Structural modified organo-feldspathoid for sequestration of anionic radionuclides

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Due to relatively long half-lives and prevalence at various DOE sites ^{99}Tc and ^{129}I are anionic contaminants of concern posing potential long-term risks to public health and the environment. Moreover, the predominant chemical forms of these radionuclides i.e. pertechnetate (TcO_4^- and iodide (I^-)/iodate (IO_3^-), exhibit high mobility in oxidizing environments rendering clean-up a technical challenge and costly endeavor. Among proposed remedial technologies for ^{99}Tc and ^{129}I are structural immobilization/stabilization in low-temperature waste forms. The application of this remedial strategy has been largely hindered by the higher concentration of competing anions commonly found in groundwater and nuclear waste streams.

Because increased surface area and ligand modification of feldspathoid generally enhance affinity for hydrophobic anions, we evaluated the effectiveness of using structural modified organo-feldspathoid (SMOF) for enhanced removal of ^{99}Tc and ^{129}I from contaminated groundwater. The SMOF materials are aluminosilicate minerals comprising of alternating SiO_4 and AlO_4 tetrahedral units covalently joined by bridging O-atoms to form three-dimensional flexible frameworks with well-defined pores/cavities.

In this study we hydrothermally synthesized and characterized SMOF materials to elucidate the influence of surface area, porosity, and organic/inorganic modification on SMOF selectivity for Tc/I. At the time of this abstract submittal ongoing SMOF characterization emcompasses the use of a suite of analytical instrumentation (XRD, XAS, SEM, BET analysis, wet chemistry) to probe the physicochemical properties of these sorbents. The loading capacity for Tc/I and alteration to the SMOF materials are determined. Additionally, the binding mechanisms of Tc/I are evaluated to understand better the speciation of Tc and I within the SMOF framework. The results of SMOF characterization, adsorption and desorption experiments in the presence of competing ions under environmentally-relevant conditions will be reported.