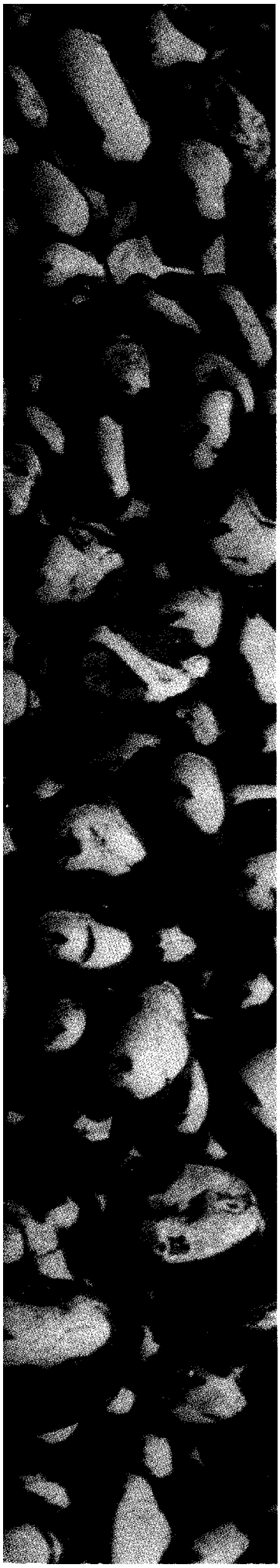

Cost and Performance Report

Chemical Extraction for Uranium Contaminated Soil

RMI Titanium Company Extrusion Plant

Ashtabula, Ohio

Innovative Treatment Remediation Demonstration

U.S. Department of Energy

July 1998

This report was prepared for the U. S. Department of Energy by:

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ACRONYMS

AEC	U.S. Atomic Energy Commission
ART	Alternative Remedial Technologies, Inc.
DOE	U.S. Department of Energy
EM-40	DOE Headquarters Office of Environmental Restoration
EPA	U.S. Environmental Protection Agency
ITRD	Innovative Treatment Remediation Demonstration
NRC	U.S. Nuclear Regulatory Commission
pCi/g	picocuries per gram
RMI	RMI Titanium Company
RMIDP	RMI Decommissioning Project
RMIES	RMI Environmental Services
RBR	rotary batch reactor
WBS	work breakdown structure
XRF	X-ray fluorescence

FOREWORD

The U.S. Department of Energy (DOE) is working to accelerate the acceptance and application of innovative technologies that improve the way the nation manages its environmental remediation problems. The DOE Office of Environmental Restoration (EM-40) established the Innovative Treatment Remediation Demonstration (ITRD) Program to help accelerate the adoption and implementation of new and innovative soil and ground water remediation technologies. Developed as a public-private partnership in cooperation with Clean Sites, Inc., and the U.S. Environmental Protection Agency (EPA) Technology Innovation Office and coordinated by Sandia National Laboratories, the ITRD Program attempts to reduce many of the classic barriers to the use of new technologies by involving government, industry, and regulatory agencies in the assessment, implementation, and validation of innovative technologies.

The ITRD Program is an operational testing and evaluation program that assists DOE facilities in identifying and evaluating innovative technologies that can remediate their sites in a cost-effective and responsible manner. The technologies considered for evaluation are those that lack the cost and performance information that would otherwise permit their full consideration as remedial alternatives. The technologies have often shown promise in bench- or small-scale applications but have limited pilot- or full-scale operational performance data.

Funding is provided through the ITRD Program to assist participating site managers in identifying, evaluating, implementing, and monitoring innovative technologies. The program provides technical assistance to the participating DOE sites by coordinating DOE, EPA, industry, and regulatory participation in each project; providing funds for site-specific treatability and pilot studies for optimizing full-scale operating parameters; coordinating technology performance monitoring; and by developing cost and performance reports on the technology applications.

In 1995, the ITRD Program initiated a joint project with DOE Plants in Ohio to investigate the use of innovative technologies for the remediation of heavy metal-contaminated soils. In 1996, the DOE Ashtabula Area Office joined the ITRD Ohio Heavy Metals Project, with particular interest in physical and chemical treatment of uranium-contaminated soils. Preliminary technology assessments indicated that processing contaminated soil on-site could save DOE-Ashtabula up to $25 million over the proposed baseline remedial design of soil excavation and off-site disposal. The ITRD Program sponsored a soil treatability study on Ashtabula soils during the summer of 1996 with promising results. Based on these results, DOE Ashtabula and the ITRD Program sponsored a pilot-scale soil treatment remediation in January and February 1997. The purpose of this Cost and Performance Report is to document the project activities, present demonstration data, and provide evaluation results on the operational cost and performance of this soil treatment process.

1. SUMMARY

From 1962 to 1988, the RMI Titanium Company (RMI) performed uranium extrusion operations for the U.S. Department of Energy (DOE) and its predecessor agencies at the RMI Extrusion Plant in Ashtabula, Ohio. The uranium metal processed at the site included depleted and slightly enriched material (1% to 2.1% uranium-235) that was subsequently used in nuclear and non-nuclear weapons. During the early years of uranium extrusion and machining, particulate uranium was generated and discharged from roof vents and stacks and settled onto the surrounding soils. Characterization studies indicate that approximately 80% to 90% of affected on-site and off-site soils contain less than 300 picocuries per gram (pCi/g) of contamination. The decontamination and decommissioning plan, pending approval by the U.S. Nuclear Regulatory Commission (NRC), establishes 30 pCi/g as the cleanup level for total uranium.

To explore alternatives to a baseline remediation approach of excavation, transport, and off-site disposal, RMI Environmental Services (RMIES) and Alternative Remedial Technologies, Inc. (ART) conducted a bench-scale treatability study to test the ability of a carbonate extraction process to leach uranium from contaminated RMI soils. These tests, conducted during the summer of 1996, characterized site soils and tested various extraction chemicals and process parameters with promising results. Based on parameters determined in this study, RMIES and ART developed a pilot-scale process to provide operating data for full-scale soil remediation at the Ashtabula Site. This report summarizes cost and performance data collected during the pilot plant operation of an ex situ soil remediation technology to treat uranium-contaminated soils at the RMI Ashtabula site.

The pilot plant incorporated the following processes. Contaminated soils were loaded into a rotary batch reactor with a heated carbonate-bicarbonate solution to form a 30% solids slurry. The leaching solution was allowed to contact the soils for 1 to 2 hours. A wet screening process separated oversize material (> 1 mm), and the remaining slurry was transferred into sequential thickeners to separate soils from the uranium-bearing liquids. The soil fraction was dewatered by filter press and underwent no further treatment. The radiological activity of these treated soils was measured by X-ray fluorescence (XRF) and verified by alpha spectroscopy to determine the effectiveness of the chemical extraction process. An ion-exchange system was used to remove the uranium from the liquid. The uranium eluted from the ion exchange resin, a “yellowcake” product, was recovered by chemical precipitation. All of the pilot plant equipment was located and operated in a portion of an existing building on-site.

The pilot plant operated from January 7, 1997, through February 14, 1997, during which time 38 batches (approximately 64 tons) of soil were processed. Key operating parameters that were varied in the test included feed-soil type and activity, reaction temperature, and leaching time. Important information that was studied for full-scale operations included leaching performance, ion exchange loading and regeneration, and uranium precipitation. The pilot operations confirmed that most of the RMI Site soils could be effectively treated for uranium by using a sodium carbonate extraction at 0.2 *M*, a temperature of approximately 115EF, and an effective retention time of 1-1/2 hours. Pilot plant results indicate uranium removal efficiencies of up to 94% (with an average of about 82% in the pilot project) and an estimated volume reduction of contaminated soils for disposal of 95%. The free release standard of 30 pCi/g was met for most soils treated by the process.

