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Efficient Removal of Perfluorooctane Sulfonate in Water Using Layered Double Hydroxides

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Background/Objectives. Perfluorooctane sulfonate (PFOS) is one of the most often detected perfluorinated compounds in both biota and aqueous systems. Because of its toxicity, potential for bioaccumulation, and its common occurrence in water resources, PFOS has become a compound of global concern and been recognized as an emerging environmental pollutant. Therefore, there is an urgent need to develop an effective method to remove PFOS in aqueous systems to protect human health and ecosystems. In this study, we seek for efficient, cost-effective and sustainable materials, which can be used to remove PFOS in groundwater.

Approach/Activities. Layered double hydroxides (LDHs), a class of anionic clays with layered structures, were investigated to evaluate their capacity to remove PFOS from aqueous systems, hence, their potential to be used as a filling material for a permeable reactive barrier system to remediate PFOS contaminated groundwater. Different types of LDHs with different intercalated anions, including nitrate, carbonate and chloride, were prepared in order to compare their uptake capacities. Batch experiments were conducted to investigate the removal efficiency, kinetics and the effect of solution chemistry on the PFOS removal. Characterizations such as XRD and FTIR were employed to investigate the PFOS removal mechanisms.

Results/Lessons Learned. Uptake capacity for PFOS by different LDHs follow the order of $NO\text{-}3 > CO2\text{-}3 \approx Cl^{-}$ intercalated LDHs. With PFOS initial concentrations lower than 200 mg/L, more than 90% PFOS in water can be removed rapidly within 1h by $NO\text{-}3$ intercalated LDH. PFOS removal favors acidic conditions and high Mg^{2+} concentrations in aqueous solutions. PFOS uptake mechanisms by different LDHs include electrostatic interactions, interlayer anion exchange and hydrophobic interactions.