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Removal of organic micropollutants in an artificial recharge system

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Emerging contaminants including pharmaceutically active compounds (PhACs), personal care products (PCPs) and pesticides are increasingly being identified in the environment. Emerging pollutants and their transformation products show low concentration in the environment (ng/L), but the effects of the mixtures and lifelong exposure to humans are currently unknown.
Many of these contaminants are removed under aerobic conditions in water treatment plants. However, several pharmaceuticals and metabolites present in wastewater are not eliminated by conventional treatment processes. Several lab studies, however, show that the behaviour of many of these micropollutants is affected by the dominant redox conditions. However, data from field experiments are limited and sometimes contradictory.
Artificial recharge is a widespread technology to increase the groundwater resources. In this study we propose a design to enhance the natural remediation potential of the aquifer with the installation of a reactive layer at the bottom of the infiltration pond. This layer is a mixture of compost, aquifer material, clay and iron oxide. This layer is intended to provide an extra amount of DOC to the recharge water and to promote biodegradation by means of the development of different redox zones along the travel path through the unsaturated zone and within the aquifer. Moreover, compost, clay and iron oxide of the layer are assumed to increase sorption surfaces for neutral, cationic and anionic compounds, respectively.
The infiltration system is sited in Sant Vicenç dels Horts (Barcelona, Spain). It consists of a decantation pond, receiving raw water from the Llobregat River (highly affected from treatment plant effluents), and an infiltration pond (5600 m2). The infiltration rate is around 1 m3/m2/day. The system is equipped with a network of piezometers, suction cups and tensiometers. Infiltration periods have been performed before and after the installation of the reactive layer. Water from the Infiltration pond, the unsaturated zone and groundwater have been sampled and analyzed in order to elucidate the effect of the reactive layer. First results of micropollutants under natural conditions show significant removal rates of atenolol and Ibuprofen as well as the recalcitrant behaviour of carbamazepine. Once the layer was installed, carbamazepine concentration in groundwater samples was lower than the concentration in the infiltration water. These preliminary results are promising but, however, they need to be confirmed by further analysis, which will be conducted during the next weeks.