SOLIDIFICATION TESTS CONDUCTED ON TRANSURANIC MIXED OIL WASTE (TRUM) AT THE ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE (RFETS)

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ABSTRACT

Rocky Flats Environmental Technology Site (RFETS) near Golden, Colorado is the first major nuclear weapons site within the DOE complex that has been declared a full closure site. RFETS has been given the challenge of closing the site by 2006. Key to meeting this challenge is the removal of all waste from the site followed by site restoration. Crucial to meeting this challenge is Kaiser-Hill's (RFETS Operating Contractor) ability to dispose of significant quantities of "orphan" wastes. Orphan wastes are those with no current disposition for treatment or disposal. Once such waste stream, generically referred to as Transuranic oils, poses a significant threat to meeting the closure schedule. Historically, this waste stream, which consist of a variety of oil contaminated with a range of organic solvents were treated by simply mixing with Environstone. This treatment method rendered a solidified waste form, but unfortunately not a TRUPACT-II transportable waste. So for the last ten years, RFETS has been accumulating these TRU oils while searching for a non-controversial treatment option.

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INTRODUCTION

Several years ago the Pollution Prevention Program identified a new high tech waste solidification product (Nochar PetroBond®) as a potential solution to the TRU Oil problem. The Building 771/774 Closure Project in conjunction with the Material Stewardship Program, is leading an effort to demonstrate this new immobilization agent as an acceptable treatment and disposal method for more than 500 gallons of transuranic mixed (TRUM) organic waste currently housed at the Site. Management believes a solution is now within reach. With success seen so far, it appears that this orphan liquid waste could soon be accepted by the Waste Isolation Pilot Plant (WIPP) as its final resting place (1). In December–

2000, a treatability study was conducted in Building 774 on approximately 12 liters of oil. This waste was mixed with an oil solidification polymer called Nochar PetroBond®. Nochar has now been used successfully at many U.S. DOE sites, and some Nuclear Facilities overseas, to encapsulate and solidify organic liquid waste. However, this is the first application of the Nochar PetroBond® on large quantities of transuranic waste destine for disposal at WIPP. Meeting the WIPP transportation and disposal criteria for a new organic base waste form poses new challenges for the Nochar® technology, which has been extremely successful for other waste streams.

NOCHAR TECHNOLOGY DESCRIPTION

The new innovative technology that was implemented is a high technology 3rd generation elastomeric polymer offered by Nochar® Corporation of Indianapolis, Indiana (2). From extensive experience in major commercial oil spill operations, Nochar® has designed a product for use in the nuclear environment that will absorb organics, solvents and other hydrocarbons with a mixture or "formula" of high tech polymers that can be designed to address the specific characteristics of a variety of waste liquids. It bonds the organic liquid into a soft, sponge rubber-like material.

Nochar is non-toxic, non-hazardous, non-corrosive and non-biodegradable (3). It produces no heat during the solidification process. It is incinerable to less than 0.02 % ash therefore allowing for possible final incineration at a later date. It has an absorbent capacity of up to 15:1 (ratio of oil to agent by weight) and up to 85:1 (ratio of water to agent using AcidBond®), with minimal volume increase. It has been tested to 40 MRad gamma exposure with limited evidence of radiological degradation, and as a single step process, requires no mixing.
Toxicity Characteristics Leaching Procedure (TCLP) analysis of NOCHAR® solidified oil shows effective results in almost every application to date (4).

THE NOCHAR® TECHNOLOGY DEPLOYMENT PROGRAM (NTDP)

Through sponsorship by U.S. DOE – Ohio, the Deactivation and Decommissioning Focus Area (DDFA), and the Transuranic Mixed-waste Focus Area (TMFA), Nochar PetroBond® has now been successfully deployed at sites in the U.S. and Canada through this technology "share" program. **A project team has been organized and involves the following team members when a deployment is initiated:**

- Deployment Project Engineer / Technical Expert
- Nochar Corporation Technical Consultant
- Host Site Project Management
- Host Site Technical Experts
- Deployment Project Manager / Coordinator