Based on cost data obtained during pilot plant construction and operation, a detailed cost-benefit assessment for a production-scale plant has been completed. The projected base cost for the design, procurement, construction, and operation of a 10-ton/hr production plant on a 20,000-ton campaign is approximately $325/ton. The cost for complete soil remediation using the chemical extraction approach is $565/ton, including excavation, operations, restoration, amortization, and profit. The existing project baseline cost for soil remediation—which includes characterization, excavation, packaging, certification, transportation, burial, and restoration—is $857/ton. Thus, soil remediation using chemical extraction offers an approximate $300/ton cost advantage at this site. Chemical extraction implementation on a 20,000-ton campaign will not only result in a treatment savings of $6 million, but will also result in a schedule reduction that will save an additional $6.7 million, leading to a total potential savings to DOE of $12.7 million.

2. SITE INFORMATION

Identifying Information

Facility:	RMI Titanium Company Extrusion Plant Site
Location:	Ashtabula, Ohio
OU/SWMU:	Uranium-contaminated soils from Areas B, C, and D
Regulatory Driver:	NRC Decommissioning Plan
Type of Action:	Soil remediation/pilot operations
Technology:	Chemical treatment (carbonate extraction of uranium)
Period of operation:	1/7/97 to 2/14/97
Quantity of soil treated:	64 tons (38 batches)

Site Background

The RMI Extrusion Plant is located in Ashtabula Township, approximately 1 mile south of Lake Erie, in the northeast corner of the State of Ohio. The plant is located in a sparsely populated, industrialized area of Ashtabula County, approximately 2 miles northeast of the center of the city of Ashtabula, outside the city limits.

The 28.5-acre property is privately owned by the RMI Titanium Company. However, DOE owns 12 buildings on the RMI property and is responsible for the cleanup of all contamination associated with work performed under its former contracts with RMI. This cleanup is being conducted under the RMI Decommissioning Project (RMIDP) sponsored by the DOE Office of Environmental Restoration (EM-40).

Most of the RMI Site is relatively flat, with no more than about 4 ft variation, except for a small gully draining a portion of the eastern section of the site. A plan view of the RMI Extrusion Plant is shown in Figure 1. Areas of concern for this study were Area B, which includes soils in and around production buildings; Area C, located north of Area B; and Area D, a grassy area located east of Areas B and C.

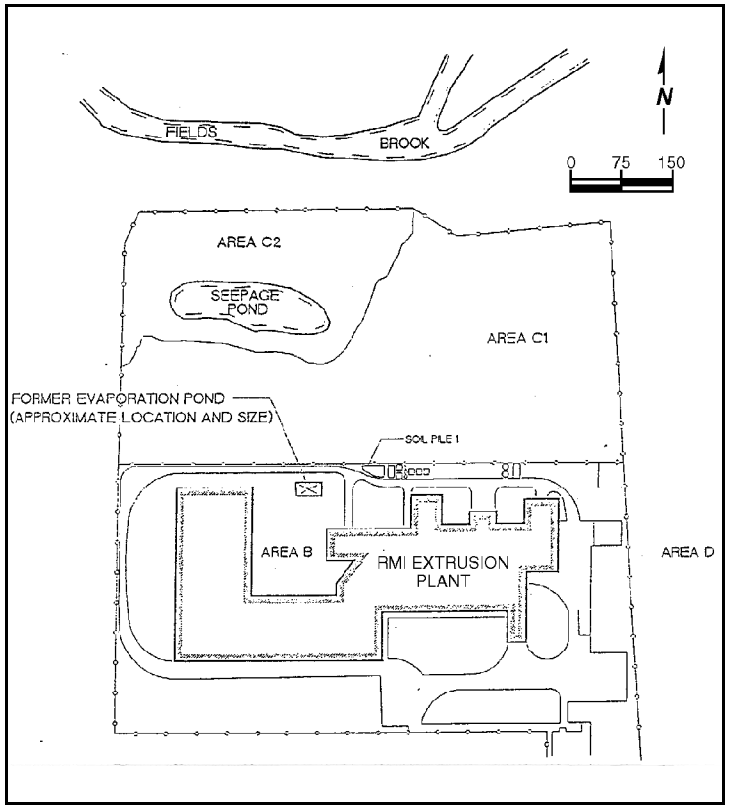


Figure 2. Location of RMI Extrusion Plant and Areas B, C, and D.

Site History

The RMI Titanium Company historically held contracts with the U.S. Government [Atomic Energy Commission (AEC) and DOE] to process uranium metal into forms useable in nuclear and non-nuclear weapons production (SIC Code 9631A-Department of Energy Activities). RMI conducted uranium extrusion operations at the Ashtabula plant from 1962 to 1988 under AEC license and NRC license. The uranium metal processed at the site included both normal enriched and slightly enriched material (1% to 2.1% uranium-235), as well as depleted uranium.

The DOE mission no longer includes processing uranium at the RMI Extrusion Plant facilities. However, DOE is contractually obligated to fund and provide technical direction to RMI for the removal of residual contamination so that RMI can terminate its NRC license. Based on NRC guidelines[1], RMIDP submitted a Decommissioning Plan to NRC in April 1995 that proposed a soil cleanup level for total uranium of 30 pCi/g.

Release Characteristics

The primary practice that contributed to contamination at the RMI site was uranium manufacturing. Particulate uranium was generated in the extrusion building during operation of the uranium extruding and machining equipment. Hoods and fans were used to exhaust the fine uranium dusts and fumes outside the building. Particulate deposition from the exhaust system contaminated the surrounding soils with uranium.

Because the predominant wind direction was to the north, Area C, located north of the production building, is suspected to have been impacted primarily by eolian deposition, though it may have also received contamination from nonpoint-source storm water runoff. As a finishing step in the extrusion process, nitric acid was used to surface treat the uranium products. The nitric acid solution was neutralized to recover the uranium, and the resultant supernatant was disposed in a small solar evaporation pond located on the northern boundary of Area B. Overflow from the pond as well as storm water runoff from Area C drained into a low-lying area that acts as an intermittent pond in the northern part of Area C. Uranium-handling activities conducted in the eastern portion of Area B appear to have resulted in the eolian deposition of uranium dusts and fumes in Area D. Area D also receives storm water runoff from the eastern side of Area B.

Site Contacts

RMIDP is managed by Ward Best of the DOE Ashtabula Area Office [(216) 993-1944]. The managing cleanup contractor for the site is RMI Environmental Services. The RMIES project manager for this project was Jeff Kulpa [(216) 993-2804]. The pilot project manager for ART was Erik Groenendijk [(813) 264-3529].

3. MATRIX AND CONTAMINANT DESCRIPTION

Site Geology/Hydrology

The type of matrix processed by the chemical extraction treatment system was high clay-content soil (ex situ). Site topsoils are composed of silt loams and clay loams, all characterized by low to moderately low water permeability. Subsoils are primarily wave-washed clay glacial till, interspersed with silt, loam, sand, and gravel, both layered and in isolated beds. Depth to the underlying shale bedrock is approximately 20 to 25 ft.

The regional hydrogeology in the vicinity of RMI is characterized by low ground water yields from both bedrock and surficial material. Because of the extremely low hydraulic conductivity, the regional water supply has little dependence on ground water.

Contaminant Characterization and Properties

The primary contaminant addressed in this application was the radioactive heavy metal uranium. Natural uranium contains three isotopes in the following distribution: uranium-234 (0.006%), uranium-235 (0.72%), and uranium-238 (99.27%). The radioactive half-life for these isotopes range from 245,000 years (U-234) to 4.5 billion years (U-238). Uranium and its compounds are highly toxic, both from a chemical and radiological standpoint. The isotopic distribution of the RMI soils used as feed material for this application is shown in Table 1.

Uranium commonly exists in two oxidation states. It was expected that much of the uranium at the RMI Site, especially that deposited from stack emissions in Areas C and D, was in the oxidized or U^{+6} state. This form of uranium is very soluble and lends itself readily to chemical treatment and removal. Uranium contamination associated with processing wastes, such as that in some soils in Area B, is often in the reduced or U^{+4} state. This form of uranium is much less soluble and more easily complexes with organic matter in the soil. Therefore, this form of uranium would be more recalcitrant to chemical treatment. To improve removal, oxidizers such as hydrogen peroxide or acids can be used to oxidize the uranium to the U^{+6} state and make it more soluble. Depending on the buffering capacity and the organic content of the soil, this type of chemical addition can be costly for what is often only a marginal improvement in contaminant removal efficiency.

