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Investigation of mineral-based soil amendments for stabilization of perfluoroalkyl substances (PFAS) in simulated groundwater environments

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Groundwater systems impacted by perfluoroalkyl substances (PFAS) represent a significant environmental issue and there still remains limited knowledge of basic geochemical information concerning sorption to soil and groundwater injection amendments. Once PFAS are released into the environment, their fate and transport are largely controlled by the geochemical factors of the soil and groundwater in the surrounding area. Iron-based and carbon-based amendments are two options for remediation that are generally considered safe and effective for a wide variety of inorganic and organic contaminants in a wide variety of environmental systems. In this work, we employed a coupled treatment approach for immobilizing perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) in simulated groundwater systems using two mineral-based treatment solutions (zerovalent iron coupled with activated carbon). The main objectives were to determine the overall efficiency of the two amendments at reducing PFAS in simulated groundwater systems using fixed column systems and batch reactors and assess how ionic strength plays a role in overall sorption isotherms. We also investigated the integrity of the amendments over time using advanced imaging techniques, particularly looking at particle aggregation, soil infiltration, and soil particle surface coverage. Understanding PFOS and PFOA immobilization as a function of ionic strength is integral to assessing the long-term remediation potential of carbon-based and iron-based amendments.