Reoxidation of Bioreduced Uranium by Dissolved Oxygen and Nitrate and Restoration of Reduced Conditions at ORIFC site, Oak Ridge, TN

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A. WS Reoxidation of Bioreduced Uranium by Dissolved Oxygen and Nitrate

**ABSTRACT**

This research objective is to study enhanced contaminant stability strategies for source control. The work was performed in bioreduced soils, area 1, DOE-RD-95 102, Oak Ridge, TN, in situ demonstration of a highly-reduced contaminated soil that was capped by controlling groundwater flow and stimulating microbial growth through weekly injection of ethanol. Aqueous U(VI) was below the US EPA drinking water limit (70 μg/L). The bioreduced U(VI) was stable under anaerobic conditions. The impact of DO and nitrate reoxidation on the reburial of bioreduced uranium and the restoration of reduced conditions at the ORIFC site, Oak Ridge, TN were examined. The nitrate reoxidation test indicated that U(VI) reducing activity was re-established following reoxidation. This microorganism may play a role in oxidation of FeS and U(IV).

**DO Re-oxidation Test**

This test was performed by introducing dissolved oxygen (DO) into the reduced area for 70 days. U(VI) reoxidation of uranium occurred but the extent of reoxidation differed for different wells. Field and SMB activities resumed as soon as ethanol was added. U(VI) reoxidation activity also resumed.

**Nitrate Re-oxidation Test**

Trace and Nitrate Injection. This test was performed by injection of nitrate into inner loop to oxidize the reduced zone. Uranium was injected into the well flow area (FW101-2 and FW101-3). All other wells were also oxidized by the bioinoculation.

**Geochanical Response and Bioreaction.** Nitrate occurred in M.S. after injection and decreased as soon after nitrate injection stopped and ethanol was injected (A). Nitrate and ammonium were produced during nitrate injection (B & C). U(VI) remobilized during nitrate injection (D). Ethanol injection (E) restored the activity of sulfate reduction (F & G) and Facilitated reduction (H).

**Uranium can be reduced and immobilized in situ.** Bioreduction/immobilization of U in situ

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**Impact of Invasion of Contaminated Groundwater**

This test was performed by suspension of contaminated groundwater from the invasion of contaminated groundwater. Initially, bromide was injected to the test area and then the invasion was stopped. Disappearance of bromide and increase in tritium concentration indicated the invasion of bioreduced groundwater. The invasion itself was immobilized in terms of visible changes in orange-yellow color and other ion chromatograms.

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**Microcosm test confirmed that nitrate caused the rebound of U(VI).** The test was performed using reduced sediment samples from FW106 (U content 10.2m g/kg) at pH 6.3. Initial nitrate concentration was 0.01, 0.1, 1, 10, 100 ppm. Test was performed in 150 mL serum bottles ambient temperature. Each bottle contained 130 mL sediments and groundwater. Ethanol (25 mmol) was added to reduce uranium and then reoxidized with nitrate.