Nature and Extent of Contamination

The contaminated media at the site are clay soils with a small sand fraction and non-native gravel that was used for plant service roads. The uranium at the RMI site is generally stratified within shallow topsoils with highest activities found in the top 6 in. of soil. Site characterization data indicate that uranium activities fall below the treatment standard of 30 pCi/g at 12 to 18 in. depth. Beta/gamma radiation survey maps, gamma spectroscopy area characterization data, and site historical information were used to locate soil within the designated areas.

Uranium levels in the selected feed material for the pilot project were in the range of 74 to 146 pCi/g (Table 1). Project soils with known levels of other contaminants above regulatory limits were omitted from the scope of the pilot plant project and were not selected as feed material. Soils excavated from Areas B, C, and D and existing soil piles were mixed, segregated and staged outside the treatment system building as feed material for processing. The areas selected for excavation were previously identified to have high levels of uranium contamination, providing sufficient variation in uranium activity and soil composition. Soils from three existing soil stockpiles from Area B were blended to provide the "Area B Blend Pile" feed material. Two other feed piles from Area B were composed predominantly of non-native gravel from fire roadways and storage area foundations. This matrix was selected because: (1) a large volume of contaminated gravel exists within Area B, and (2) it would test whether the soil processing technology is suitable for soils with a high percentage of oversize material.

Table 1. Summary results of feed soil analyses (by alpha spectroscopy) for pilot operations

Source area	Pile	Percent oversize	Total isotopic uranium (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)
Area B	P01-soil	17% > 1.0 mm	103	42	2.6	58
Area D	P02-soil	5% > 1.0 mm	129	56	2.3	71
Area D	P03-soil	4% > 1.0 mm	90	36	7.7	46
Area C	P04-soil	4% > 1.0 mm	133	50	2.4	81
Area C	P05-soil	6% > 1.0 mm	145	46	6.3	93
Area B	P06-soil	33% > 1.0 mm	76	25	6.0	46
Area B	P07-soil	18% > 1.0 mm	133	56	5.4	71
Area B	P08-soil	20% > 1.0 mm	134	55	3.0	76
Area B	P09-gravel	57% > 1.0 mm	146	31	4.8	110
Area B	P10-gravel	46% > 1.0 mm	74	26	2.3	46

Matrix Characteristics Affecting Treatment Cost or Performance

Based on bench-scale treatability testing and a review of the soil washing/chemical extraction literature, the matrix parameters listed in Table 2 were found to be important in determining the effectiveness of soil treatment technologies. The RMI site generally consists of high clay-content soils. Because the contaminants tend to bind to fine soil fractions, and because these fractions make up a high percentage of the RMI soils, typical soil treatment such as physical separation are not effective at this site. The potential benefit of the chemical treatment process is its ability to treat the fine fractions of the soil matrix and separate the uranium contamination from the soil matrix, thereby significantly reducing the volume of contaminated soil requiring off-site disposal.

Table 2. Matrix characteristics affecting treatment cost or performance

Parameter	Value
Soil classification	Silt loams and clay loams
Clay content/particle size distribution	Areas C & D: high clay content; 5% > 2 mm, 25% sand/silt, 70% fines (<0.045 mm)[2] Area B: lower clay content; 32%>2 mm, 25% sand/silt, 43% fines; includes some non-native crushed stone.[2]
Total organic carbon	Areas C & D: much of the sand size material is natural organic material Area B: low organic material

4. TECHNOLOGY DESCRIPTION

A chemical extraction process, designed to leach uranium from contaminated clay soils using a sodium carbonate/bicarbonate solution, was evaluated in this pilot project. Chemical extraction and leaching has been used extensively in the mining industry for the extraction and concentration of metals. Carbonate (CO_3^{2-}) and bicarbonate (HCO_3^-) leaching has historically performed well to recover uranium from ore. More than one-third of the uranium mills operated in the United States have used the carbonate leaching process at one time or another.

The carbonate extraction process involves application of a bicarbonate solution to uranium-contaminated soil. The process dissolves (leaches) uranium in the form of uranyl carbonate. The formation of highly soluble anionic carbonate uranyl species, including uranyl dicarbonate [$UO_2(CO_3)_2^{2-}$] and uranyl tricarbonate [$UO_2(CO_2)_3^{4-}$], allows for effective removal of the uranium from the soil and high concentrations of uranium in the leachate solution. Because other metal compounds such as iron, aluminum, titanium, etc. are nearly insoluble in carbonate solutions, carbonate extraction can produce a high-purity uranium solution. Other advantages of carbonate leaching include the relative ease with which a uranium product can be precipitated directly from the leachate solution and the relatively noncorrosive and safe handling characteristics of carbonate solutions.

Treatability Study

In the summer of 1996, RMIES and ART conducted bench scale studies to determine the feasibility of using carbonate-bicarbonate extraction to remediate the uranium-contaminated soils at the RMI Extrusion Plant Site. This study found that the Ashtabula soils could be treated effectively using a 0.2 *M* sodium bicarbonate solution at a temperature of approximately 115EF and a retention time of 1.5 hrs.[2] In this treatability study, chemical treatment using carbonate extraction achieved removal efficiencies of up to 90% and was effective in meeting the treatment standard of 30 pCi/g for uranium for most of the site soils.

Carbonate Extraction System Description

Based on the results of the treatability study, a pilot plant was designed to process 2-ton batches of contaminated soil, optimizing the key parameters identified in the laboratory study. The equipment used in this demonstration included plant components provided by ART, RMI, Fernald, and some leased and purchased equipment. Table 3 describes key plant components. These include a rotary batch reactor (Figure 2) in which a heated carbonate solution is contacted with the feed soils, a liquid/soils separation unit to remove the soluble uranium, a dewatering system for the soils, and an ion-exchange system to allow removal of the uranium from the liquid.

The pilot plant was installed in the existing Northwest Warehouse at the RMI Site. Existing electrical, water, and natural gas infrastructure were used. The plant required an area of approximately 100 ft by 100 ft.

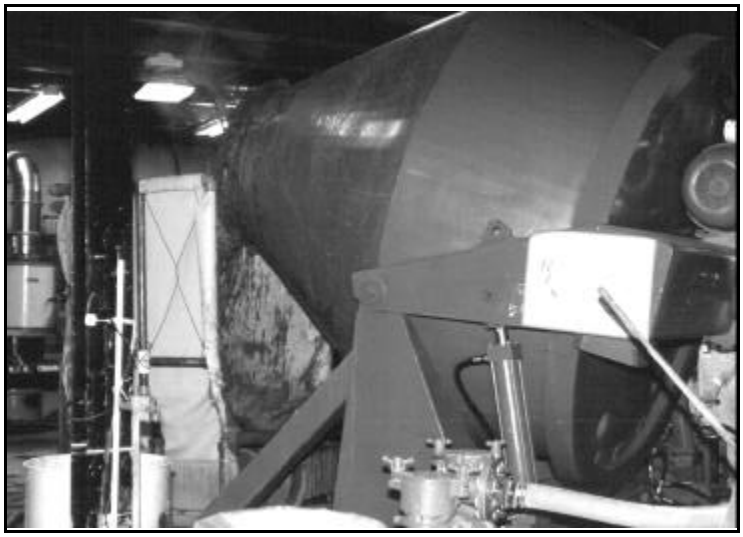


Figure 2. Rotary batch reactor in operation.

Table 3. Pilot plant components.

Rotary batch reactor (RBR)	A 5-yd^3 cement mixer with hydraulic emptying mechanism. The RBR was a refurbished cement mixer purchased for the project.
Wet screen	A wet vibrating screen with variable-speed drive and a sump pump unit provided by ART.
Motor control center (MCC)	A module with control room and electrical control panel. The electrical panel of the MCC was modified to accommodate the electrical controls specific for the pilot project. Provided by ART.
Thickening tanks	Two 2500-gal, cone-shaped tanks with rake mechanisms provided by ART.
Filter press for soil dewatering	A trailer-mounted, self-supporting, 50-ft^2 plate-and-frame filter press leased from Metropolitan Environmental Services.
Filter press for filtering pregnant leachate	A small modular filter press provided by Fernald.
Ion exchange	Two upflow 10-ft^3 ion-exchange columns with associated pumps and valves. Purchased.
Tanks/pumps/mixers	Various processing tanks, pumps, and mixers used were obtained from Fernald, RMI, and ART. These components were complemented as required with new purchased units.
Boiler/Air Compressor	A 2,000,000-BTU/hr natural gas boiler was leased to provide steam for heating the carbonate solution and for evaporation of residual waste water. A 50-HP industrial air compressor was leased to provide air for operation of the process pumps.
Evaporators	Used tanks retrofitted with steam coils. Provided by RMI for evaporation of process waste waters.

