PETRO BOND® OIL SOLIDIFICATION POLYMER: HELPING TO SOLVE OIL WASTE PROBLEMS IN THE DOE COMPLEX

Under the Guidance and Funding of the
Large-Scale Demonstration and Deployment Project
(LSDDP) at the DOE Mound Facility

Ward G. Brunkow, The Chamberlain Group, Ltd.
Dennis R. Campbell, Nochar, Inc.
Donald R. Krause, BWXT Services, Inc.

ABSTRACT

The DOE Office of Science and Technology, Deactivation and Decommissioning Focus Area is sponsoring a Large-Scale Demonstration and Deployment Project (LSDDP) at the DOE's Miamisburg Environmental Management Project (MEMP), commonly known as the Mound Site. The goals of the LSDDP are to:

- Demonstrate existing developed technologies that are unproven and/or unknown with respect to tritium Decontamination and Decommissioning (D&D) applications
- Determine whether the technologies are superior, in safety and/or cost, to current "baseline" technologies, and
- Communicate the demonstration results in such a manner that potential end users of the demonstrated technologies can easily decide whether or not to adopt these as "baseline" tools for performing future D&D work.

This third objective is the focus of this paper, using the results of the PetroBond® demonstration. Substituting an innovative technology that is a safer, cheaper, faster, or better alternative into a baseline project is not only a prudent idea but also something that DOE sites will surely embrace in order to reduce cost and schedule.

The LSDDP at Mound has demonstrated two technologies for solidifying fluids/sludges: (1) WaterWorks Crystals, to solidify water-based fluids, and (2) Nochar N-990 PetroBond® to solidify oils and oil-based fluids, such that the solidified materials meet the waste acceptance criteria at the final disposal facilities. In the LSDDP, both WaterWorks Crystals® and Nochar® PetroBond® completed bench scale tests and full-scale demonstrations and are being deployed for operational use at Mound. The project focus has now become to accomplish additional deployments at DOE sites that have immediate need for treatment and disposal of waste oils and aqueous fluids/sludges.

It is the intent of this project to obtain descriptions and characterization profiles of the sludge or waste stream to be treated at each site, then to evaluate the target solution to confirm applicability to the technology already demonstrated at Mound. After evaluation, the project will assist the site in the first

application of the technology, at a bench scale and then in full scale, in order to provide at least one drum of successfully solidified waste. The end product of these deployments is characterization data and a summary of conclusions on the sludges that will inform other facilities of the safety and viability of the product. **This paper will discuss primarily the oil solidification deployments.**

INTRODUCTION

In August of 1999, the U.S. Department of Energy Mound Environmental Management Project (DOE-MEMP) Office and BWXT of Ohio, Inc. (BWXTO) conducted a demonstration utilizing Nochar Petro Bond® polymer oil absorbent. The intent of the demonstration was to compare the Nochar Petro Bond® agent with the baseline options for disposal, which are incineration, long term storage for decay, and existing organic solidification agents. There is a critical need at the DOE-MEMP for a simple and effective disposal method for tritiated oil, preferably something that will meet waste acceptance criteria (WAC) requirements for Nevada Test Site (NTS). Vacuum pumps that supported glove boxes used over the past several decades produced reservoirs of tritiated and heavy metal laced mixed waste oils as defined by the Resource Conservation and Recovery Act (RCRA). This critical need is compounded by the fact that the Mound Site is now shut down and undergoing remediation, and tritiated oil disposal is on the critical path work schedule.

The Mound demonstration was conducted in three phases, with Phase III being solidified tritium contaminated mixed waste oil in a 22 gallon DOT poly shipping container. This container with solidified Nochar® is illustrated in Figure 1. In all phases of the demonstration, the Nochar® agent formed an acceptable solidified mass with waste oils. The Toxicity Characteristics Leaching Procedure (TCLP) values were found to be several orders of magnitude below burial site limits on specific metals. The product proved to be very easy to use and required no agitation or mixing, thus facilitating safety and ALARA measures. The material easily absorbed the nine gallons of oil used in the demonstration within 1 hour, thus providing a quick and efficient stabilization agent. In a restrictive environment that will not allow for mixing and/or other typical solidification steps, this agent would prove to be the ideal material. The product is safe, easy to use and cost effective, and has the potential to produce considerable savings over other disposal methods. A few months after the conclusion of the demonstration, the Mound Waste Management Department received a letter of approval from NTS, waste profile Number AMDM-000000032, for "Solidified Oil Using Nochar PetroBond® Stabilization Agent". Upon receipt of this approval, the Mound LSDDP concentrated on the final stage of its mission, that is, at the conclusion of a highly successful demonstration, taking measures to deploy this technology wherever useful throughout the DOE to solve complex problems and achieve cost savings.

