Evaluation of Cation-Bridging Sorption of Per- and Polyfluoroalkyl Acids by Soils

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**Abstract**

Per- and polyfluoroalkyl substances (PFAS) are a diverse group of widespread contaminants, and their potential threat could be essentially related to their environmental fate and sorption in soils. Sorption of PFAS by soils is affected by the presence of cations in soil and water; sorption could be enhanced by interacting with multivalent cations on soil surfaces. In this study, sorption of PFAS with carboxylic head groups and sulfonic head groups (PFNA and PFOS) by K+- and Ca2+-saturated soils was measured to evaluate the contribution of cation-bridging interaction to PFAS sorption by soils. To do so, we added several low molecular weight organic ligands, such as acetate, succinate, malonate, benzoate, *o*-phthalate, and phosphate, to reduce the numbers of the binding sites for PFAS. Several lines of evidence suggest the existence of cation-bridging interactions. 1) Much higher sorption was observed by Ca-saturated soils than that by K-saturated soils. 2) The presence of organic ligands could block a portion of Ca2+-bridging sites resulting in a decreased PFAS sorption. Both ligands and PFAS compete for the cation-bridging sites i.e. Ca2+ associated with soil surfaces. 3) PFAS with a sulfonic head group could form stronger interaction with Ca2+-soils compared to carboxylic group. A speciation model will be developed to quantitatively describe the cation-bridging interaction between PFAS and Ca2+ on soil surfaces.

Keywords: Per- and polyfluoroalkyl substances, Sorption, Soils, Cation-bridging, Ligands