Treatment System Schematic and Operation

A flow diagram for the RMIES/ART pilot treatment system is provided in Figure 3. The key processing steps and the overall system operation are described in the following paragraphs.

One to two tons of premixed soil was batch loaded into the rotary batch reactor (RBR), and a 0.2 *M* sodium carbonate/sodium bicarbonate solution was added to achieve a 30% solids slurry. For batches run at elevated temperatures, the carbonate solution was heated before being added to the RBR.

After the initial leaching period was complete, the slurry was pumped to a wet screen to remove oversize material (>1 mm). This oversize material received no further treatment. The slurry containing particles less than 1 mm was transferred to sequential thickeners (No.1 and No.2). The thickeners performed the solids separation. Fresh leach solution was added to produce a slurry containing approximately 10% solids. This fresh leach solution rinsed the uranium-rich leach solution from the soil and permitted additional uranium extraction. Flocculent was added to allow suspended fines to settle out of solution. Dewatering of the treated soil was performed by means of a plate-and-frame filter press. The filter cake produced by the filter press was staged as clean soil.

The uranium-rich supernatant received further processing. Uranium dissolved within the leach solution was recovered using dual upflow ion-exchange columns. A small filter press was used upstream from the ion exchange columns in order to remove fine particles from the pregnant leachate and protect the ion exchange columns. In passing through the ion exchange columns, the dissolved uranyl carbonates were adsorbed onto the ion exchange resin. The leachate was recycled back into the system. Once loaded, the ion-exchange resin within a column was regenerated to permit resin reuse. The resins were regenerated by backwashing the columns with a 1.5 *M* sodium chloride and 0.05 *M* sodium carbonate solution.

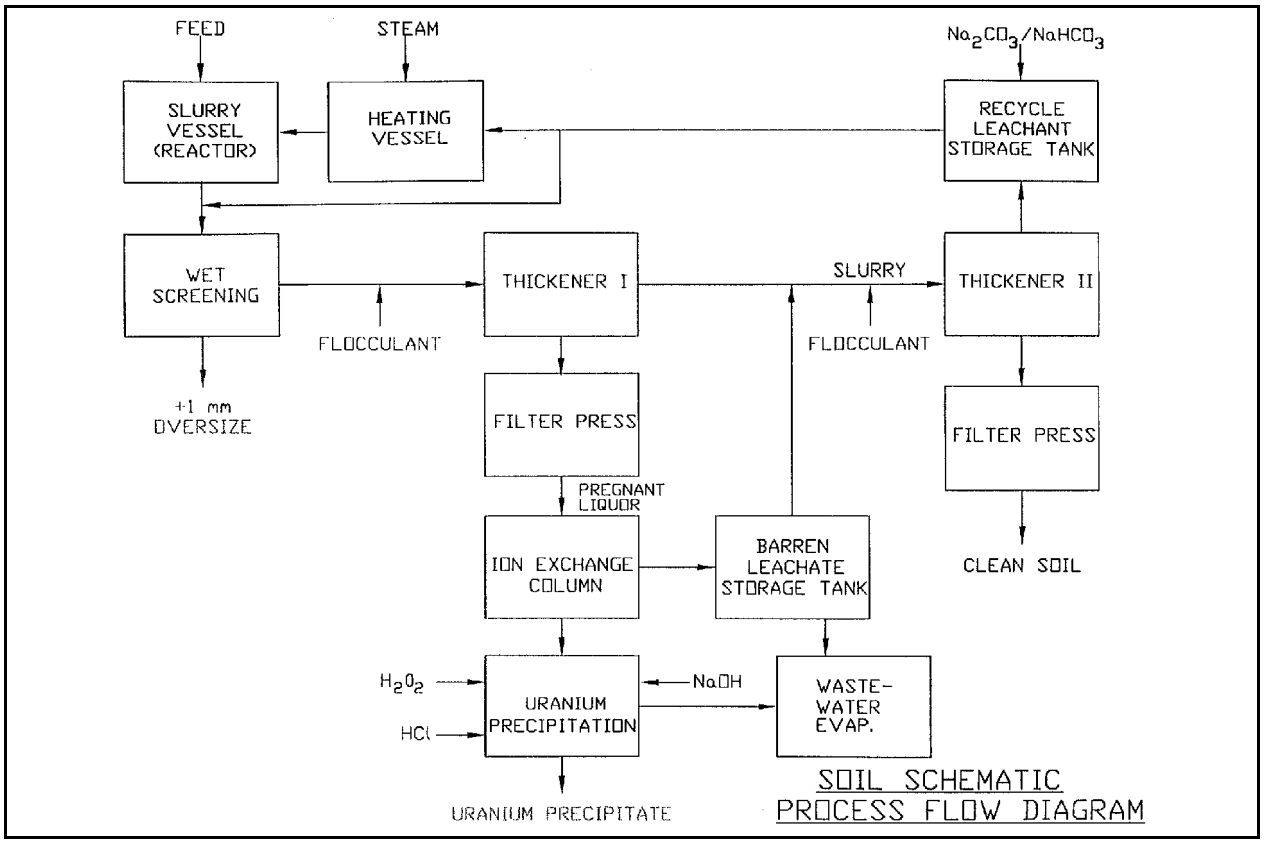


Figure 3. RMI/ART carbonate extraction soil treatment process flow diagram.

Uranium eluted from the resin during regeneration was recovered by a two stage chemical precipitation reaction. First, hydrochloric acid was used to lower the pH (< 2) and drive off excess carbonate as carbon dioxide. This step was followed by the addition of hydrogen peroxide and pH adjustment with sodium hydroxide. These compounds brought about the precipitation of uranium as “yellow cake.” An extremely small volume (< 1 qt for the 38 batches) of liquid residue from this backwashing process was collected and evaporated.

Operating Parameters

Based on the results of the treatability study, the following process parameters were varied as part of the pilot plant operation:

C feed soils (various areas and feed contamination concentrations),
C reaction temperature (ambient, 110 to 120EF, and 140EF), and
C leaching time (1 to 2 hrs).

The operating parameters for the 38 batches processed during this demonstration are given in Section 5. The slurry density in the RBR was 30% solids and was not varied during the pilot processing. Important information that was expected to be gained from the pilot study pertaining to full-scale operations included overall leaching performance, ion exchange performance, resin loading and regeneration capabilities, and uranium precipitation efficiency.

5. CHEMICAL EXTRACTION SYSTEM PERFORMANCE

Demonstration Objectives and Approach

The primary objectives of the pilot study were to assess whether the chemical extraction process would be successful on a large scale and obtain the necessary operational data to support full-scale soil remediation at the Ashtabula Site.

To meet these objectives, data were collected for the following purposes:

- validating the bench-scale findings at a processing scale similar to full scale,
- obtaining process information on specific operational parameters that will be used to optimize performance specifications,
- investigating and resolving process parameters that were not determined at the bench-scale level (specifically, resin fouling issues and possible chloride buildup in the recycled extraction volumes), and
- validating X-ray fluorescence (XRF) as a process control tool for use during full-scale soil processing operations.

Performance Evaluation Criteria

To determine the feasibility of using the carbonate extraction process in a full-scale application at Ashtabula required evaluation of several aspects of the process. The operational and performance criteria used to assess this pilot project included the following:

- the removal efficiency of the process as measured by the uranium activities in the feed soil versus the uranium activities in the treated soil,
- the ability to treat the RMI soils to meet the 30 pCi/g free release standard,
- the ability to achieve a significant volume reduction in the amount of soil requiring off-site disposal, and
- the ability to demonstrate a mass balance for uranium.

