INNOVATIVE TREATMENT METHODS FOR MIXED WASTE SLUDGE IN THE SODIUM COMPONENTS MAINTENANCE SHOP AT ANL-W

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ABSTRACT

Various facilities at the Idaho National Engineering and Environmental Laboratory (INEEL) have generated 165 drums of Mixed Low Level Waste (MLLW) sludge that could not be sent off site for private sector treatment because of high radiation levels. Treatment of these sludge wastes with a potential to be classified as "no path forward waste" has been conducted by Argonne National Laboratory-West (ANL-W) over the last four years. ANL-W has provided a proven method to test, treat, and dispose of the mixed waste sludge. Treatment and stabilization of aqueous sludge waste is accomplished by solidification via high-shear mixing with clays and cements conducted inside a shielded drum solidification station.

Significant innovation in shielding techniques for 30 gallon and 55 gallon drums has allowed the MLLW to be treated at the Sodium Component Maintenance Shop (SCMS) at ANL-W. The SCMS is Resource Conservation and Recovery Act (RCRA) permitted treatment facility for MLLW identified with waste codes D001 through D011. Each waste stream is different and requires careful planning and implementation of treatment methods to ensure proper treatment and disposal. Meeting the waste acceptance criteria of the disposal facility requires bench-scale test analyses which include thermal cycling, free-liquids testing, and metal immobilization via Toxicity Characteristic Leaching Procedure (TCLP) for particular metals.

Treatment and disposal of mixed waste sludge required a unique facility to handle the waste up to 1000 mR/hr on contact radiation readings. Methods developed include sleeving the drums prior to removal of the sludge, adding additional shielding to the solidification station over pack, configuring a 30 gallon drum inside a 55 gallon drum with steel shot and concrete. All of these techniques helped to reduce worker exposure and facilitate treatment. These innovative measures have allowed SCMS personnel to successfully treat 165 drums of MLLW and meet the waste acceptance criteria of the LLW disposal facility. The procedures to characterize and treat and the configuration of the solidification station for the different waste streams are described in this paper.

INTRODUCTION

ANL-W personnel have successfully treated 165 drums of mixed low level waste sludge at the Sodium Components Maintenance Shop (SCMS) for the INEEL. The 165 drums have been treated during three major campaigns. Each campaign is considered a new waste stream which must be bench scale tested to ensure full scale treatment will result in drums that will meet the LLW disposal facilities waste acceptance criteria. Each campaign resulted in higher radiation readings and as such required ANL-W personnel to change equipment and procedures to reduce personnel exposure. This paper discusses RCRA treatment requirements and ALARA personnel considerations during drum treatment and handling. Meeting RCRA mixed waste underlying treatment standards to facilitate disposal is the

number one concern. This paper describes RCRA and Universal Treatment Standards (UTS) limits for lead and chromium (other characteristic heavy metals applicable to the 165 sludge drums treated at SCMS).

Once a waste stream has been reviewed and approved for treatment at SCMS a 200 ml sample is bench tested (recipe development) using various treatment media. The waste streams described in this paper have been treated with ferrous sulfate to change the valence of the chromium from hexavalent chromium to trivalent chromium. The addition of water allows mechanical mixing of the sludge, clays, and cements associated with the treatment media. If the bench test sample passes the analytical analysis for chromium and lead where the results are less than 0.60 and 0.75 parts per million respectively full scale treatment may begin at SCMS.

Full scale treatment is done in the SCMS Solidification station. There were three types of drum configurations handled in the 165 drum campaign. The first waste stream was sent over in 30 gallon drums over-packed inside 55 gallon drums, the second was in 55 gallon drums, and the third was inside a 30/55 gallon drum fill fabrication layout that contained high density cement and steel shot. Treatment capabilities for each of these configurations will be discussed in detail.

The paper will share the lessons learned from sludge treatment at SCMS in four areas: first, the paper will describe bench scale testing; second, it will define the three types of drum configurations that were handled; third, it will explain the changes to the solidification station and fourth, it will summarize the lessons learned (optimum configuration) to reduce personnel exposure in the future.

