Extraction of poly- and perfluorinated alkyl substances (PFAS) from solid matrices

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ABSTRACT
Recent studies suggest that toxic and highly persistent poly- and perfluorinated alkyl substances (PFAS) are much more prevalent in tissue and soil than in water. The increasing length of perfluoroalkyl chain in PFAS is correlated strongly to lower solubility/higher adsorption behaviour of a particular PFAS molecule in the environment. This poses a significant challenge to developing analytical methods, especially for the extraction of PFAS from solid matrices. The adsorption and mobility of PFAS (perfluoroalkyl chain length C6-C14) through soil were investigated by rinsing a soil column with 60 mL spiked rainwater at pH 4, pH 10 and pH 5.3. PFAS which adsorbed onto the soil column were extracted using a conventional vortex/sonication method. Aqueous eluate and extracts were analyzed using LC-MS/MS and quantified using an internal standard method. PFAS with chain length C6-C9 migrated completely or partially through the column and were effectively extracted from soil with 100% recovery. However, long-chain PFAS (C12-C14) did not appear to migrate through the column and had less than 50% recovery from the soil. By extension, the use of ASE for extraction of longer chain perfluoroalkyl acids (C16, C18), sulfonates and sulfonamides from solid matrices was also investigated. The results of this study will inform our understanding of how to evaluate the transport of PFAS through soil and the assessment of PFAS bioaccumulation in tissue and food.

SEARCHING FOR LONG-CHAIN PFAS” IN SOIL

RESULTS

1. pH has no significant effect on the adsorption of PFAS to soil under the conditions investigated.
2. C6 to C8 PFAS migrated completely or partially out of the soil column and were present in the aqueous eluate.
3. C10 to C14 PFAS did not appear to migrate through the soil under the conditions investigated and were not present in the aqueous eluate.
4. C11 to C14 PFAS were extracted under 50% recovery from the soil using a conventional sonication/vortex method.
5. C11 to C14 PFAS were extracted fully from soil using accelerated solvent extraction (ASE).

CONCLUSIONS
Accelerated solvent extraction (ASE) is an effective technique for extracting a variety of PFAS, most notably long-chain PFAS →C11, from several solid matrices. The use of ASE for extraction of longer chain perfluoroalkyl acids (C16, C18), sulfonates and sulfonamides from solid matrices was also investigated and continued the trend of high extraction of longer chain PFAS using ASE. The results of this study will inform our understanding of how to evaluate transport studies of PFAS through soil and the assessment of PFAS bioaccumulation in tissue and food.