bioactive and therefore potentially harmful substances, such as pharmaceuticals and pesticides, from entering the aquatic environment. Some pathways through which those pollutants reach surface waters are hardly controllable, e.g. agricultural runoff. The manufacturing and use of chemicals, however, could be controlled more easily. From the regulatory side, there are testing guidelines in place that dictate to assess the transformation potential of chemicals that may enter surface waters prior to their registration on the market. However, there is scientific consensus that transformation kinetics observed in those regulatory studies do not directly project into compound behaviour in the environment. A thorough understanding of relevant system-specific differences that govern the transferability from laboratory to field systems is still missing.
This Master Thesis is embedded in the context of a project that targets the connection between a substance's persistence measured in different regulatory water-sediment test systems and its fate in the environment.
We follow the dissipation of 44 micropollutants, mostly pharmaceuticals and pesticides, in various laboratory test systems. We then use the observed concentration-time series to estimate transformation rate constants. The ultimate goal is to generate substance-specific and therefore system-independent parameters that can be used to predict transformation kinetics in rivers based on experimental data from lab studies.
For surface water bodies, the fate and transport of individual compounds is controlled by complex interactions between abiotic and biotic processes such as hydrolysis, direct and indirect phototransformation, microbial biotransformation and sorption. While we are currently investigating biotransformation in running experiments, we are missing information on the abiotic transformation pathways of our target compounds. To close this knowledge gap, we are seeking a student who will perform sorption and phototransformation experiments in the lab.
Briefly, sorption experiments will be carried out with two different sediments in various solids-to-water ratios at two micropollutant concentration levels representative of lab and field conditions. Samples will then be analysed for solid-sorbed and dissolved compound concentrations using liquid chromatography - mass spectrometry (LC-MS/MS). A sun-simulator will be used to determine direct and indirect phototransformation in samples containing the investigated micropollutant mixture and different contents of dissolved organic matter. In addition to this experimental work, a thorough literature study on previous research on sorption and phototransformation behaviour will be necessary to bring the results in context with existing data.
We encourage motivated master students with a background in environmental science, analytical chemistry, or related fields to apply. During your time at Eawag, you will perform independent lab work and acquire skills in sample preparation, LC-MS/MS analysis and potentially simple kinetic modelling.

Keywords: micropollutants, sorption, phototransformation, LC-MS/MS

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