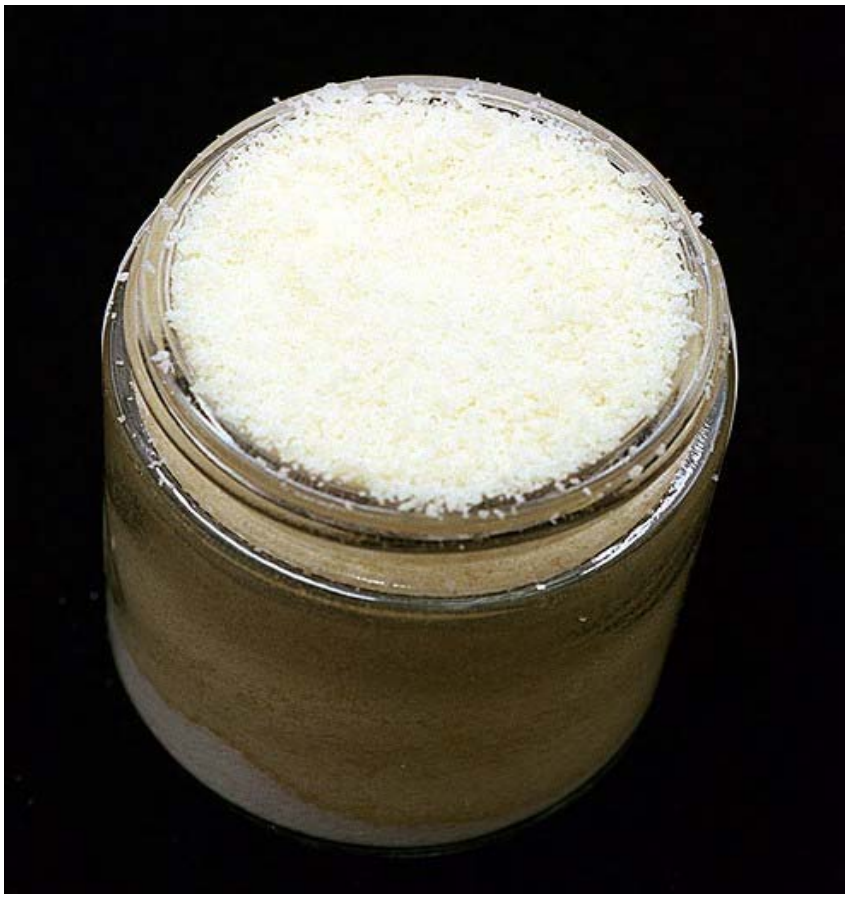

Fig. 1. PetroBond® solidified oil sample.

The program involves the following planned activities:

- Contact Waste Management and/or Project Management at each DOE Site to determine if the site has a need and desire to test Nochar® with a problem liquid organic waste stream.
- Obtain a characterization profile of the sludge / solution to be treated at the site.
- Evaluate the waste stream to confirm applicability of the technology.
- Draft a brief project plan for each site to be reviewed by all cognizant representatives.
- Obtain representative samples of the waste in question from the site, for use in the deployment of Nochar® to that site, and prepare the site facilities for deployment.
- Train the site personnel in the use of the technology under the guidance of the technology representative, who will also assist the site in the first application of the technology in a bench test verification, and then in a drum/large container size demonstration, so that at least one large scale container of waste is successfully solidified.
- Examine and/or test the solidified sludge at each site, as required, in order to ensure that the (WAC) for the intended disposal facility will be met. In some cases a visual examination after solidification may suffice. In other cases, TCLP, total metals analysis, or other testing may be required by the site (5).
- Prepare a summary report to document the application and success of each EM-50 deployment of demonstrated technology to a site.

The Nochar Technology Deployment Program pays for its involvement with the host site, including providing the Nochar test product. The Host site pays for its own site costs and subsequent testing costs.

Deployment projects completed or in progress to date include: disposal of tritiated mixed waste oil at MEMP (est. 50,000 Ci inventory), solidification and transport of PCB / TRU oil at MEMP, solidification of (HB-40) organic coolant LLRW at Whiteshell Labs- Canada for safe store application, solidification of TRU oil at Rocky Flats for disposal at WIPP, motor oil treatment at Envirocare–Utah, stabilization of multi-phase vacuum pump oil at Sandia National Lab, solidification of radioactive contaminated Purex solution at Savannah River Site, and Ashtabula Environmental Management Project (AEMP) where LLRW was stabilized and buried.

Sites where continued testing and/or study are taking place include: Savannah River Site, Princeton Plasma Physics Lab, Los Alamos National Lab, Sandia National Lab, Idaho National Engineering & Environmental Lab, Battelle Labs Columbus, Hanford, Portsmouth DOE, and Chalk River Ontario.

RFETS SOLIDIFICATION TESTS

Testing began with samples of Texaco R/O 32 oil that has been used for decades as pump oil lubricant at Rocky Flats Site. Bench tests were conducted at Nochar headquarters in Indianapolis, Indiana over a two week period with "virgin" oil to determine initial material bonding ability. These tests showed good success with compatibility between the oil and polymer. Based on the success of these initial tests, plans were made to proceed with three TRU oil waste streams. These included:

- Methanol based waste with various other organic contaminants (such as cyclohexane).
- Mixed organic waste (a composite of various lab wastes).
- Contaminated used pump oil waste.

