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Micropollutants in urban watersheds : substance flow analysis as management tool

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Micropollutants released by cities into water are of increasing concern as they are suspected of inducing long-term effects on both aquatic organisms and humans (eg., hormonally active substances). Substances found in the urban water cycle have different sources in the urban area and different fates in this cycle. For example, the pollutants emitted from traffic, like copper or PAHs get to surface water during rain events often without any treatment. Pharmaceuticals resulting from human medical treatments get to surface water mainly through wastewater treatment plants, where they are only partly treated and eliminated. One other source of contamination in urban areas for these compounds are combined sewer overflows (CSOs). Once in the receiving waters (lakes, rivers, groundwater), these substances may re-enter the cycle through drinking water. It is therefore crucial to study the behaviour of micropollutants in the urban water cycle and to get flexible tools for urban water management. Substance flow analysis (SFA) has recently been proposed as instrument for water pollution management in urban water systems. This kind of analysis is an extension of material flow analysis (MFA) originally developed in the economic sector and later adapted to regional investigations. In this study, we propose to test the application of SFA for a large number of classes of micropollutants to evaluate its use for urban water management. We chose the city of Lausanne as case study since the receiving water of this city (Lake Geneva) is an important source of drinking water for the surrounding population. Moreover a profound system-knowledge and many data were available, both on the sewer system and the water quality. We focus our study on one heavy metal (copper) and four pharmaceuticals (diclofenac, ibuprofen, carbamazepine and naproxen). Results conducted on copper reveals that around 1500 kg of copper enter the aquatic compartment yearly. This amount contributes to sediment enrichment, which may pose a long-term risk for the benthic organisms. The major sources (total of 73%) of copper in receiving surface water are roofs and contact lines of trolleybuses. Thus technical solutions have to be found to manage this specific source of contamination. Application of SFA approach to four pharmaceuticals reveals that CSOs represent an important source of contamination: Between 14% (carbamazepine) and 61% (ibuprofen) of the total annual loads of Lausanne city to the Lake are due to CSOs. These results will help in defining the best management strategy to limit Lake Geneva contamination. SFA is thus a promising tool for integrated urban water management.