FIU | Applied Research Center
FLORIDA INTERNATIONAL UNIVERSITY

U.S. DEPARTMENT OF ENERGY

ENVIRONMENT & ENERGY / ENVIRONMENTAL REMEDIATION

PROJECT: Environmental Remediation Science & Technology: *Re-oxidation of Redox Sensitive Contaminants Immobilized by Strong Reductants*

CLIENT: U.S. Department of Energy
PRINCIPAL INVESTIGATOR: Dr. Leonel Lagos
LOCATION: Richland, Washington

Description:

FIU's Applied Research Center (ARC) is providing experimental support to Pacific Northwest National Lab's (PNNL's) for potential in situ treatment technologies for vadose, groundwater, and perched water zones located within the 200 Area at the Hanford Site.

The perched water zone located beneath the 200-DV-1 Operable Unit at Hanford presents a challenge due to elevated concentrations of uranium (U) and technetium (99Tc). There is a potential for these contaminants to infiltrate into the underlying aquifer, exacerbating the existing groundwater contamination issue, which includes elevated levels of ^{99}Tc and nitrate (NO_3^-).

This research focuses on the application of strong reductants, namely zero valent iron (ZVI), sulfur-modified iron (SMI), and calcium polysulfide (CPS), to sequester the co-located contaminants. These reductants have shown promise in immobilizing U and Tc by reducing them to lower oxidation states that are less mobile and soluble.

It is important to evaluate the potential re-oxidation of the previously immobilized contaminants under aerobic (oxidizing) conditions. Both Tc(VII) and U(VI) can undergo re-oxidation and re-mobilization when exposed to oxidizing conditions. Therefore, this research assesses the effectiveness of the applied reductants in preventing re-oxidation and ensuring long-term immobilization of the contaminants.

Benefits:

This research evaluates re-oxidation behavior and kinetics of ^{99}Tc in the presence of other co-contaminants (e.g., ^{238}U and NO_3^-) after initial immobilization via reduction. The results from these experiments will be used to determine the extent of Tc re-oxidation in the presence of co-contaminants, uranium, and nitrate, to be able to evaluate the effects of different reactants and their concentrations and provide insights for remedial actions.

Accomplishments:

- FIU investigated re-oxidation behavior of perched and groundwater contaminants, such as ^{99}Tc(VII), in the presence of ^{238}U and NO_3^-, that have been initially reduced by strong reductants such as 0.1% and 1% ZVI and SMI in batch experiments under initial anaerobic conditions followed by aerobic conditions.

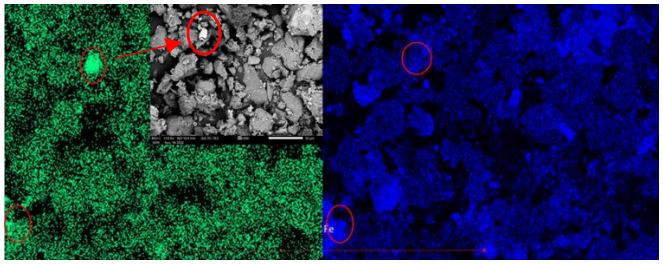

Figure 1. EDS maps of PW sample treated with 1% SMI sacrificed after Phase 1 showing alignment of U and Fe.

- Experiments determined that under anaerobic conditions, both ZVI and SMI exhibited effective reduction of all contaminants. In aerobic conditions, ZVI demonstrated slightly better resistance to re-oxidation compared to SMI.
- In sediment-free perched water (PW) samples treated with 1% MSI, there was a higher degree of resistance to re-oxidation observed for U and Tc compared to ZVI. The concentration of re-oxidized U in the sediment-free PW solution remained high, suggesting the need for additional methods to effectively sequester U.
- These findings highlight the challenges associated with the re-oxidation of U and the necessity for additional sequestration methods indicative of the complexity of the remediation 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