Monitoring of priority pollutants in dynamic stormwater discharges from urban areas

The European Water Framework Directive (WFD) from 2000 has put focus on the chemical status of surface waters by the specified Environmental Quality Standard (EQSs) and the requirements for monitoring of surface water quality throughout Europe. When considering the water quality of urban stormwater runoff it is evident that surface waters receiving large amount of urban stormwater runoff will be at risk of failing to meet the EQSs. Therefore stormwater treatment is crucial. However, as stormwater quality varies orders of magnitude between sites, stormwater monitoring is important in order to design the right treatment level to protect surface waters. Stormwater runoff is very dynamic both quality and quantity wise. In order to optimize the sampling of such phenomena, advanced sampling equipment is required. Such equipment is expensive, and furthermore, it is time consuming to conduct the sampling campaigns. Therefore this PhD project aimed at improving monitoring programs for priority pollutants in stormwater runoff. By comparing results from a literature study and a screening campaign to the EQSs, it was found that heavy metals (especially Cu and Zn), polyaromatic hydrocarbons (PAHs), Di(2-ethylhexyl)-phthalate (DEHP) and pesticides were the main pollutants of general concern in stormwater runoff and of concern at the studied catchment (glyphosate was found to be the most relevant pesticide in a Copenhagen setting). These priority pollutants are therefore relevant to monitor in stormwater discharges. Sorption of pollutants to particulate matter and dissolved organic carbon is important for both the toxicity of the pollutants and for removal in stormwater treatment systems. Furthermore sorption is important for sampling using the most common types of passive samplers, which are based on uptake of analytes by diffusion, since they only sample the freely dissolved and labile fraction of analytes. Passive dosing was therefore developed during this PhD project as an easy, fast and precise method for partition measurements of hydrophobic organic compounds (HOC) in aqueous samples such as stormwater runoff. The principle of the method is that the freely dissolved concentration of the HOC is controlled by partitioning from a pre-loaded polymer and the total concentration in the sample at equilibrium is measured. Partition measurements in stormwater runoff samples revealed a partition ratio log KTSS for fluoranthene of 4.59, and free fractions in stormwater runoff of 0.04-0.5. The partition ratio can be used in modeling of stormwater treatment systems. The passive dosing method can be used for surface water monitoring to relate freely dissolved concentrations to total concentrations. For stormwater monitoring, diffusion based passive samplers are not appropriate to use. The reason is that the sampler measures time-weighted concentrations, whereas it is important to know the concentration at a certain moment in time. This PhD project aimed to improve sampling methods and showed that flow-through passive samplers can be used for monitoring purposes.

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