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:
Evaluation of Ammonia Fate and Biological Contributions During and After Ammonia Injection for Uranium Treatment

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

Description:

This research task is focused on the potential biological and physical mechanisms associated with the fate of ammonia after injection into the unsaturated subsurface. These tests identify and quantify factors controlling the relative rate of these processes. Expected processes include biological transformation, ammonia partitioning, and geochemical reactions. Tests examine mechanisms of potential importance using controlled laboratory systems to complement efforts underway at PNNL using Hanford sediments.

Results of the preliminary experiments and evaluation of literature suggest that ammonia gas injection has the potential to be a feasible method for the sequestration of radionuclides. In the agriculture industry, NH_3 gas injection is the only gaseous fertilizer used to supply nitrogen to improve crop production. After the injection, ammonia is captured in the soil moisture and clay minerals before vaporization. The pH of the application area can increase dramatically, but the physical mechanisms associated with the fate of ammonia in unsaturated soil are still unknown and has not been researched much.

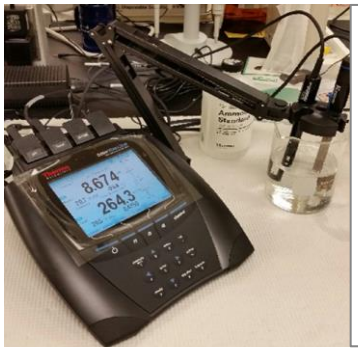
Literature suggested that the amount of ammonia in the soil solutions required to increase soil pH depends on the soil cation exchange capacity (CEC) since NH_3 can be sorbed to the CEC or incorporated into clay. Gaseous NH_3, when in contact with soil moisture, dissolves in and reacts to form NH_4^+ and OH^- ions. Ammonia losses increase with temperature and can be very high in dry neutral or alkaline soil. Also, soils rich in carbonate, which is typical for the Hanford Site, require more ammonia due to the existing soil buffering capacity and the formation of ammonia carbonate.

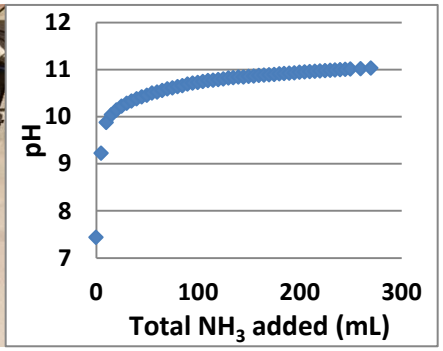
Benefits:

- Ammonia (NH_3) gas technology offers the potential and feasibility of radionuclide sequestration.
  - Increased pH in pore water
  - Precipitation of mineral phases
  - Penetration to low permeable zones
- Investigates factors that affect ammonia gas partitioning in the vadose zone soil.
  - Soil characteristics
  - Pore water composition
  - Bicarbonate ions → Increased buffer capacity
  - Temperature variation
- Evaluates response of microbial community.

Accomplishments:

Initiated potentiometric study using an Ion-Selective ammonia electrode to measure pH, temperature, ammonia concentration and conductivity in solutions with varying parameters of temperature and bicarbonate concentrations.





Thermo Scientific Orion VERSA STAR pH/ISE/Temperature Module

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.

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