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# A multi-method approach to understand the fate of organic micropollutants during riverbank filtration

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Riverbank Filtration (RBF) is a widespread, low-cost method to achieve high quality drinking water. It uses the cleaning effect of subsurface flow for removal of pathogenic microbes and chemical contaminants. Since little is known about the processes in the hyporheic zone and the following aquifer controlling natural attenuation of organic micropollutants during RBF, we investigated the fate of micropollutants from the river through two groundwater transects using a combination of different methods.

The field site was a RBF system located in the lower part of the Swiss river Thur catchment. This RBF system is characterized by travel times of a few days up to two weeks for the drinking water well (Vogt et al 2010). As a main approach to study subsurface processes like retardation and biodegradation of organic micropollutants we conducted a highly spatiotemporally resolved sampling in spring 2010. It included continuous sampling of the river water and daily sampling of two groundwater transects, from which three piezometers were equipped with a packer system allowing simultaneous sampling in different depths. We analyzed 78 compounds including pesticides, pharmaceuticals, corrosion inhibitors, and their transformation products. The results of two compounds are presented exemplarily.

The pesticide MCPA was found in the river at elevated concentrations of up to 650 ng/L during a high discharge event in the application period. Concentrations in a groundwater transect were one order of magnitude lower in the first two wells without any notable retardation. In further wells no MCPA was found which implicates a strong degradation of MCPA within the first meters of the aquifer. To quantify the degradation of MCPA in the aquifer we carried out a push-pull test, which allows for determination of in situ degradation rates. The results confirmed the good degradability of this compound in the aquifer and coincide with degradation half-lives reported in literature.

Benzotriazole, a widely used corrosion inhibitor in households, showed only slow decreasing concentrations along the groundwater transect in answer to fast decreasing concentrations in the river during increasing discharge at a rain event. Slower decreasing concentrations in the lowest aquifer layer verify the travel time differences in different depths shown by Vogt et al.. From the time difference between the observed concentration decrease and reported travel times it can be deduced that benzotriazole is retarded in the aquifer. During low flow conditions, benzotriazole concentrations remained high even after a travel time of over 10 days and reached the drinking water well at a concentration of 200 ng/L. However, there is evidence for slow biodegradation of benzotriazole in the aquifer. A transformation product of benzotriazole, which we detected in batch experiments with sewage sludge, could also be detected in the aquifer and concentrations were highest in wells with older water.

The combination of the results of the different physical, chemical and biological methods help to understand the fate of micropollutants in the RBF system and to evaluate the vulnerability of the drinking water production regarding to those contaminants.

References:
Vogt, T., Hoehn, E., et al. (2010). "Fluctuations of electrical conductivity as a natural tracer for bank filtration in a losing stream." Advances in Water Resources 33(11): 1296-1308.