FIU | Applied Research Center
FLORIDA INTERNATIONAL UNIVERSITY

U.S. DEPARTMENT OF ENERGY

ENVIRONMENT & ENERGY / ENVIRONMENTAL REMEDIATION

PROJECT: Rapid Deployment of Engineered Solutions to Environmental Problems: ***Remediation Research and Technical Support for Savannah River Site***

CLIENT: U.S. Department of Energy
PRINCIPAL INVESTIGATOR: Dr. Leonel Lagos
LOCATION: Savannah River Site, Aiken, SC

Description:

FIU's Applied Research Center (ARC) is supporting the U.S. Department of Energy's Savannah River Site in remediating uranium in F/H area seepage basins.

The F/H area seepage basins received approximately 1.8 billion gallons of acidic (pH 3.2-5.5) waste solutions contaminated with radionuclides and dissolved metals. The acidic nature of the basin waste solutions caused the mobilization of metals and radionuclides, resulting in contaminated groundwater plumes. The major constituent of concern is uranium (U). The pump-and-treat treatment system designed and built in 1997 became less effective prompting research for new remediation alternatives.

This project investigates the effect of silicate injections to groundwater resulting in a pH increase leading to U(VI) sequestration and evaluates if any synergy between U(VI) and humic acid will influence the behavior of U(VI). ARCADIS technology demonstrated the in situ addition of carbohydrate substrate molasses to create anaerobic reactive zones for metal and radionuclide remediation via the Enhanced Anaerobic Reductive Precipitation (EARP) process.

The investigation involves the analysis of groundwater and soil to verify the removal of U(VI) as well as mineralogical studies relating to the re-oxidation of a bioreduction zone. The effectiveness of the EARP process is being evaluated for the treatment of radionuclides and metals (U(VI), Fe, Mg, S, and Si) and the total organic carbon.

The main objectives are to:

- Evaluate whether a base solution of dissolved silica can replace the previously used carbonate base and if silica solutions have enough alkalinity to restore the pH of the treatment zone.
- Investigate the hypothesis that some uranium in the current treatment zone is bound to silica and study if any synergy between humid acid (HA) and silica influences the behavior of uranium.
- Monitor the U(VI) bioreduction after the ARCADIS demonstration at the F-Area, the in situ addition of a carbohydrate substrate to create reactive zones for metal and radionuclide remediation via the EARP process.
- Analyze groundwater and soil samples from the bioreduction site to verify the continued sequestration of U(VI) and study mineralogical changes related to re-oxidation process.

ABOUT

Since 1995, the Applied Research Center (ARC) at Florida International University (FIU) has provided critical support to the Department of Energy's Office of Environmental Management (DOE-EM) mission of accelerated risk reduction and cleanup of the environmental legacy of the nation's nuclear weapons program. ARC's applied research is performed under the DOE-FIU Cooperative Agreement (under Contract # DE-EM0000598) and provides technical support to DOE EM in the area of environmental remediation and STEM workforce development and training.

Project Contact:
Dr. Yelena Katsenovich
Ph: (305) 348-2338
Email: katsenov@fiu.edu
10555 W. Flagler Street, EC 2100
Miami, FL 33174
arc.fiu.edu

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Benefits:

- Provides information on whether dissolved sodium silicate solutions have enough alkalinity to replace the carbonate base being used to correct the acidic nature of the contaminated sediments.
- Investigates the effect of silica solutions or colloidal Si on the uranium removal and proves the hypothesis that some uranium in the treatment zone is bound to silica.
- Provides insight of synergetic interactions between humic acid and silica that influences the behavior of uranium.
- Microcosm studies determines whether solid phases of reduced iron such as siderite and pyrite would arise in the reducing zone and explain the types of reaction that might occur in the anaerobic aquifer.

