TA-16

Los Alamos
NATIONAL LABORATORY

Solid Waste Regulatory Compliance (SWRC)
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Date: June 3, 2002
Refer to: SWRC:02-041

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

James P. Bearzi
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303

Dear Mr. Bearzi:

SUBJECT: TREATABILITY STUDY NOTIFICATION

The purpose of this letter is to provide notification that Los Alamos National Laboratory (EPA ID NM0890010515) plans to conduct a treatability study for soils that contain barium from site operations pursuant to Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1, (20 NMAC 4.1), which incorporates 40 CFR 261.4(f). The study will be conducted by the Hydrology, Geochemistry, and Geology Group (EES-6). The soils to be studied are from within Cañon de Valle at Technical Area 16 (TA-16). A total of 5000 grams of soil will be treated in this study.

The treatability study is intended to determine the effectiveness of aqueous sodium sulfate (Na_2SO_4) solutions at reducing barium solubility in soils and sediments from TA-16. The goal is to reduce the barium to a mineral phase with a low solubility (e.g. barite). The results from the laboratory scale treatability study will then be used to evaluate the feasibility of the technique on the field scale. The anticipated start date for the treatability study is August 1, 2002.

If you have any questions, please contact Jack Ellvinger at 667-0633.

JW/LV/vh

Sincerely,

James L. White
Group Leader

6361

Enc. 1) Treatability Study Process Description, Treatability Study of Barium Contaminated Soils

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ENCLOSURE

TREATABILITY STUDY PROCESS DESCRIPTION

TREATABILITY STUDY OF BARIUM CONTAMINATED SOILS

Facility Name:	**Los Alamos National Laboratory (LANL)** **Earth and Environmental Science Division** **Hydrology, Geochemistry, & Geology (EES-6)**
Facility EPA ID Number:	**NM0890010515**
Project Title:	**Treatability Study of Barium Contaminated Soils**
Project Contact:	**Donald D. Hickmott, LANL, EES-6** **MS D462** **Phone: 505-667-8753** **Fax: 505-665-3285**
Other Contacts:	**Maureen A. McGraw, LANL, EES-6** **MS D469** **Phone: 505-665-8128** **Fax: 505-665-3285**

Project Description:

The intention of this treatability study is to determine the effectiveness of aqueous sodium sulfate (Na_2SO_4) solutions at reducing barium (Ba) solubility in soils and sediments from Cañon de Valle at Technical Area 16 (TA-16). The goal is to react the barium in soils to a mineral phase with a low solubility (e.g. barite) that will not be mobile in surface water run off or in the alluvial aquifer. The results from the laboratory scale treatability study will then be used to evaluate the feasibility of the technique on the field scale.

Project Objectives:

Objectives for this treatability study are as follows:

1) Evaluate the effectiveness of Na_2SO_4 at reducing Ba solubility in soil/sediment samples from Cañon de Valle at TA-16.

2) Compare the effectiveness of batch experiments versus flow through column experiments at reducing Ba solubility.

Project Discussion:

Description of Waste to be Treated: The soils to be treated are from the alluvial system in Cañon de Valle, including surface, subsurface, and overbank sediment samples. The barium-contaminated soils are derived from the outfall and drainage of the high explosives machining building at TA-16. Barium is the most abundant inorganic contaminant of potential concern in sediments, with bulk concentrations ranging up to 40,300 mg/kg according to the Corrective Measures Study Plan for Potential Release Site 16-021(c), (LA-UR-98-3918).

The first set of experiments will be batch studies where homogenized soil samples are placed in a bottle with the Na_2SO_4 solution, and vigorously shaken for a predetermined length of time. The soil and fluid are then separated. The leachability of the barium after treatment is determined by Toxicity Characteristic Leaching Procedure (TCLP) analysis and compared to a control that does not undergo treatment. The variables to be evaluated include: the ionic strength of the Na_2SO_4 solution; the contact time between the sediment and solution; and the ratio between the fluid and rock samples. Table 1, shows the matrix of experiments proposed. Not all the studies listed in the table will necessarily be performed depending on results from earlier experiments. In addition, experiments will be performed both on soils that would be classified as hazardous waste upon generation and on lower concentration soils.