Performance Summary

Start-up testing of the pilot system began in December 1996. Following this initial testing, the system operated throughout the month of January and during the second week of February 1997. During this period, 38 batches of soil were processed, each coming from one of the ten staged piles from Areas B, C, and D. Table 4 is a summary of the operating conditions by batch. Each batch weighed between 1 and 2 tons, and a total mass of 64 tons of feed soil were processed through the plant. Figure 4 shows the removal of one of the batches of treated soil from the RBR.

Figure 4. Removing treated soil from the RBR.

Table 4. Summary of batches processed

Batch	Source area	Pile	Total uranium activity by alpha spec (pCi/g)	Temp. (EF)	Leaching time (hrs)	Date processed
01	B blend pile	P01	103	110-120	1	--
02	B blend pile	P01	103	110-120	1	1/8/97
03	B blend pile	P01	103	110-120	1	1/9/97
04	B blend pile	P01	103	110-120	1	1/10/97
05	Area D	P02	129	110-120	1	1/11/97
06	Area D	P02	129	110-120	1	1/14/97
07	Area D	P02	129	110-120	1	1/15/97
08	Area D	P02	129	110-120	1	1/15/97
09	Area C	P04	133	110-120	1	1/16/97
10	Area C	P04	133	120-130	1	1/16/97
11	Area C	P04	133	110-120	1	1/17/97
12	Area C	P05	145	110-120	1	1/18/97
13	Area C	P05	145	110-120	1	1/19/97
14	Area C	P05	145	110-120	1	1/20/97
15	Area D	P03	90	110-120	1	1/20/97
16	Area D	P03	90	100-120	1	1/21/97
17	Area D	P03	90	60-70	2	1/21/97
18	Area D	P03	90	60-70	2	1/22/97
19	Area B	P07	133	60-70	2	1/23/97
20	Area B	P07	133	110-120	1	1/25/97
21	Area B	P06	76	110-120	1	1/25/97
22	Area B	P06	76	110-120	1	1/27/97
23	Area B	P08	134	110-120	1	1/27/97
24	Area B	P08	134	110-120	1	1/27/97
25	Area B	P08	134	110-120	1	1/28/97
26	Area B	P09	146	110-120	1	1/28/97
27	Area B	P09	146	110-120	1	1/28/97
28	Area B	P10	74	110-120	1	1/29/97
29	Area B	P10	74	60-70	2	1/29/97
30	Area C	P04	133	60-70	2	1/30/97
31	B blend pile	P01	103	140-150	1	1/31/97
32	Area B	P06	76	130-140	2	2/10/97
33	Area B	P06	76	110-120	2	2/11/97
34	Area B	P08	134	110-120	2	2/12/97
35	Area B	P08	134	130-140	2	2/12/97
36	B blend pile	P01	103	110-120	2	2/13/97
37	B blend pile	P01	103	150-160	2	2/13/97
38	Area B	P07	133	-	2	2/14/97

Uranium Removal Efficiency

From the leaching process, two treatment products were produced: treated soil (< 1 mm) and treated oversize (> 1 mm). Table 5 summarizes the treated soil results and key operating conditions by batch. Uranium activity was monitored using XRF as a real-time process measurement tool; results were later verified by alpha spectroscopy. The correlation of XRF analysis to alpha spectroscopy is illustrated in Figure 6 at the end of this section. A full discussion of the XRF validation process as well as project data quality objectives and quality control (including field and laboratory duplicate sample analysis, matrix spike samples, etc.) is included in the *RMIES/ART Soil Washing Pilot Project Report, Vol. 1*.[3]

Table 5. Summary of results for treated soil (< 1 mm) by pile

Pile	Source area	Uranium activity of feed by alpha spec (pCi/g)	Batch	Processing conditions RBR				Treated soil		Removal efficiency	
				Temp. (EF)	pH	Total carbonate (moles/ liter)	Cont-act time (hrs)	XRF (pCi/ g)	alpha spec (pCi/ g)	XRF (%)	alpha spec (%)
P01	B blend pile	103 103 103	01/02 36 37	110-120 110-120 150-160	10.1 10.3 10.2	0.20 0.17 0.15	1 2 2	37 42 37	47 41	64% 59% 64%	54% 60%
P02	D	129 129 129	05/06 06/07 08	110-120 110-120 110-120	9.9/10 9.9/9.9 9.9	0.16/0.18 0.18/0.12 0.14	1 1 1	14 9 8	 12	89% 93% 94%	 91%
P03	D	90 90	16 17	110-120 60-70	10 9./9	0.15 0.17	1 2	13 11	 12	86% 88%	 87%
P04	C	133 133 133	09 10 11	110-120 120-130 110-120	9.8 9.8 10	0.14 0.14 0.15	1 1 1	10 13 9	13 	92% 90% 93%	90%
P05	C	145 145	12 13	110-120 110-120	10 9.9	0.16 0.15	1 1	22 17	 14	85% 88%	 90%
P06	B	111* 111*	32 33	130-140 110-120	10.1 10.2	0.19 0.16	2 2	32 25	 30	75% 80%	 74%
P07	B	160*	38	140	n.a.	n.a.	2	24	27	86%	84%
P08	B	166* 166* 166*	24/25 34 35	110-120 110-120 130-140	10.1/10.3 9.7 9.3	0.16/0.15 0.11 0.07	1 2 2	28 22 34	32 35	84% 88% 81%	82% 80%
P09	B	314*	26/27	110-120	10.2/10.4	0.19/0.17	1	48		86%	
P10	B	132*	28/29	60-120	10.0/10.3	0.17/0.22	1	49	47	63%	65%

* Estimated maximum of U activity in soil fraction < 1 mm
n.a. = not analyzed

For the batches treating Area C and Area D materials, the treated soil product (< 1mm) varied consistently in the range of 12 to 14 pCi/g uranium as measured by alpha spectroscopy. Contaminant removal efficiencies ranged from 87% to 91%, averaging 90%.

For the batches treating Area B materials, the treated soil product (<1 mm) results ranged from 27 to 47 pCi/g uranium as measured by alpha spectroscopy and did not consistently meet the treatment standard of 30 pCi/g. The matrix of the Area B soils probably affected the removal efficiencies. The total activity measured for the feed pile (A_{feed}) reflects the sum of the activity from the two size fractions (<1 mm and

>1 mm). Area B soils contain appreciable amounts of gravel-type material, but most of the uranium will be bound by the finer soil fractions as a result of the higher surface area of the fine material. Therefore, the actual feed concentration in these finer-grained fractions, as shown in Table 5, was often higher than the intended 70- to 150-pCi/g range.

The estimates of the activity in the finer grained fraction of the Area B soils were based on the following approach. The mass fraction of each size range (M_{pile}, $M_{<1mm}$, and $M_{>1mm}$) was known, as was the initial activity for the feed pile (A_{pile}). The activity of the treated oversize material ($A_{>1mm\ treated}$) was measured and used to estimate the lower limit for initial activity associated with material larger than 1mm ($A_{>1mm}$). The following equation, which describes total activity, was rearranged to solve for the maximum initial activity per gram that might be associated with the fine fraction in Area B soils ($A_{<1mm}$):

$$Activity = A_{pile}M_{pile} = A_{<1mm}M_{<1mm} + A_{>1mm}M_{>1mm}$$

The maximum activity associated with the finer fraction was estimated to range from 111 to 314 pCi/g. As shown in Table 5, the contaminant removal efficiencies based on these estimated initial activity levels ranged from 65 to 84%. Even after matrix effects are considered, the uranium present in Area B soils apparently does not leach as well as the uranium in Areas C and D soils. The depositional mechanism responsible for contamination in Area B is different than the airborne deposition suspected in Areas C and D, and the uranium present in Area B soils is of a different chemical form, which can affect extraction efficiency. During full-scale operations, identification and selective excavation of untreatable "hot spot" soils within Area B will probably be necessary.

