Volume 13

Washington University
Undergraduate Research Digest

Spring 2018

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Perfluorooctanesulfonate (PFOS) is a water-soluble compound that is corrosive and toxic to both humans and the environment. PFOS solubilizes in water to form perfluorooctanoic acid (PFOA), which is extremely persistent in the environment. PFOA cannot be separated from water by physical or chemical treatment processes due to its stable composition and solubility. This has led to the study of other unique approaches in environmental nanochemistry that offer potential solutions for PFOS treatment and remediation.

Magnetic metal oxide nanoparticles have shown promise in treating radionuclide contaminated systems due to their high surface to volume ratios, thermodynamically favorable surface chemistries, and enhanced redox potentials. In this unconventional treatment process, iron oxide and manganese iron oxide nanoparticle surfaces are used as foundations for sorption and bind to the compound of interest. Once bound, the magnetic properties of the nanoparticle allow for easy separation from water. This method of nanoparticle sorption is not exclusive for radionuclides and can be engineered to treat many different compounds depending on how the nanoparticles are functionalized. For this reason, functionalized iron oxide nanoparticles also have the potential to treat PFOS contaminated systems.

To observe and optimize the efficiency of PFOS sorption on a nanoparticle, a library of iron oxide of iron oxide and manganese oxide nanoparticles engineered with PEI and CTAB were synthesized. Theoretically, the negative dipole in the PFOA should bond with the positive dipole ends of the PEI and CTAB functionalities due to electrostatic attractions. Iron oxide, manganese-rich iron oxide, and iron-rich manganese oxide were synthesized in various sizes (8nm, 12nm, 16nm, 20nm) and with different PEI and CTAB polymer lengths (.55K, 5K, 25K). Each sample underwent sorption testing in the presence of PFOA at different pH (5,7,9 +/- .2) to determine the optimal conditions for PFOA sorption.