

60317

Internal Letter



Rockwell International

Date . May 27, 1988

No. . RLK001

TO (Name, Organization, Internal Address)
. T. C. Greengard
. CERCLA/CEARP
. Bldg. 750

FROM (Name, Organization, Internal Address, Phone)
. R. L. Kochen
. Aqueous Recycle Tech
. Bldg. 779
. 4786

SUBJECT. TEST PLANS ON FOUR DEVELOPMENT PROCESSES FOR THE 903 PAD

Per your request, the following outline addresses work on four development processes regarding decontamination of soil and groundwater at the 903 Pad, East Trenches, and Mound Areas. These processes are actinide adsorption on Metal Recovery Agent (MRA), actinide adsorption on activated carbon, column tests using magnetite for actinide removal, and actinide removal via mineral jig. Please refer to letter addressed to you from A. J. Kallas, "Development Tests for the 903 Pad, East Trenches, and Mound Areas," issued April 14, 1988, for a more comprehensive summary of each of the studies.

Actinide Adsorption on MRA

- (Purpose) Determine if a biomass material called Metal Recovery Agent (MRA) is effective in removing plutonium and americium from aqueous solution.
- (Test Plan 1) Evaluate actinide loading on the MRA granule (batch test).
 1. Hydrate the MRA granule at room temperature for 24 hours in distilled water (10 ml water/g granules).
 2. Suspend 0.5 g (dry weight basis) of MRA granules in 1 liter of 1.0×10^{-4} g/l Pu-239 and 1.4×10^{-6} g/l Am-241 solution at a pH of 4. Repeat the procedure for pH 9 actinide solution. (The actinide solutions are prepared from standard stock material).
 3. Place the suspensions in an incubator/shaker at 150 rpm and ambient temperature for 48 hours.
 4. Separate the MRA granules from each solution by filtering thru No. 42 Whatman paper.
 5. Determine the initial and final actinide concentrations in solution. Screen both water and MRA samples for Pu-239 concentrations in ARTs Building 779 Lab. Samples analyzed for Pu and Am by the Building 881 Analytical Labs.
- (Test Plan 2) Evaluate actinide removal efficiency by a column test.
 1. Hydrate MRA granules at ambient temperature for 24 hours in distilled water (10 ml H₂O/g granules).

DOCUMENT CLASSIFICATION
REVIEW WAIVER PER
CLASSIFICATION OFFICE

2. Add sufficient amount of granules to an upflow column 19 mm i.d. to a bed depth of 16 cm. Pass 2 liters of distilled water upflow through the granule column to remove air bubbles. Determine displacement volume of column system.
3. Pass the actinide solution (pH 4) at 10 ml/min. through the column. Collect the four 0.5 liter composite samples of the effluent after adjusting for column volume displacement.
4. Pu-239 concentrations in the 0.5 liter samples screened in ARTs Building 779 Lab. Samples (0.5 l) analyzed for Pu and Am by the Building 881 Analytical Labs.
5. Repeat above test procedure at pH 9.

Actinide Adsorption on Activated Carbon

- (Purpose) Determine if actinides in aqueous solution will adsorb onto granular activated carbon (GAC).
- (Test Plan) Evaluate actinide loading on GAC by a column test.
 1. Deaerate 40 g of GAC in 200 ml distilled water by boiling for 1 hour.
 2. Transfer hot carbon slurry (with aid of distilled water wash bottle) to an upflow column (19 mm i.d. X 36 cm long).
 3. Determine volume displacement for carbon column system.
 4. Wash the carbon column (upflow) with distilled water (30 ml/min) to remove carbon fines. (Continue to wash until no carbon fines are visible). Keep carbon in column covered with water.
 5. Pass distilled water (pH 7), as a blank, through the carbon column (upflow) at the recommended (Calgon Corp.) flow rate of 30 gal/min over 12.6 ft² (30 ml/min). Collect 3.1 liters of effluent after adjusting for column volume displacement.
 6. Repeat procedure No. 5 with an actinide solution (U-234, U-238, Pu-239/each at 50 pCi/l and 10 pCi/l Am-241) at pH 7. The actinide solutions are prepared from standard stock material (Chemical Standards Lab, Building 881).
 7. Per request of analytical personnel acidify column effluent samples with conc. HNO₃ to a pH <2 and determine final actinide concentrations in effluent (Building 881, Analytical Labs).

8. Collect 5 g of carbon from both bottom and top of column after each experiment and analyze for actinide content (Building 881, Analytical Labs).

Column Tests (Magnetite) for Actinide Removal

- (Purpose) Evaluate actinide removal efficiency of magnetite in a column mode.
- (Test Plan 1) Optimize time for magnetite activation (batch test) while keeping actinide adsorption time constant.
 1. Activate 0.1 g magnetite (BK-5599-from Pfizer Corp.) with 13 ml 0.02M Ba(OH)₂ for 0.1 minute at 200 rpm and ambient temperature. Decant (via permanent magnet) and discard Ba(OH)₂ solution.
 2. Add 50 ml of actinide solution (1 X 10⁻⁴ g/l Pu-239/1 X 10⁻⁶ g/l Am-241) at pH 12.0 to the activated magnetite and stir (200 rpm) for 10 minutes.
 3. Decant supernatant liquid from magnetite solids and magnetically filter at a rate of 10 ml/min through a glass column (2.0 cm i.d. X 25 cm long) packed with a 10 cm plug of fine #431 stainless steel wool. (This column is a magnetic polish filter and not a magnetite column). The column is placed between pole faces of an ANAC Model 3470 Laboratory electromagnet while a field strength of 2000 Gauss is applied.
 4. Determine the actinide concentration in the column effluent, as well as in the initial stock solution (Building 881, Analytical Labs). Pu-239 concentrations screened in ARTs Building 779 Lab.
 5. Double the activation time and repeat the procedure. Do this for 8 different time periods. Keep the actinide adsorption time in these experiments constant (10 minutes).
 6. Select optimum activation time (based on actinide removal from effluent).
- (Test Plan 2) Optimize time for actinide adsorption via magnetite (batch test) while keeping magnetite activation time constant.
 1. Repeat magnetite activation procedure in step 1 of Test Plan 1 using the optimum activation time determined from Test Plan 1.