Bench Scale Testing

The Resource Conservation and Recovery Act (RCRA) is an environmental law that is used among other things to properly dispose of treated mixed waste (radioactive and hazardous) at a disposal facility. RCRA requires the cradle (time it was generated) to grave (ultimate disposal) management of mixed waste. It was enacted in 1976 to address the issue of how to safely manage and dispose of the huge volumes of industrial waste generated nationwide.

Mixed waste can't be disposed of without proper treatment and land disposal of treated liquid is not allowed. Liquids must be solidified for land disposal. Mixed waste requiring treatment at SCMS typically includes sludge's containing chromium and lead. Sludge's are solidified by adding water (for moisture). They require binding the chromium and lead constituents for land disposal. This is accomplished by adding high-shear clays and cements. Bench top testing uses small amounts of the representative waste stream mixed with the treatment material to simulate treatment. Mixed waste must be treated to meet the universal treatment limits. The Universal Treatment Standard limits for chromium and lead are 0.60 and 0.75 parts per million.

SCMS personnel tested the three waste streams for chromium and lead in their mixed waste. Treated hazardous waste is tested using a chemistry procedure called Toxicity Characteristic Leaching Procedure, which is used to test the waste after treatment. Chromium and lead results that are less than 0.60 and 0.75 parts per million can be properly disposed in a land repository. One hundred grams of treated waste is added to 2000 grams of glacial acetic acid

(using the waste amount and 20 times as much, by weight of acetic acid). The solid treated waste and the acid are tumbled for 18 hours. The acidic liquid is chemically tested and when the results are less than 0.60 and 0.75 parts per million the waste treatment personnel can plan for full-scale treatment to facilitate low level disposal of the mixed waste.

SCMS Treatment of Different Drum Configurations

ANL-W personnel have treated three different kinds of mixed waste sludge in one solidification station shown in Figure 1. The three waste streams differ by their drum configurations.

Fig. 1. SCMS solidification station.

The three configurations of sludge drums treated to date at SCMS Solidification station include a 30 gallon drum over packed inside a 55 gallon drum, 55 gallon drum, and 30/55 gallon drum fabrication filled with high density concrete and steel shot. Each configuration is described below.

30 gallon Drum inside a 55 gallon drum Treatment

The first treatment project consisted of treating 200 gallons of sludge generated from radioactive liquid waste disposal. The waste stream was RCRA characteristic for corrosives and contained underlying hazardous waste constituents for cadmium, chromium, lead, and nickel. The 30 gallon inside a 55 gallon drum was selected by the generator because they had a small area in which to fill containers.

The 30 gallon was removed from the 55 gallon drum using the Annex monorail hoist and the sacrificial drum lifting device was attached to the outside of the 30 gallon drum. The technician bands and tape seals the smaller end of a transfer sleeve (used to mate the drum to the solidification station) to the outside of the 30 gallon drum just below the drum retaining ring and then transferred the drum into the solidification station over pack. The 30 gallon paddle and the sample equipment are placed on top of the 30 gallon lid. All of this work is done with the technician standing next to and over the top of the radioactive sludge. It was the first sludge treatment project and the radiation levels were between 45 and 400 mR/hr at 1" and required ANL-W personnel to considerer As Low As Reasonable Achievable

(ALARA) principles. Drum treatment was quick with the 30 gallon drums and took an average of 2 hours per drum. Radiation readings on the treated drums decreased considerably to between 4 and 90 mR/hr at 1" (because the sludge volume was only 5 to 7 gallons).

55 gallon Drum Treatment

The second treatment project was approximately 1,260 gallons of sludge generated from radioactive liquid waste disposal and characteristic for chromium, lead, and mercury. The sludge also contained underlying hazardous waste constituents for cadmium, silver, cyanides, and methyl ethyl ketones, total PCBs, nickel, and barium. The 55 gallon drum was filled with sludge using the Teledyne radiation detector and the pumping was stopped when the radiation reading was < 300 mR/hr at 1". In this contract the generator used Cam lock fittings when pumping the waste and filling was done outside. Therefore, the drums could not be pre-sleeved; which helps to reduce worker exposure.