Fig. 1: Solidified Oil in Burial Liner – Top View

At the time of this writing a number of sites have expressed an interest in using WaterWorks Crystals® and/or PetroBond®. Deployments with Nochar® have been conducted at five sites. The Mound Site is considered the first deployment project. Additional sites with which the Mound Sludge Initiative Deployment project is presently interacting include:

- AEMP-Ashtabula, OH - has oils slightly contaminated with uranium along with other LLW oils that also need disposition. These containers include several types of problems: kerosene butyl-phosphate mixtures, lube-oil based liquid, several grease-based compounds, and water/oil mixtures in numerous containers. Another container has various oils with RCRA metals. Toxic Substance Control Act (TSCA) incineration is the only identified path for disposition of many of these containers.
- West Valley, NY - has about 2500 containers of water-based sludge, of which roughly two-thirds were partially stabilized from previous attempts. A proven technology needs to be deployed and confirmed acceptable, in order to establish this waste stream's final disposition.
- Sandia - has thirty-five 20-gallon containers with metals slightly above regulatory limits, and varying amounts of tritium contamination. Incineration has been tried but without much success in cost reduction.

- Princeton Plasma Physics Laboratory - has about 30 gallons of slightly contaminated vacuum pump oil that needs to be solidified for disposal.
- Rocky Flats - has expressed interest in both WaterWorks and Nochar®. The site has about 43,000 gallons of aqueous and non-aqueous solutions.
- Savannah River - has expressed an interest in various areas, particularly PUREX and tritiated oils.
- INEEL - has 2000-5000 gallons of kerosene base medium that is radioactively contaminated.
- Los Alamos – has numerous small quantities of various legacy wastes that will need disposal.
- Fernald - has 3000 gallons of PCB radioactive waste RCRA oils that will need disposal.
- Pantex Site – has a quantity of radioactive and chemically contaminated aqueous sludge mixture that was accumulated during a mercury contaminated spill.
- Laboratory for Energy Related Health Research (LEHR) – low-level aqueous based tank sludges.

SLUDGE INITIATIVE PROGRAM

The purpose of the Sludge Initiative Program is to deploy, to numerous DOE sites, two technologies that were demonstrated and deployed at Mound through EM-50's Large-Scale Demonstration and Deployment Project (LSDDP). In the LSDDP at Mound, both WaterWorks® and Nochar® completed bench scale tests and full-scale demonstrations and are presently being deployed for operational use at the Mound facility. The intent is to accomplish additional deployments at DOE sites that have immediate need for treatment and disposal of waste oils and aqueous sludges. The total estimated cost of this project, including target sites' estimated contribution of $90,000, is approxiately $250,000 at this time.

The program involves the following planned activities:

- Obtain a description and characterization profile of the sludge or solution to be treated at the site.
- Evaluate the target sludge to confirm applicability of the technology already demonstrated at Mound.
- Draft a brief project plan for each site, to be reviewed by the LSDDP Integrating Contractor (IC) Team, by the site, and by the technology representative.
- Obtain representative samples of the sludge in question from the site, for use in the deployment of WaterWorks or 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 drum or 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 Waste Acceptance Criteria 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.
- Prepare a summary report by the LSDDP Lead Test Engineer to document the application and success of each additional EM-50 deployment of demonstrated technology to a site.

PROJECT TEAM DESCRIPTION AND RESPONSIBILITIES

Project Management:

Mound Large-Scale Demonstration and Deployment Project IC Team, headed by Don Krause (BWXTO), assisted by DOE Ohio, provides overall project management. Coordination of deployment and site contact conducted by a Consultant with the Chamberlain Group, Ltd.

Mound LSDDP Team:

When provided with the necessary data and information, reviews the waste characterization data for technology applicability, based on testing and experience at Mound. Reviews the draft Project Plan for the new sites. Makes comments and suggestions.

Lead Test Engineer/Technical Representative:

Prepares Project Plan for review by LSDDP team and respective sites. Provides the solidifying agent and works on site at the respective facilities to accomplish training and deployment of the technology; writes a summary report that will assist in further application at other DOE facilities.

Technology Receiving Site:

Provides characterization information on the sludges, obtains samples, prepares facilities, conducts safety evaluations and procedure writing, conducts the deployment on site, works with the technical representative, evaluates and provides testing on the results, provides a data summary of conclusions, ensures site access for the Mound LSDDP Team. Figure 2 illustrates a typical setup of waste stabilization operations at a participant site.

Fig. 2: Waste Oil Stabilization Operations at a Participant Site

DEPLOYMENT SITES VISITED

Presently, five DOE sites have been oil waste participant sites. Of these, three have achieved successful deployments. Two sites are pending receipt of final results/data. A brief summary of the work completed and successes achieved follows:

DOE Mound – Miamisburg, OH:

Approximately one curie of tritiated mixed waste lubricants was successfully solidified and shipped to NTS based on the high performance of Nochar® in meeting physical and analytical guidelines. Superior TCLP results are given in Table I. The remaining inventory of > 50,000 curies of mixed waste oil remains at the site. Operations are being planned and conducted at this time to collect all remaining oil throughout the plant and prepare for waste shipment to meet the goal of decommissioning by 2005.

