

Sorptive Removal of F-53B by Organo-Layered Double Hydroxide: Sorption Performance and Mechanism

Da Ding (Key Laboratory of Soil Environment and Pollution Remediation, Institute of Soil Science, Chinese Academy of Sciences, Nanjing, China; University of Chinese Academy of Sciences, Beijing, China)

Xin Song (xsong@issas.ac.cn) (Key Laboratory of Soil Environment and Pollution Remediation, Institute of Soil Science, Chinese Academy of Sciences, Nanjing, China)

Background/Objectives. The worldwide elimination and restriction of legacy per- and polyfluoroalkyl substances (PFASs) promote the production and use of their alternatives, and consequentially, the release of these alternatives into the environment. Chlorinated polyfluorinated ether sulfonate (trade name F-53B), a Chinese-made mist suppressant for the hard chrome plating industry, has been increasingly applied as an alternative to perfluorooctane sulfonate (PFOS). It has been reported that F-53B was widely detected as being equally or more harmful than PFOS. However, there has been limited study on the remediation of F-53B from aqueous solutions. Layered double hydroxides (LDHs) were found to be fast and effective in the sorptive removal of PFOS. Therefore, the sorption performance and mechanism of F-53B by an organo-LDH was explored in this project.

Approach/Activities. This project was conducted in a laboratory. The organo-LDH was synthesized by intercalating with sodium dodecyl sulfate (SDS) and nitrate (denoted as SDS-NO₃-LDH) via co-precipitation at low supersaturation. Its sorption kinetics and isotherm were investigated in batch experiments, as well as the effects of solution chemistry, including initial pH, background electrolyte and co-existing ions. Furthermore, sorption mechanism was explored via X-ray diffraction (XRD), Fourier transform infrared (FTIR), scanning electron microscope (SEM), Brunauer–Emmett–Teller (BET) N₂-adsorption method, zeta potential, and water contact angles.

Results/Lessons Learned. SDS-NO₃-LDH showed satisfying sorptive removal performances of F-53B in the presence of co-existing ions, exhibiting the potential for the practical remediation for F-53B contamination. The sorption kinetic and isotherm data fitted well with the pseudo-second-order model and Freundlich model, respectively, indicating a chemisorption process and a heterogeneous surface reaction. Electrostatic interaction, H-bond, anion exchange, and hydrophobic interaction were involved in the sorption of F-53B on the SDS-NO₃-LDH.