The technician prepared this drum for treatment by installing the anti-rotation device on the outside of the 55 gallon waste drum and using the annex monorail hoist and 55 gallon drum lifter. They then lifted the drum into the solidification-station over pack. Next they removed the outer drum-lid retaining ring and installed the transfer sleeve on the outside of the drum. The 55 gallon paddle and the sample equipment are placed on top of the 55 gallon sleeve. This time installing the sleeve was done with the drum inside the shielded over pack reducing personnel exposure. Drum treatment took longer, 2.5 hours per drum. Radiation readings on the treated waste decreased by approximately one half.

30 gallon Drum Inside a 55 gallon Drum with Concrete & Steel Shot

The third treatment project was 400 gallons of sludge generated from radioactive liquid waste disposal and characteristic for cadmium and lead and containing underlying hazardous waste constituents for chromium. The 30/55 Gallon Drum fill fabrication filled with high density concrete and steel shot up to the 2/3 mark between the 30 gallon and 55 gallon drum was effective at allowing higher levels of radioactive sludge to be treated. The average dose rate on the drums was allowed to be less than 150 mR/hr at 1" from vertical midpoint from the drum exterior. The drums could not exceed 1 R/hr at any point without specific approval by ANL-W project personnel. To ensure the bottom of the drums stayed less than 1 R/hr, sodium polyacrylate (SAP) was added to the drums. Suspending the solids as pumped with SAP avoided > 1R/hr hot spots on the bottom of the drums.

The technician prepared this drum for treatment by installing the anti-rotation device on the outside of the 55 gallon waste drum and using the annex monorail hoist and a 55 gallon drum lifter they put the drum into the solidification-station over pack. They removed the outer drum lid retaining ring and inspected the transfer sleeve on the inside of the drum. The 30 gallon paddle and the sample equipment are placed on top of the 55 gallon sleeve. Again the work was done with the drum inside the shielded over pack. Treatment took an average of three hours.

SCMS Solidification Station

The SCMS Solidification Station has been used to treat mixed waste generated at ANL-W and at the INEEL. This paper is focusing on the 165 drums of mixed waste sludge that have been successfully treated by ANL-W personnel using high shear mixing with clays and cements conducted inside a shielded drum solidification station.

The solidification station is used to treat pre-filled containers of sludge. It consists of an enclosure (glove box), a variable speed/position mixer, and a hydraulic lift platform. Containers requiring treatment are placed within a shielded over pack and raised into position under the mixer. The containers are then connected to the solidification station using a bag-in sleeve system. The mixer is operated at varying speeds and elevations within the container to ensure a homogenous mixture using a disposable blade apparatus. Mixed waste, water, ferrous sulfate, and high-shear clays and cements are added as required for treatment based on waste form development. The treated container is inspected for free liquid and a sample is taken. The treated container is then removed from the solidification station by cutting a tapping both ends of the transfer sleeve see Figure 2.