Table I: Mound Solidified Mixed Waste Oil TCLP Analysis – Quanterra Labs

Analyze	Physical Form	Result	Units	Reg Limit (mg/L)	Dilution	Method	SW-486
Mercury	Solid	.00092	mg/L	*0.2	4	TCLP Metals	EPA 7470
Arsenic	Solid	ND	mg/L	5	4	TCLP Metals	EPA 6010
Barium	Solid	ND	mg/L	100	4	TCLP Metals	EPA 6010
Cadmium	Solid	0.014	mg/L	1	4	TCLP Metals	EPA 6010
Chromium	Solid	0.0047	mg/L	5	4	TCLP Metals	EPA 6010
Copper	Solid	0.12	mg/L		4	TCLP Metals	EPA 6010
Lead	Solid	0.29	mg/L	5	4	TCLP Metals	EPA 6010
Selenium	Solid	ND	mg/L	1	4	TCLP Metals	EPA 6010
Silver	Solid	ND	mg/L	5	4	TCLP Metals	EPA 6010
Zinc	Solid	0.071	mg/L		4	TCLP Metals	EPA 6010

Note: baseline values for untreated mixed waste oil were comparable to bench test I and II non-treated oil. Worst case metals analysis was approximately 7.2 mg/L - Mercury.

***** Current Nevada Test Site (NTS) LDRs for Hg limit it to 0.025 mg/L.

Princeton Plasma Physics Lab (PPPL) – Princeton, NJ:

Oil solidification operations have been started on approximately 30 gallons of radioactive contaminated duoseal vacuum pump oil. Final analytical results are pending.

Ashtabula Environmental Management Project (AEMP) – Ashtabula, OH:

Bench test samples of radioactive contaminated waste oil with up to 50% water content were successfully stabilized. Thirty gallons of radioactive contaminated PUREX solution were successfully stabilized. These tests verified that stabilization with Nochar® would meet shipping and burial requirements for these waste profiles.

Sandia National Labs:

Approximately 20 gallons of radioactive mixed waste oils and lubricants were bench tested and solidified. This batch of waste oil represented < 1 curie and the deployment to this site was found to be successful. These waste oils included light phase vacuum pump oils, dark phase vacuum pump oils, hydraulic fluids, and a high viscosity vacuum pump oil. In all cases (except for planned failures), the Nochar® deployment met all physical and analytical requirements to meet waste acceptance criteria for disposal at Sandia's host burial site and showed acceptable TCLP results. Sandia has a milestone dates to dispose of several hundred gallons of mixed waste oil including problem or orphan waste on site. This deployment could possibly help them achieve the required scheduled completion dates.

Savannah River Site:

A deployment was recently conducted at SRS dealing with their problem waste stream of radioactive and chemical contaminated PUREX solution. This is a large waste disposal problem for SRS: incineration moratoriums threaten to eliminate that option soon and present inventories reflect 40,000 gallons of legacy purex waste. At a recent Citizen Advisory Board (CAB) meeting in Aiken, SC, an additional 113,000 gallons of spent solvent still in process was identified as a future waste disposal project. Physical results of recent bench tests showed a high amount of success with Nochar® easily producing a high integrity "rubbery" compound. These samples were recently irradiated up to 40 million Rads with a draft report showing acceptable results at this time. Analytical results are pending completion of submitted TCLP samples yet. Nochar® at this time promises to provide a much needed solution to these enormous waste disposal tasks including the disposal of potential large inventories of tritiated mixed waste oil in the future.

Rocky Flats Environmental Technology Site (RFETS):

A deployment to RFETS has been tentatively scheduled the first week in December-2000. The site has a wide range of complex waste disposal issues including sizeable orphan waste inventories. Work plans presently include bench tests of methanol based waste with various organic contaminants, mixed organic composite lab waste, and used pump oil waste that could include Pu / Am / U constituents in addition to normal listed RCRA identified metals.

CONCLUSION

The intention of identifying and deploying an innovative and beneficial technology such as Nochar® has been a huge success at the LSDDP Host Site – Mound DOE. The mission of the LSDDP is simply stated in the project title, Large Scale Demonstration and "Deployment". The response within the DOE complex to work together in solving significant waste issues has been excellent. All sites and facilities in need are encouraged to participate in this deployment initiative. We believe the deployment setup, procedures, and results, as well as the data obtained from this technology, will aid in providing a solution for complex waste handling issues for the rest of the DOE complex, and possibly, for the entire Nuclear Industry.

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Technology Contacts

Specific questions regarding this solidification product should be directed to:

Mr. Dennis Campbell, Vice President
Nochar®Environmental Protection Products
8650 Commerce Park Pl. – Suite (K)
Indianapolis, IN 46268
(317) 613-3046
nochar@in.net

Specific question regarding demonstrations/ deployments should be directed to:

Ward G. Brunkow
Lead Test Engineer
DOE Mound Facility
1 Mound Rd. – P.O. Box 3030
Miamisburg, OH 45343
(937) 865-3826
brunwg@doe-md.gov

Specific questions regarding the Mound Sludge Initiative Program should be directed to:

Don Krause
Project Manager
BWXT Services, Inc.
P.O. Box 3030
Miamisburg, OH 45342
(937) 865-4501
kraudr@doe-md.gov

Richard Govers
Project Coordinator
The Chamberlain Group, Ltd.
2200 Langhorne Rd – Suite 201
Lynchburg, VA 24501
(804) 528-4365
104563.317@compuserve.com