For the batches treating the Area B blend pile, the treated soil product (<1 mm) was in the range of 41 to 47 pCi/g and could not be treated successfully below the 30 pCi/g standard. Removal efficiencies varied from 56% to 62%. This low extraction efficiency for the blend pile most likely is caused by the fact that this pile included soil from one hot-spot pile containing 587 pCi/g uranium. It is recognized that the blending of hot-spot soils now stockpiled on-site with other soils for treatment is not an effective solution for treatment but instead may render a larger soil volume as untreatable to the 30 pCi/g standard. Because hot-spot soils represent only a small volume at the site, the best remedy for these soils appears to be off-site disposal.

Table 6 shows the relationship between activities in the various size fractions of Area B soils. For the batches which treated Area C and D materials, the treated oversize product (> 1 mm) averaged about 5% (dry weight) of the total feed material with uranium activity in the range of 21 to 40 pCi/g. The treated

Table 6. Summary of results for combined treated soil - Area B

Pile	U- activity in whole soil prior to treatment alpha spec (pCi/g)	Treated soil (< 1 mm)		Treated oversize fraction		Treated whole soil	Removal efficiency (%)
		Mass fraction (%)	U-activity by alpha spec (pCi/g)	Mass fraction (%)	U-activity by alpha spec (pCi/ g)	U-activity by alpha spec (pCi/ g)	
P06	76	67%	30	33%	6	22	71%
P07	133	80%	27	20%	11	24	82%
P08	134	80%	35	20%	6	29	78%
P09	146	43%	48	57%	19	31	79%
P10	74	54%	47	46%	5	28	63%
Average		65%		35%			75%

oversize in Area B materials averaged about 35% of the feed material with uranium activity ranging from 5 to 19 pCi/g. The treated oversize in the Area B blend pile amounted to 17% of the feed material with uranium activity of 58 pCi/g. Note that when the treated oversize and the treated soil are recombined, most of the treated whole soil activities were below the free release threshold.

Leaching Kinetics

Leaching kinetics were evaluated by sampling the contents of the RBR at four time intervals. Samples were centrifuged and the activity was measured in the supernatant. This sampling indicated that most of the extractable uranium is removed from the soil within the first 30 minutes of contact with the leaching solution. An average of 85% of the uranium in solution at 75 minutes was already in solution at 30 minutes. Extending the contact time from 75 to 135 minutes resulted in only a marginal 3 pCi/g increase in uranium removal.

When comparing the leaching kinetics at ambient (60 to 70EF) versus elevated temperature (140EF), it appears that at elevated temperature, kinetics increase, but it is unclear whether a direct correlation to the quality of the final end product can be made. It appears that no significant improvement in leaching performance occurred when temperatures were raised from 110 to 120EF to approximately 140EF.

Performance of Ion Exchange

The ion-exchange system (Figure 5) effectively removed uranium from the pregnant leachate. The columns were installed in a sequential configuration. The average feed concentrations delivered to the first ion exchange column was 16 ppm (5 pCi/g), and the output concentration from the second column was 1.7 ppm (0.5 pCi/g with 91% removal efficiency).

Resin loading achieved in the pilot project was 0.0087 and 0.0073 lb uranium per pound of resin. The resin loading was lower than expected from bench-scale tests (up to 0.04 lb/lb), but is acceptable for full-scale operations. The pilot project demonstrated that the ion exchange resin effectively removed uranium from solution, and was not affected by the buildup of organic material in the process liquids.

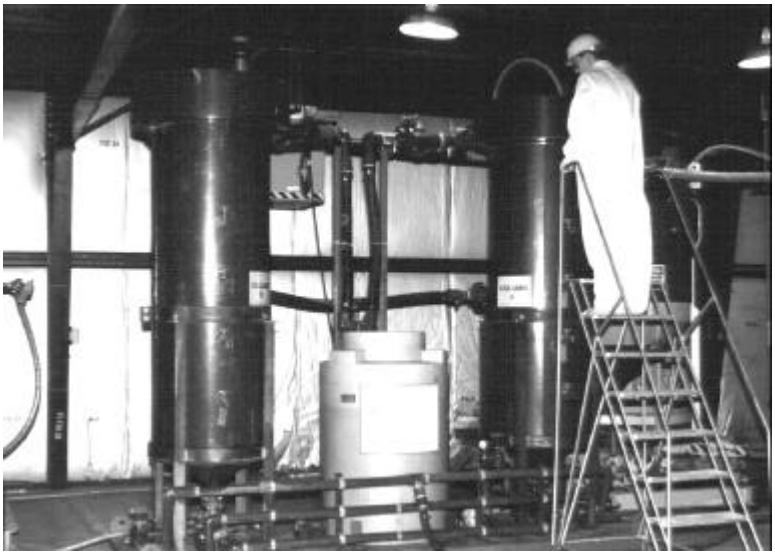


Figure 5. Operation of the Ion Exchange System.

Uranium Mass Balance

Based on uranium concentrations in the process feed, calculations show that about 15.3 lbs of uranium were in the soils processed during pilot processing. Based on the measured amount of uranium recovered in the various process streams, the ion-exchange system, and the regenerant solutions, the total amount of recovered uranium was calculated at 13 lbs. Based on the multiple data points and the variability associated with each data point, the 85% closure of the mass balance is considered appropriate for a process involving nonhomogeneous soil contamination.

Table 7 summarizes overall system performance relative to stated objectives. On average, the plant obtained an 82% uranium removal efficiency, met the treatment standard of 30 pCi/g for most soils, which resulted in a 95% volume reduction (i.e., <5% residual waste requiring off-site disposal). No new hazardous waste streams were generated as a result of the soil processing activities.

Table 7. Performance summary

Performance measures	Values/results
Quantity of soil treated	64 tons (38 batches)
Removal efficiencies	Varied by soil type and batch; overall average appx. 82%.
Volume reduction	95%; <5% residual waste requires off-site disposal.
Evaluate leaching kinetics	A contact time of a minimum of 75 min is recommended for design of a full-scale system. Increasing reaction time and temperature increased extraction efficiency significantly on some soils but only marginally on others.
Evaluate the performance of the ion-exchange system	Average feed concentration to ion exchange was 16 ppm and output 1.7 ppm, resulting in 91% average removal efficiency. Resin loading achieved was 0.0087 and 0.0073 lb uranium/lb resin.
Mass balance	85% closure; Calculated 15.3 lbs U in feed, 13 lbs U recovered.
Evaluate potential for resin fouling	Resin fouling was not a significant issue.
Evaluate potential leachate recycle problems	Some chloride buildup was observed to a level of 0.015 *M* (or 0.5 g/L). However, because of the short pilot period, no equilibrium conditions were achieved. The leachate solution gradually changed to a dark brown/blackish color, likely caused by the dissolution of organic compounds in the soil matrix. No evidence exists that the organic compounds interfered with leaching.
Evaluate XRF as an expedient and reliable predictor of total uranium concentrations during processing	XRF performed well, with a correlation coefficient between XRF and alpha spectroscopy of appx. 0.94 (see Figure 6).

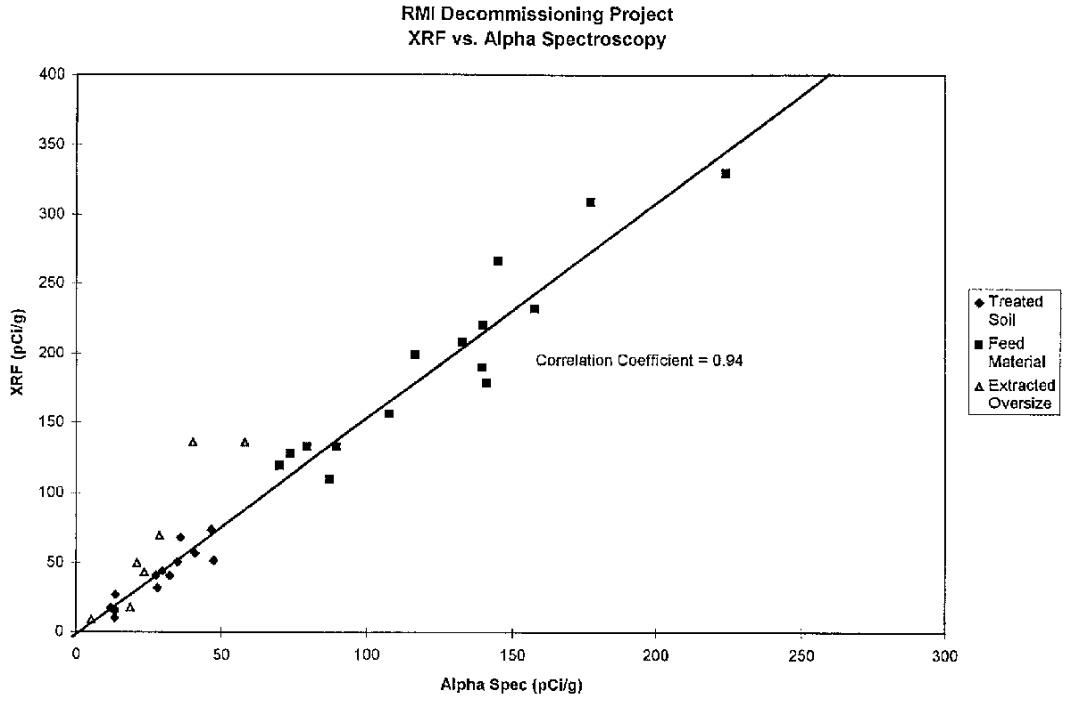


Figure 6. XRF vs. alpha spectroscopy.