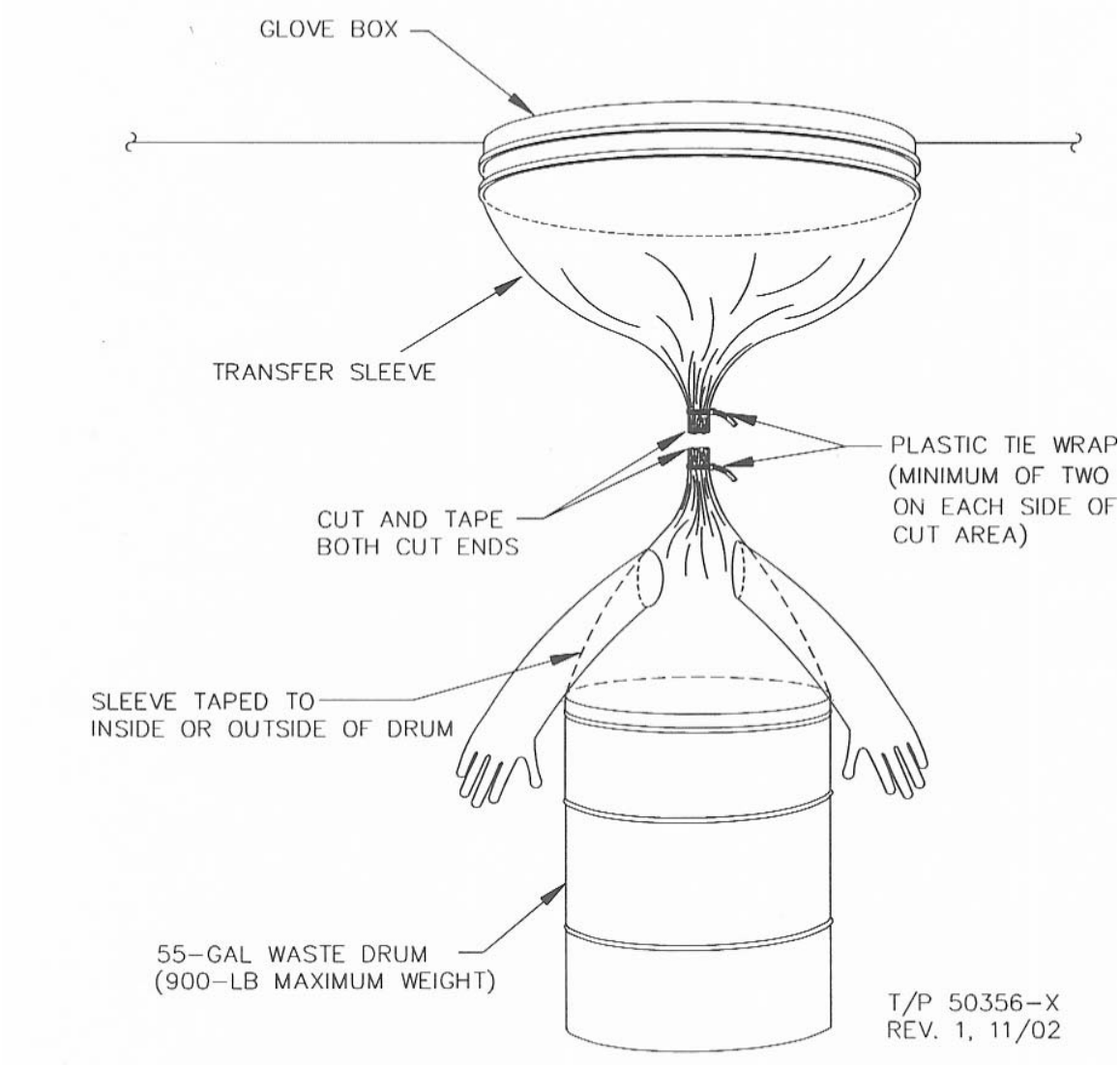

Fig. 2. Pre-sleeved drum.

After treating the first 70 drums it was determined that adding shielding to the over pack pallet shielding assembly was necessary which was accomplished by adding shield "A" and shield "B" to the over pack/ Pallet shielding assembly shown in Figure 3 which added 950 lbs weight for an entire over pack of approximately 2230 lbs.

The ideal solidification set up would be bench testing prior to pumping the waste and using a shielded 30/55 gallon drum fill fabrication filled with high density concrete and steel shot and then installing the sleeve on the inside of the 55 gallon drum and then filling the 30 gallon container with sludge and two pounds of sodium polyacrylate to keep the solids from forming a hot spot. The 30 gallon container needs a quick snap lid like a Tupperware lid to reduce the generators exposure time when containerizing the sludge.

Fig. 3. SCMS Solidification Station Shielded Over Pack.

CONCLUSION

The 40 CFR Part 268.48 treatment standard limits must be met to certify the solid waste as Low Level Waste to ensure that it meets the disposal facilities Waste Acceptance Criteria. The ALARA configuration for treatment of higher radioactive (200 mR/hr to 1000 mR/hr) low level waste sludge is to properly bench test the waste prior to pumping and or digging out the sludge into the waste treatment drum. SCMS technicians have implemented ALARA procedures to ensure they stay within ANL-W exposure limits. Shielding the sludge protects the workers and the best configuration is the 30/55 gallon drum fill fabrication filled with high density concrete and steel shot and then installing the sleeve on the inside of the 55 gallon drum and then pre filling the 30 gallon container with two pounds of sodium polyacrylate to keep the solids from forming a hot spot sludge and then adding the sludge. The 30 gallon container needs a quick snap lid, like a Tupperware lid to reduce the generators exposure time when containerizing the sludge.

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