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Urban stormwater infiltration as an entry path of residuals of biocides and their transformation products into groundwater

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Biocidal active substances are deployed as preservatives to water-based polymer resin paints and renders which are commonly applied on external thermal insulation composite systems. Stormwater induced leaching of biocides from facades leads to their entry into urban surface water. There is an increasing interest on the study of transformation products (TPs) of such substances which commonly develop due to natural degradation processes (e.g. photolysis and microbial degradation). So far, most TPs are still unknown. In some cases, TPs show increasing toxicity and persistence compared to their mother compounds why they pose a further potential risk to humans and environment.
As long as barrier effects of stormwater infiltration facilities is insufficient, they could be a possible entry path of biocides and TPs into subjacent groundwater. The BMBF project MUTReWa (Measures for a sustainable approach to pesticides and their transformation products in the regional water management) analyses this entry path of the biocidal substances Diuron, Terbutryn and Octhilinone (OIT) and their TPs. The investigated infiltration system was a swale-trench-system in the German city Freiburg, which was constructed according to the German technical guideline (DWA) A-138.
Sampling of water from swale and trench was conducted during three storm events (12 samples) as well as three groundwater sampling campaigns (21 samples). Duplicate water samples were prepared by solid phase extraction and analyzed by LC-MS/MS (triple quadrupole).
All three biocides could be quantified in stormwater runoff samples in a range of 5-160 ng L-1. Furthermore, seven TPs of Terbutryn were present. The fact that Diuron and Terbutryn as well as five Terbutryn-TPs were detected in the underlying trench suggests that the soil filling of the swale trench system did not provide sufficient retention of organic pollutants. Groundwater samples showed maximum concentrations of biocides in the range of 20 ng L-1. Concentrations of biocides in groundwater were higher in downgradient samples of the swale trench system compared to upgradient ones. At the same time, TPs were measured more frequent in up- (19 %) than in downgradient samples (53 %). Detected TPs were Terbutryn TP-212, OIT TP-214 as well as Diuron TP-219. The latter one is referred to as Diuron-Desmethyl and could be quantified with cmax = 5 ng L-1 in downstream samples.
These results prove the hypothesis, that biocides and their TPs may enter the groundwater via swale-trench-systems if they have insufficient retention capacity. Alternative entry paths of biocides into groundwater as well as the generalization of the results need to be checked. At present, an acute groundwater hazard cannot be assumed. However, due to the fact that toxicity of the TPs is largely unknown, potential risks cannot be completely ruled out. Since urban stormwater infiltration facilities were primarily constructed with regard to quantitative water management, they cannot guarantee a complete retention of all pollutants and preventive measures at emission source areas are required.