Accomplishments:

- Evaluated the influence of sodium silicate on the pH of a solution containing Savannah River Site soil, synthetic groundwater, and uranium (IV).
- Examined the potential use of sodium silicate for uranium removal from the aqueous phase via precipitation, as well as to restore the pH of the treatment zone. Investigated the optimal concentration of sodium silicate.
- Investigated the effect of humic acid (HA) and colloidal Si on the uranium removal by studying the synergetic interactions between humic acid and silica that influences the behavior of uranium.
- Performed XRD analysis on SRS F-Area sediments to identify quartz, goethite, kaolinite, and montmorillonite.
- Monitored the pH of sediments augmented with mixture of basal media, sulfate, molasses with pH adjustment and without pH adjustment, the overall pH of the samples was observed to decrease over time.
- Studied the sorption behavior of Huma-k on Savannah River Site sediments (FAW-1: 70'-90') in acidic conditions (pH4).
- Evaluated the influence of environmental effects such as pH (from 4 to 7.5) in the sorption behavior of Huma-K on Savannah River Site sediments.
- Studied the effect of pH (from pH 4 to 7.5) on 50 ppm Huma-k precipitation.

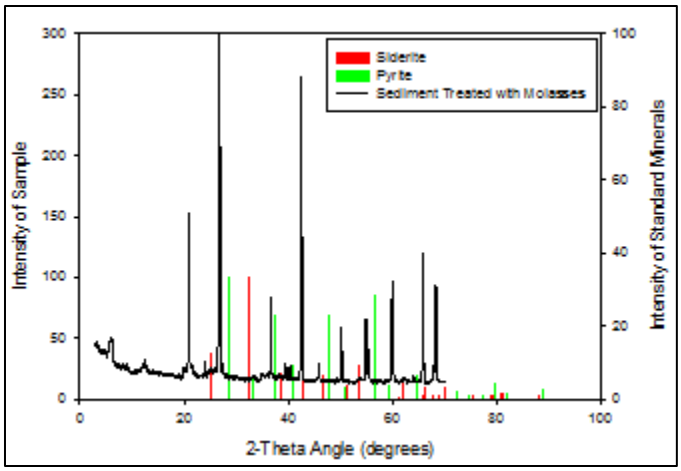

Fig. 1XRD pattern of sediment treated with Molasses compared against Siderite and pyrite

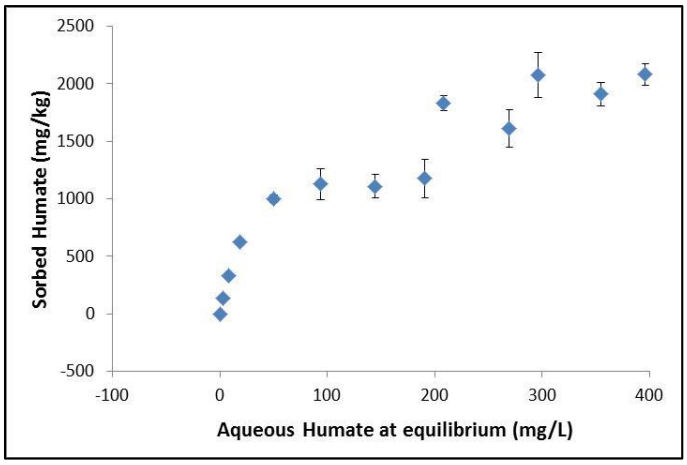

Fig. 2 sorption behavior of Huma-k on Savannah River Site sediments (FAW-1: 70'-90') @ pH 4

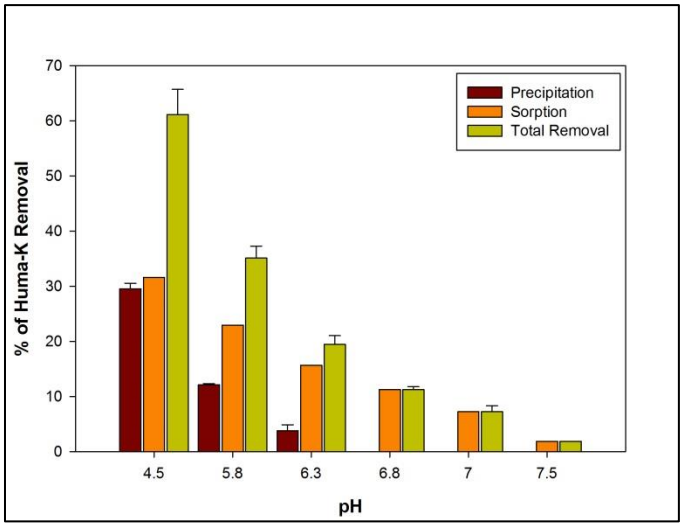

Fig. 3 effect of pH on Huma-k precipitation