2. Repeat step 2 in Test Plan 1 but stir for only one minute.
3. Continue with steps 3 and 4 in Test Plan 1. Double the contact time between the actinide solution and activated magnetite. Repeat this procedure and obtain 5 data points for the contact time between the actinide solution and activated magnetite.
4. Select optimum residence time for actinide adsorption onto magnetite (based on actinide removal from effluent).

·(Test Plan 3) Actinide removal from aqueous solution via magnetite in a column mode.

1. Add appropriate amount of magnetite to an upflow column (19 mm i.d.). The bed depth of the column is determined from adsorption capacity of magnetite (2 g magnetite lowers Pu from 10^{-4} to 10^{-8} g/l or lower). Place 0.1 μm filter into column (magnetite particle size is $\sim 0.3 \mu\text{m}$). Determine displacement volume of column system.
2. Add appropriate volume of 0.2M $\text{Ba}(\text{OH})_2$ to activate magnetite at a flow rate determined from Test Plan 1.
3. Pass ~ 1 liter of the actinide solution (used in Test Plans 1 and 2) at a flow rate determined from Test Plan 2. Collect 0.1 liter composite samples of the effluent after adjusting for column volume displacement. Analyze samples as per procedures in Test Plans 1 and 2.
4. Repeat Test Plan 3 evaluating two or more flow rates. Select optimum flow rate (based on actinide removal from effluent).

·(Test Plan 4) Magnetite regeneration batch test.

1. Use actinide contaminated magnetite solids (0.1 g) from Test Plan 2.
2. Determine the best 1 ml acid leach (HNO_3 or HCl) at 0.1, 0.2, 0.4, 0.8, and 1 Molar concentrations to remove actinides from magnetite surface. Rinse magnetite with two or three 1 ml distilled water rinses. Measure actinide concentrations in the acid leach, water rinses, and magnetite solids (Building 881, Analytical Labs)
3. Reactivate cleansed magnetite as per step 1 in Test Plan 2.

.(Test Plan 5) Magnetite column recycle test.

1. Use column of actinide contaminated magnetite obtained from Test Plan 3 experiments.
2. Cleanse magnetite with a selected volume of acid leach and distilled water (determined from Test Plan 4). Analyze effluent from column as per standard procedure.
3. Reactivate magnetite in column with 0.02M Ba(OH)₂ as per step 2 in Test Plan 3.
4. Repeat Test Plan 5 two or more times to confirm usefulness of magnetite column for actinide removal from aqueous solution.

Mineral Jig Tests

.(Purpose) Determine the efficiency of removing actinides from Rocky Flats soil with a Denver Laboratory Model 1-M Mineral Jig.

.(Test Plan 1) Test three operating variables and make adjustments on the jig using <0.42 mm (<35 mesh) actinide free, Rocky Flats soil (2 Kg batch test).

1. First Variable - Dilution Adjust for proper water flow to jig. Allows for segregation of the heavier from the lighter soil particles.
2. Second Variable - Bedding Material The bedding material, No. 1 Jig Shot (7 mesh), is placed (double layered) in the screen compartment directly on the screen of the mineral jig. Smaller bedding material such as magnetite may be placed on top of No. 1 Jig Shot if the soil feed (35 mesh) is too fine. The bedding material allows the heavier particles to pass through.
3. Third Variable - Stroke Suction stroke of the plunger varies from 0 to 1/4-inch. Fine particles require a shorter stroke.

.(Test Plan 2) Evaluate actinide removal from Rocky Flats soil via mineral jig.

1. Use 2 Kg [<0.42 mm (<35 mesh)] actinide spiked soil and slurry with aqueous NaOH at pH 12.5 to give a dilution of 50% solids. Use actinide spiked soil (~20,000 d/m/g Pu-239 and ~3,000 d/m/g Am-241) from Chem Stds Lab, Building 881.
2. Follow steps in Test Plan 1 and fine tune the variables.

T. C. Greengard
Page 6
May 27, 1988

- (Test Plan 3) Evaluate actinide removal from Rocky Flats soil via mineral jig after wet screening, attrition scrubbing, and separating the soil into various fractions as per the conceptual primary and secondary processes. (Requires about 8 Kg soil to produce ~2 Kg soil at <0.42 mm for mineral jig test). Soil samples sent in 10 gal shipping containers to the Building 881 Analytical Labs.

If you have any questions regarding the information in this letter, please contact me.



R. L. Kochen
Aqueous Recycle Technology

cc:

R. E. James
C. M. Johnson
A. J. Kallas
S. C. McGlochlin
S. A. Pettis