



Investigation of runoff generation from anthropogenic sources with dissolved xenobiotics

A KREIN, J PAILLER, C GUIGNARD, J IFFLY, L PFISTER, and L HOFFMANN

Centre de Recherche Public-Gabriel Lippmann, Department of Environment and Agro-Biotechnologies, 41 rue du Brill,
L-4422 Belvaux, Luxembourg

In the experimental Mess basin (35 km², Luxembourg) dissolved xenobiotics in surface water are used to study the influences of anthropogenic sources like separated sewer systems on runoff generation. Emerging contaminants like pharmaceuticals are of growing interest because of their use in large quantities in human and veterinary medicine. The amounts reaching surface waters depend on rainfall patterns, hydraulic conditions, consumption, metabolism, degradation, and disposal. The behaviour of endocrine disruptors including pharmaceuticals in the aquatic environment is widely unknown. The twelve molecules analyzed belong to three families: the estrogens, the antibiotics (sulfonamides, tetracyclines), and the painkillers (ibuprofen, diclofenac).

Xenobiotics can be used as potential environmental tracers for untreated sewerage. Our results show that the concentrations are highly variable during flood events. The highest concentrations are reached in the first flush period, mainly during the rising limb of the flood hydrographs. As a result of the kinematic wave effect the concentration peak occurs in some cases a few hours after the discharge maximum.

In floodwater (eleven floods, 66 samples) the highest concentrations were measured for ibuprofen ([U+F06D] g/l range), estrone, and diclofenac (all ng/l range). From the tetracycline group, essentially tetracycline itself is of relevance, while the sulfonamides are mainly represented by sulfamethoxazole (all in ng/l range). In the Mess River the pharmaceuticals fluxes during flood events proved to be influenced by hydrological conditions. Different pharmaceuticals showed their concentration peaks during different times of a flood event. An example is the estrone peak that - during summer flash floods - often occurred one to two hours prior to the largest concentrations of the painkillers. This suggests for more sources than the sole storm drainage through the spillway of the single sewage water treatment plant, different transport velocities for single compounds or the existence of substance separating buffer storage in the stream network. In conditions of low intensity rainfall events and a few days of antecedent dry weather, acute peaks of pollution are discharged in the receiving waters. The influence of housing areas, main roads and sewer systems are obvious. These are characterized by rapid source depletion. Precipitation events of very small intensity and amount make themselves visible often as single peak storm events, which result predominantly from the sealed surface of this area. More accurate assessment of pollutant loads entering urban receiving water bodies is needed for improving urban storm water management and meeting water quality regulations.