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Soil Column Experiments to Study Leaching and Transformation Behaviour of 8:2 diPAP and 6:2 diPAP

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Per- and polyfluoroalkyl substances (PFASs) are fluorinated anthropogenic compounds of which numerous have a high thermal stability, high surface tension, water and oil repellence. PFASs are used e.g. as surfactants, in agrochemical products and in fire extinguishing foams. Due to negative effects to the environment and human health some compounds are already declared as Persistent Organic Pollutants (POPs) or Substances of Very High Concern (SVHC). The behaviour of PFASs in environmental matrices can differ dependent on the molecular structure and environmental conditions. Sorption, for example, depends on soil characteristics, compound properties such as the carbon chain length and the functional group. When PFASs are found in soils, the knowledge of factors affecting the leaching behaviour in soil can be helpful to assess plant availability and risk of groundwater contamination.

In some contamination cases, e.g. Rastatt/Baden-Baden, Germany, PFASs precursors such as polyfluoroalkyl phosphate diesters (diPAPs) are present in soil and are transformed into PFAAs (perfluoroalkyl acids), a sub-group of PFASs, which are stable in the environment. To study the behaviour of diPAPs in soil, 8:2 diPAP and 6:2 diPAP were applied to 50 cm soil-filled columns with a concentration of 1 mg per kg soil. For two years, the columns are watered on 3-5 days per week with an average weekly natural rainfall of Baden-Württemberg. The leaching water is collected and analysed every two weeks. After the first year, there was no detection of precursors in the leaching water. The main products were, in accordance with literature, PFPeA (Perfluoropentanoic acid) and PFHxA (Perfluorohexanoic acid) for the precursor 6:2 diPAP and PFHpA (Perfluoroheptanoic acid) and PFOA (Perfluorooctanoic acid) for the precursor 8:2 diPAP. The breakthrough peak of PFPeA (864 µg/l) and PFHxA (487 µg/l) was found in week nine after the start of the experiment, the major peak of PFHpA (124 µg/l) in week 15 and the peak of PFOA (303 µg/l) in week 25. Even though the major breakthrough of PFAAs was over after the first year, all of them are still found in leaching water in relatively constant concentrations: ~40 µg PFPeA/l, ~20 µg PFHxA/l (6:2 diPAP) and ~5 µg

PFHpA/l, ~50 µg PFOA/l (8:2 diPAP). Thus, as a preliminary result after the first year, there is a higher mass of PFPeA and PFHxA in the leachate compared to PFHpA and PFOA, which can be led back to higher transformation rates of 6:2 diPAP than 8:2 diPAP.

After two years, the soil columns will be cut horizontally in sections, and the soil will be analysed for precursors and PFAAs in order to calculate a mass balance. This will provide more insight into the transformation and mobilisation behaviour of investigated diPAPs and PFAAs.