6. CHEMICAL EXTRACTION SYSTEM COSTS

The RMIDP Pilot Plant Project included plant design, equipment procurement, plant construction, plant operation, data analysis, and plant decontamination.

Efforts were made to minimize the overall cost of the pilot plant project. These included:

- Obtaining plant equipment from many no-cost sources such as DOE excess listings and excess equipment inventory from RMIES.
- Other specialized equipment was obtained from an existing ART soil processing plant,
- Plant monitoring instrumentation was obtained by using excess equipment from various DOE sources,
- Several major equipment pieces such as the main filter press, the air compressor, and the steam supply boiler were leased, and
- Developing a simple and manageable operational process for production scale volumes. As such, the resulting design was fairly labor intensive but inexpensive to construct or operate.

Table 8 shows the costs for the pilot plant project, subtotaled according to accepted Federal Remediation Technologies Roundtable[4] cost elements. Table 9 summarizes utility, chemical, and resin usage. Although no linear relationship exists between pilot plant costs and full-scale costs, the pilot plant data provides an understanding of the performance of each component of the entire treatment system and its influence on overall system costs. The data therefore, can be used to help in the design and operation of a cost effective full-scale treatment system. Treatment data obtained from the laboratory treatability study were used to develop an initial estimate of the expected soil treatment costs. Based on the laboratory results, it was estimated that soil treatment costs would vary from $250 to $350/ton. The results of the pilot plant operations verified the preliminary performance results of the laboratory studies and validated the initial estimates of the soil treatment costs.

Based on the results and operational experience gained from the pilot plant, a conceptual full-scale soil treatment process and system was developed by RMI and ART. The pilot plant operations helped identify equipment, utility, chemical and labor needs. The design components and equipment, operation, and costs of the full-scale system are presented in the *RMIES/ART Soil Washing Pilot Project Report, Vol. 1*.[3] Based on the expected volume of soil to be processed, the suggested design was based on a 10-ton/hr continuous feed soil treatment facility that uses standard soil handling and processing equipment. The equipment would be housed in a 60,000-ft^2 building to be constructed at the site. Excavated soil would be stockpiled in a 5,000-ft^2 heated building and on a 10,000-ft^2 concrete pad. These facilities would allow year-round operation of the soil treatment system. The plant would require three operators and a foreman for each of the two daily shifts. Operations would be conducted about 14 hrs/day, allowing up to 140 tons of soil to be processed daily.

RMI has submitted a fixed unit price, performance-based, privatized contract proposal to DOE based on the full-scale design. The proposal includes the following key parameters.

- Capital investment for plant design, procurement, and construction would be provided by RMI and ART,
- The proposal is for processing the first 20,000 tons of soil which are currently accessible,
- The construction and first campaign will be completed by August 1998, and
- The proposed fixed price for site preparation, soil excavation, soil processing, residual disposal, depreciation, profit, and site restoration is $565/ton processed.

The existing project baseline cost for soil remediation—which includes characterization, excavation, packaging, certification, transportation, off-site disposal, and restoration—is $857/ton. Therefore, soil treatment at RMI under the conditions outlined above is projected to save DOE approximately $300/ton for treatment and an additional $6.7 million in schedule reduction-related costs, resulting in a total savings of more than $12.7 million when compared with the baseline case. An additional 18,000 tons of soil will be processed following site dismantlement activities. While soil processing costs have not been determined for this second volume, savings are expected to be at least an additional $12 million, resulting in a total site savings of nearly $25 million due to this soil treatment process.

Table 8. RMI soil processing pilot project cost by interagency work breakdown structure (WBS)

Cost element (with interagency WBS Level 2 code)[5]	Description	Costs	Subtotals
Mobilization and preparatory work (331 01)	Construct/modify temporary utilities, site improvements	$ 24,700	$ 165,541
	Transportation and freight	$ 24,245	
	Labor - design, site prep, ESH, HP, QA support	$ 31,044	
	Filter press mobilization	$ 1,925	
	Plant construction materials	$ 18,451	
	Rigging subcontractor support	$ 12,276	
	Labor - plant construction, ESH, HP, and QA	$ 52,900	
Monitoring, sampling, testing, and analysis (331 02)	Laboratory consumable procurement	$ 6,884	$ 136,612
	XRF calibration	$ 4,208	
	Laboratory setup labor	$ 19,920	
	Laboratory operations labor	$ 79,600	
	Off-site lab QA analyses	$ 16,400	
	Laboratory demobilization	$ 9,600	
Chemical treatment (331 12)	Procurement of equipment, including RBR and ion-exchange system	$ 90,526	$ 286,802
	Filter press usage cost	$ 58,800	
	Rentals - steam plant, air compressor, ART equipment	$ 27,200	
	Plant operations materials	$ 16,076	
	Labor - plant operations, ESH, HP, and QA support	$ 94,200	
Decontamination and Decommissioning (331 17)	Filter press	(incl. below)	$ 0
Disposal (commercial) (331 19)	Waste management and disposal	$ 16,000	$ 16,000
Demobilization (331 21)	Filter press decon and demobilization	$ 2,195	$ 21,395
	Other equipment demobilization	$ 8,400	
	Plant labor for demobilization	$ 10,800	
Data compilation & report writing		$ 12,320	$ 12,320
Total cost			$ 638,670

Table 9. Pilot plant usage of utilities, chemicals, and resin

Item	Usage	Cost
Utilities		
Water	30,000 gal	$ 128
Natural gas	525,000 ft^3	$ 2,906
Electricity	24,300 kWh	$ 2,430
Chemicals		
Flocculent	50 gal	$ 1,449
Anti-foaming agent	3 gal	$ 26
Sodium carbonate	3,650 lb	$ 602
Sodium bi-carbonate	360 lb	$ 300
Resin	25 ft^3	$ 6,250

7. REGULATORY/INSTITUTIONAL ISSUES

The pilot plant operation involved the use of heavy equipment, chemicals, elevated steam pressure and temperature (i.e., 150 psig and 370EF maximum temperature), 120 V and 480 V (3 phase) electrical power, compressed air, sample crushing, X-ray generating instruments (i.e., XRF analyzer), liquid nitrogen and other laboratory hazards, and generated wastewater. As a result of these hazards and concerns, all work was performed in accordance with RMI's Industrial and Safety Requirements, including Radiation Work Permit requirements. Monitoring and periodic contamination surveys confirmed that uranium concentrations in air and breathing zones were significantly below action levels and that contamination levels were maintained at acceptably low levels during the pilot plant project.

Regarding the acceptance of treated soil as being "clean" enough for redeposition on the RMI site, NRC has indicated the soil would be acceptable based on its having less than 30 pCi/g total uranium as measured by XRF and validated by alpha spectroscopy. EPA has deferred to the NRC for determinations on radiation standards and issues at the RMI site.

Uranium precipitate collected from the carbonate extraction process is managed and disposed off-site as low-level radioactive waste, or recycled for use in the nuclear utility industry. Wastewater generated from the pilot plant was volume reduced in two small, steam-heated evaporators. During full-scale operations, wastewater will be recycled and eventually evaporated.