Table 1: Experimental matrix of potential batch studies for reduction in barium solubility

Ionic Strength	time (hr)	fluid/rock ratio
0.01 M	0.25	10:01
	0.5	10:01
	1	10:01
	6	10:01
	24	10:01
	1	01:01
	1	05:01
	1	15:01
	1	20:01
0.10 M	0.25	10:01
	0.5	10:01
	1	10:01
	6	10:01
	24	10:01
	1	01:01
	1	05:01
	1	15:01
	1	20:01

The second set of samples will be used in column experiments. These samples will utilize homogenized soils and be packed into 1 ft long columns. The Na_2SO_4 will then be introduced into the columns at a fixed flow rate for a predetermined length of time. The variable for these experiments will be the ionic strength (Table 2). Immediately afterwards, the column will be sectioned into discrete intervals, and each interval evaluated for barium leachability. This analysis will provide information on the kinetics of the reaction, the effect of residence time, and the effect of available surface area on the conversion of barium in soils to barite and witherite.

Table 2: Experimental matrix for column studies for reduction in barium solubility

Ionic Strength	flow rate (ml/hr)
0.01	5
0.10	5

This study is designed to be an initial evaluation of the benefits of barium stabilization. There are other variables that can be considered in future experimental studies if warranted based on the results from this study. Geochemical modeling will also be used to understand the experimental results and evaluate additional variables (e.g. carbonate and bicarbonate concentrations, pH, different molalities, and the effect of different mineral phases in the soil samples) not considered in the experiments.

Amount of Soil to be Treated: Approximately 5 kilograms

RCRA Waste Code: Barium, D005

Site Treatment Plan Information: The waste stream is not covered by the Compliance Plan Volume of LANL's Federal Facility Compliance Order Treatment plan because it is newly generated waste.

Description of Waste Treatment Technology: Remediation options for contaminated soils from the TA-16-260 outfall are being evaluated in a Corrective Measure Study/Corrective Measures Implementation (CMS/CMI). Excavation would require removal of thousands of cubic yards of material, and is not considered the optimum treatment solution. One treatment method being evaluated is stabilization of barium through a reduction in solubility by chemical treatment of barium solid phase species to minerals with low solubility, such as barite and witherite. In evaluating sulfate compounds, it was determined that Na_2SO_4 was optimal because of potential regulatory concerns regarding supernatant chemistry and reaction kinetics for the other forms. For example, ammonium sulfate ($(NH_4)_2SO_4$) may cause ammonia or nitrate problems in the supernatant and both $(NH_4)_2SO_4$ and $CaSO_4$ convert witherite to barite more slowly than Na_2SO_4. The treatment technique being evaluated in this study is the initial step necessary to determine if Na_2SO_4 could be used in-situ to reduce the solubility of Ba.

Waste Management: The waste will consist of TCLP solutions contaminated with Ba, sodium sulfate solutions, and soil sediments contaminated with Ba. The TCLP solution will contain: acetic acid, sodium hydroxide, hydrochloric acid, sodium sulfate, and deionized water. A waste profile will be defined and implemented for each waste stream according to LANL procedures. The waste generated will then be disposed of based on the waste profiles in a manner consistent with state and federal regulations.

Project Milestones:

The start date will be a minimum of 45 days after submittal of the treatability study notification to the New Mexico Environment Department, Hazardous Waste Bureau.

Qualifications:

Our team has many years of diversified experience in environmental geochemistry, surface chemistry, and subsurface hydrology. This experience has allowed us understand the precautions to take, what procedures are necessary, and how to analyze the data.

Don Hickmott has a Ph.D. in Geochemistry from Massachusetts Institute of Technology (1988). He has worked on a wide range of projects in the fields of environmental geochemistry, coal chemistry, and hydrology. Areas of expertise include: trace element and stable isotope microanalysis, speciation of toxic metals in the environment, and thermodynamic modeling of aqueous chemistry. He has performed environmental work at TA-16 since 1992.

Maureen McGraw has a Ph.D. in Mineral Engineering from the University of California-Berkeley (1996). She has an experimental and modeling background in subsurface hydrology, contaminant transport, and surface and colloid chemistry.

Equipment and Facilities:

The treatability study will be performed at the Geochemistry and Geomaterials Research Laboratory (Technical Area 3, Building 494), which houses many state-of-the-art analytical instruments - an electron microprobe, scanning electron microscope, x-ray fluorescence spectrometer, inductively coupled plasma mass spectrometer, gas chromatographs, x-ray diffractometers, UV-VIS, pumps, fraction collectors, and column materials.

External laboratories through Environmental Restoration (ER) project protocol will perform TCLP analysis. The majority of the samples will be analyzed by General Engineering Laboratory (GEL).