FIU PROJECT 2 - 2012 FACT SHEET

Sequestering Uranium at the Hanford 200 Area Vadose Zone by in Situ Subsurface pH Manipulation Using NH_3 Gas Injection

FIU's Applied Research Center (ARC) is supporting the U.S. Department of Energy's Hanford Site in developing a strategy to improve the efficiency of the uranium stabilization process through pH manipulation using NH_3 gas injection.

Characterization of vadose zone (VZ) soil at the 200 Area has identified a number of radiological and hazardous contaminants, including technetium and uranium. This work is focusing on long-lived uranium contamination, which is one of the key contaminants of concern that needs to be reduced to below levels that can cause harm to human health and the environment. Injection of reactive gases such as NH_3, is an innovative remediation technology shown to mitigate uranium contamination in soil. The injection of NH_3 gas causes ammonia gas dissolution in soil moisture, with the formation of NH_4OH and a subsequent increase in pH. This manipulation will significantly alter the pore water chemistry and affect the dissolution of silica and aluminosilicate from soil minerals, followed by co-precipitation of U(VI) [as uranyl (UO_2^{2+})] and Al at higher pH conditions. The main objective of the project is to evaluate the role of major pore water constituents such as Al, Si, bicarbonate and Ca on the formation of precipitates after NH_3 injection and to examine the solubility of formed minerals under environmental conditions relevant to the Hanford vadose zone. The batch experiments include preparation of a series of vials on synthetic fluids imitating contaminated pore water. The concentrations of major constituents including silicate, aluminate and bicarbonate are in the range reported for the Hanford VZ.

Objectives

- Examine the effect of concentration ratios of silicon to aluminum, in the presence of various bicarbonate and calcium ions concentrations, on the removal process of U(VI).
- Evaluate the role of major pore water constituents such as Al, Si, bicarbonate and Ca on the formation of precipitates.
- Conduct mineralogical and morphological characterization of U(VI)-bearing precipitates by means of XRD, SEM-EDS, FTIR in combination with thermodynamic modeling.
- Examine the effect of pH, temperature and bicarbonate ions on the solubility of U(VI)-bearing to evaluate the migration potential of radionuclides.
- Conduct mineralogical characterization to confirm the identity of the solid phases before and after solubility experiments

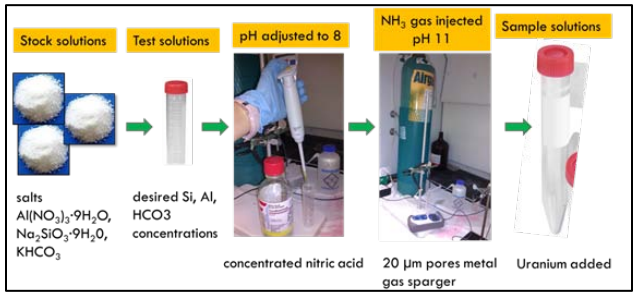

Figure 1. Experimental procedures.

Benefits

- Determines the effect of various Si, Al, Ca, and bicarbonate concentrations on the removal of uranium in the alkaline conditions. Determines what concentrations of Si tended to have greater removal efficiencies of U(VI).
- Yields information on the formation and solubility behavior of U(VI)-bearing precipitates under environmentally relevant Hanford Site VZ conditions.
- Evaluates the structural characteristics of U-bearing precipitates and relates them to the expected uranium species via solid phase characterization using XRD, SEM/EDS, and FTIR.

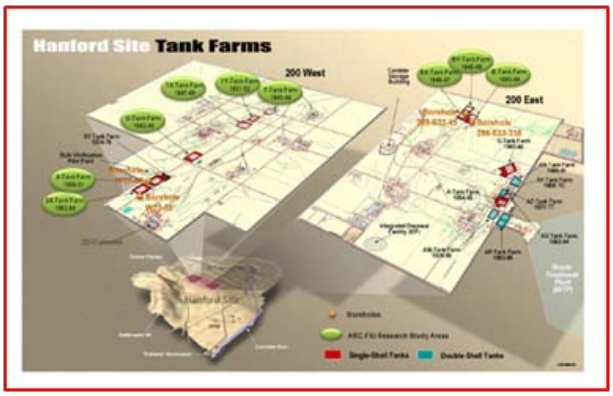

Figure 2. Hanford Site tank farms highlighting ARC-FIU research study areas.