Calculations and actual operating experience indicate that airborne emissions are negligible from this process. Airborne emissions of uranium from the evaporators are monitored and controlled to ensure that the Effective Dose Equivalent (EDE) is less than 1% of the National Emission Standards for Hazardous Air Pollutants (NESHAP) standard of 10 mrem/year (40 CFR 61.96) and that the concentrations are well below 10 CFR 20, Appendix B, uranium-in-air-concentration limits.

8. SCHEDULE

Figure 7 shows the associated tasks and schedule for the demonstration and evaluation of the RMI/ART soil processing pilot project.

ID	Task Name	Start	Finish
1	Obtain Soil Treatability Testing Results & Prepare Final Report	8/26/96	10/30/96
2	**Complete Design of Pilot Plant**	8/26/96	10/22/96
3	**Procure & Receive Equipment for Plant Construction**	9/5/96	12/12/96
4	**Complete Onsite Preparations for Pilot Plant Testing**	**9/3/96**	**12/16/96**
5	Conduct Site Preparations	9/3/96	12/11/96
6	ART Mobilize Plant at RMI	11/1/96	11/15/96
7	Receive Fernald and Procured Equipment	10/16/96	12/5/96
8	Pilot Plant Setup	11/15/96	12/16/96
9	**Excavate Soil From 4 Locations for Pilot Plant Testing**	**8/28/96**	**11/18/96**
10	Identify, Prepare & Mark All Sample Locations	8/28/96	9/17/96
11	Excavate, Prescreen, and Composite Soil Samples	10/21/96	11/18/96
12	**Pilot Plant Operations**	**12/16/96**	**2/14/97**
13	Start Up Testing	12/16/96	12/20/96
14	Soil Processing	1/6/97	1/31/97
15	Soil Processing	2/10/97	2/14/97
16	**Plant Shutdown, Cleanup, Waste Management**	2/14/97	2/28/97
17	Data Evaluation and Report Preparation	2/14/97	2/28/97

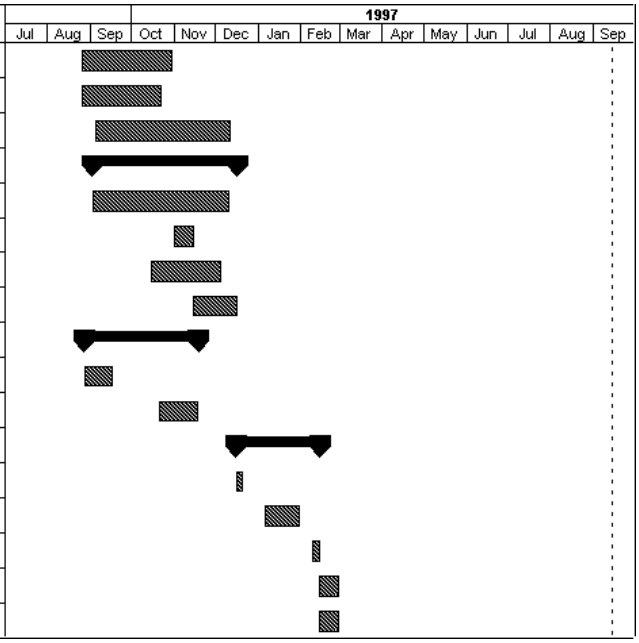


Figure 7. RMI/ART Soil Treatment Project Schedule.

9. OBSERVATIONS AND LESSONS LEARNED

Performance Observations and Lessons Learned

Overall, the results of the pilot testing verified the initial findings of the bench-scale testing. The expected optimum operating conditions identified in the bench studies—such as retention time, elevated operating temperature, and extraction solution concentration—were indeed very near the conditions determined from the pilot study, which suggests that well-designed bench-scale studies can be used to identify full-scale operating conditions. Some conditions and unit operations that could not be tested at bench scale, such as the ion-exchange system and process water recycling proved not to be major issues. The pilot operations did show that treatment of the soils at the site will have to be tailored to the type of deposition of the uranium contaminants. Therefore, the full-scale system will require some processing flexibility to treat effectively all the soils at the site. Finally, XRF proved to be an effective screening tool for residual uranium content in treated soils, and demonstrated that this method can provide effective, real-time process control for a full-scale soil treatment system.

Summary

The primary objective of the pilot plant study was to confirm the results of laboratory studies and optimize the operating parameters for full-scale soil processing at the Ashtabula Site. The RMI/ART operations included excavating site soils, erecting the pilot plant, treating the batches of soil, and collecting sufficient operating and analytical data to prove the successful attainment of the free release criteria for the treated soil while concentrating the leached uranium in a very small residual mass.

The supporting objectives were also accomplished. The results of the pilot test validated the bench-scale findings, particularly with respect to the removal efficiencies and the performance of selected system components. The pilot project also confirmed that the carbonate/bicarbonate leach solution at 0.2 *M* was effective, that the retention time of 1 to 1 ½ hrs was adequate, and that the process temperature of 115EF improved removal efficiency measurably. Additional process parameters investigated during the pilot plant operation provided essential information for the full-scale design: polymer selection for the liquid/solid separations, resin loading and regeneration, uranium precipitation, and soil dewatering.

The cost analysis conducted showed that a carbonate extraction process for the removal of uranium from predominantly clay soils is cost effective and can substantially reduce the volume of soil requiring disposal. Removal efficiencies of 75-90% are obtainable with this process and can reduce most of the site soils to the required 30 pCi/g free release level.

10. REFERENCES

1. U.S. Nuclear Regulatory Commission, *Disposal or On-site Storage of Thorium or Uranium Wastes from Past Operations*, Branch Technical Position, 46FR52601, October 23, 1981.

2. *Soil Washing Treatability Study Report of the RMI Extrusion Plant Site*, November, 4, 1996.

3. *Soil Washing Pilot Project Report for the RMI Titanium Company Extrusion Plant Site*, Ashtabula, Ohio, Vols. I and II, April 22, 1997.

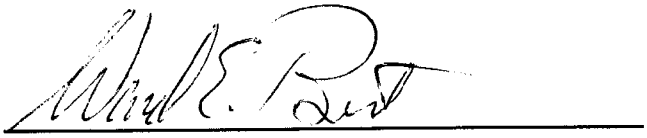
4. *Guide to Documenting Cost and Performance for Remediation Projects*, Member Agencies of the Federal Remediation Technologies Roundtable, March 1995, EPA-542-B-95-002. (downloadable at http://clu-in.com/pubitech.htm)

5. *HTRW Remedial Action Work Breakdown Structure*, Hazardous, Toxic, Radioactive Waste Interagency Cost Engineering Group, February 1996. (downloadable at http://globe.lmi.org/lmi_hcas/wbs.htm)

11. VALIDATION

Signatories:

"This analysis accurately reflects the performance and costs of the remediation."



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George V. Voinovich
Governor

February 24, 1998 RE: DOE ITRD PROGRAM

Mike Hightower, Technical Coordinator
Innovative Treatment Remediation Demonstration Program
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Alburquerque, New Mexico 87185-0755

Dear Mr. Hightower:

The Ohio Environmental Protection Agency (OEPA) Office of Federal Facility Oversight (OFFO) is a participant in the Innovative Treatment Remediation Demonstration (ITRD) Program's Ohio Heavy Metals Project. Among Ohio's ITRD-sponsored activities, a pilot-scale soil treatment technology was conducted at the DOE Astabula site. OEPA staff observed the technology, and have also reviewed the "Cost and Performance Report, Innovative Treatment Remediation Demonstration, Chemical Extraction for Heavy Metal-Contaminated Soil" final draft dated August 21, 1997. OEPA OFFO concurs with the purpose of the report, which is to convey the information gathered and reviewed by the ITRD's Technical Advisory Group. Kathy Lee Fox, a member of my staff, is a participant in ITRD's Technical Advisory Group.

If I can be of further assistance, please call me at (937) 285-6468 or Kathy Lee Fox at (937) 285-6441.

Sincerely,

Brian Nickel
Mound Project Manager
Office of Federal Facilities Oversight