The current inventory of TRU oils is in one-gallon bottles. These bottles are stored in various buildings around the site. This inventory is expected to increase as decontamination and decommissioning proceed at the former Rocky Flats Plant. The inventory of Organic and Sludge Immobilization System (OASIS) drums is about 550 (55 gallon) drums. (OASIS) produced the drums of IDC 801 waste by cementation of TRU oils, but never met WIPP disposal criteria for final waste forms. Disposition of the TRU oils and the IDC 801 drums is critical to the building 776 / 777 and 771 / 774 closure project, and the CY2005 Site Closure Plan.

Benching testing was conducted in a glove box with 21 stainless steel cans of Nochar solidified waste being generated. These cans were stored in building 371 and went through a 38 day incubation period for full scale gas generation testing as mandated by WIPP standards. After this, the solidified containers were placed in small-scale (can size) gas generation testing units and tested at elevated temperatures. Upon completion of this test, the samples were transferred back to a drum for continued gas-generation testing of the drum. Upon reaching a 90 day period, headspace gas sampling was performed as required by WIPP. Samples were also submitted for TCLP, and easily met Land Disposal Restrictions (LDRs) for sequestering heavy metals as mandated by burial sites such as Nevada Test Site (NTS) (6).

PetroBond® Demonstration Status

Batch 1 PetroBond tests showed excellent results with testing on TRU production oils / organic liquids. (Table – I). Oils tested ranged widely in Pu, metals and organic solvent concentrations (primarily non-flammable VOC, with small amounts of flammable VOC). The oil to Nochar (polymer) ratios were also

varied greatly. Testing with PetroBond and granular activated carbon (GAC) is ongoing. Cold surrogate testing was conducted at a qualified off-site lab. Cold tests with diesel fuel showed reduction of the % LEL in drum headspace was reduced to 7% with petrobond and further reduced to 0% LEL with GAC. Batch 2 petrobond tests were performed with a wide array of oils and organics from RFETS labs. A wide range of Pu, metals, aqueous co-contamination and miscellaneous contaminants existed in this batch.

Batch 1Tests include:

–TCLP/metals	Passed
–H2 Generation - drum (room temp)	Passed
–H2 Generation - can (room temp)	Passed
–H2 Generation - can (142 F)	Passed
–Flammable VOC/500ppm - can (room)	Passed
–Flammable VOC/500ppm - can (142 F)	Passed*

Batch 2:

–Being Transferred to Building 371 for H2 Generation and Flammable VOC tests

*High concentrations of non-flammable VOCs in Headspace, will be tested with GAC again

Fig. 2. PetroBond® solidified TRU oil in glovebox at RFETS

Table I. Original Sample Testing Results

Run #	Can/Sample ID # (Material Out)	Nochar Formula #	Free Liq. 12 days post treat	Room Temp Gas Gen Rate	Elevated Temp Gas Gen Rate	TCLP Metals Results	HSGS 500ppm flam
1	*773464**	*A610*	*No*			Passed	
2	*773471***	*N990*	*No*			Passed	
3	Z19216	N990	No				
4	Z19206	A610	No				
5	Z19215	N990	No	9.40E-11	4.31E-11		Passed
6	Z19209	N990	No	1.11E-10	2.98E-10		Passed
7	Z19202	N990	No	1.47E-10	5.29E-10		Passed

*Lab Sample #N0072-019

** Lab Sample #N0072-024

CONCLUSION

Organic waste solidified recently at RFETS with Nochar PetroBond® has met preliminary burial site requirements for TCLP, H2 generation and flammable VOC, thus preparing waste of this type for initial shipment to WIPP . This ready-to-use, "off the shelf" technology, has shown great ALARA benefits with ease of use in highly hazardous environments as found at Rocky Flats. Nochar polymer technology has shown superior cost effectiveness and return on investment also. Data generated from the testing of this technology at RFETS under the NTDP, shows great promise in providing a solution for this complex waste handling issue at RFETS and throughout U.S. DOE Facilities.

REFERENCES

1. Waste Isolation Pilot Plant (WIPP) – Waste Acceptance Criteria (WAC).
2. Nochar® Inc., Indianapolis, Indiana – Product literature "Nochar PetroBond® Absorbent Polyer Oil Solidification Agent".
3. MSDSs, Nochar® PetroBond A660, A610, N990 polymers.
4. Published ITSR, "Nochar Solidification Technology", DOE/EM –0598.

5. U.S. Department of Energy, Nevada Operations Office, "Approval to Ship Mound Plant Low-Level Radioactive Waste to the Nevada Test Site", December - 1999.
6. Paint Filter Liquids Test, EPA Method 9095, 40 CFR 264.314 & 265.314.