IMPLEMENTING HEAT-SEALED BAG RELIEF AND HYDROGEN/METHANE TESTING TO REDUCE THE NEED TO REPACK HANFORD TRANSURANIC WASTE

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ABSTRACT

The Department of Energy's site at Hanford has a significant quantity of drums containing heat-sealed bags that required repackaging under previous revisions of the TRUPACT-II Authorized Methods for Payload Control (TRAMPAC) before being shipped to the Waste Isolation Pilot Plant (WIPP). Since glovebox repackaging is the most rate-limiting and resource-intensive step for accelerating Hanford waste certification, a cooperative effort between Hanford's TRU Program and the WIPP site significantly reduced the number of drums requiring repackaging. More specifically, recent changes to the TRAMPAC (Revision 19C), allow relief for heat-sealed bags having more than 390 square inches of surface area. This relief is based on data provided by Hanford on typical Hanford heat-sealed bags, but can be applied to other sites generating transuranic waste that have waste packaged in heat-sealed bags. The paper provides data on the number of drums affected, the attendant cost savings, and the time saved.

Hanford also has a significant quantity of high-gram drums with multiple layers of confinement including heat-sealed bags. These higher-gram drums are unlikely to meet the decay-heat limits required for analytical category certification under the TRAMPAC. The combination of high-gram drums and accelerated reprocessing/shipping make it even more difficult to meet the decay-heat limits because of necessary aging requirements associated with matrix depletion. Hydrogen/methane sampling of headspace gases can be used to certify waste that does not meet decay-heat limits of the more restrictive analytical category using the test category. The number of drums that can be qualified using the test category is maximized by assuring that the detection limit for hydrogen and methane is as low as possible. Sites desiring to ship higher-gram drums must understand the advantages of using hydrogen/methane sampling and shipping under the test category.

Headspace gas sampling, as specified by the WIPP Waste Analysis Plan, provides the sample necessary for hydrogen/methane analysis. Most Hanford drums are not equipped with a filter

through which a headspace gas sample can be obtained. A pneumatic system is now used to insert "dart" filters. The filters were developed by the vendor and approved for WIPP certification at the request of the Hanford Site. The same pneumatic system is used to install septum-type sample ports to allow the headspace to be sampled. Together, these steps allow the Hanford Site to avoid repackaging a large percentage of drums, and thus accelerate certification of waste destined for WIPP.

INTRODUCTION

Since 1970, approximately 37,400 suspect transuranic (TRU) waste containers — mostly 55-gallon drums — were placed into retrievable storage at the Hanford Site. Hanford is retrieving these drums from their underground storage locations and preparing them for shipment to WIPP. Because these containers were packaged before the WIPP waste acceptance criteria were developed, the waste, in most cases, does not meet current criteria. Some of the commonly encountered problems include the following:

- Lack of a WIPP-approved filter
- Inability to sample headspace gas
- The presence of heat-sealed bags in the packages
- Drums that are dimensionally off-specification (too tall or too large diameter)
- Multiple layers of confinement that make decay heat limits difficult to meet.

In addition, due to their age, the drums often show signs of problems with the container or the gasket integrity. Figure 1 shows the way drums are being stored after they have been retrieved.

Fig. 1. Retrieved drums are stored indoors on pallets.

One solution to all of these problems is repackaging the drum into a container that meets all of today's requirements. However, repackaging is time consuming and expensive, and does not meet the principle of maintaining exposure to radiation as low as reasonably achievable (ALARA).

The Hanford TRU Program has recently implemented several innovations that help resolve many of the above issues, making the waste shippable without repackaging. This paper describes these recent advances in the waste-certification program.

FILTER VENTS AND SAMPLE PORTS

For TRU waste containers to be shipped to WIPP, they must be vented using a WIPP-approved filter. Thousands of Hanford's TRU waste drums generated between 1970 and the late 1980s were packaged either using a Hanford vent clip, which provided venting of the container, but is not an approved venting method, or with no vent at all.

Nuclear Filter Technology (NFT)[a] developed a dart system for inserting filters and sample ports into the top of a 55-gallon drum.(See Figure 2) This system uses compressed air and a remotely operated system to drive the filter or sample port through the steel drum lid. The Dart filter sample port penetrates the drum lid with an aluminum bronze housing, to prevent sparking. The sharp point falls into the drum upon entry, thus providing either a filtered opening for safely venting gases or a sample port for sampling the headspace gas. The darts can be used on lids up to 0.068 inches thick. To make the dart system successful at Hanford, a number of obstacles needed to be overcome.

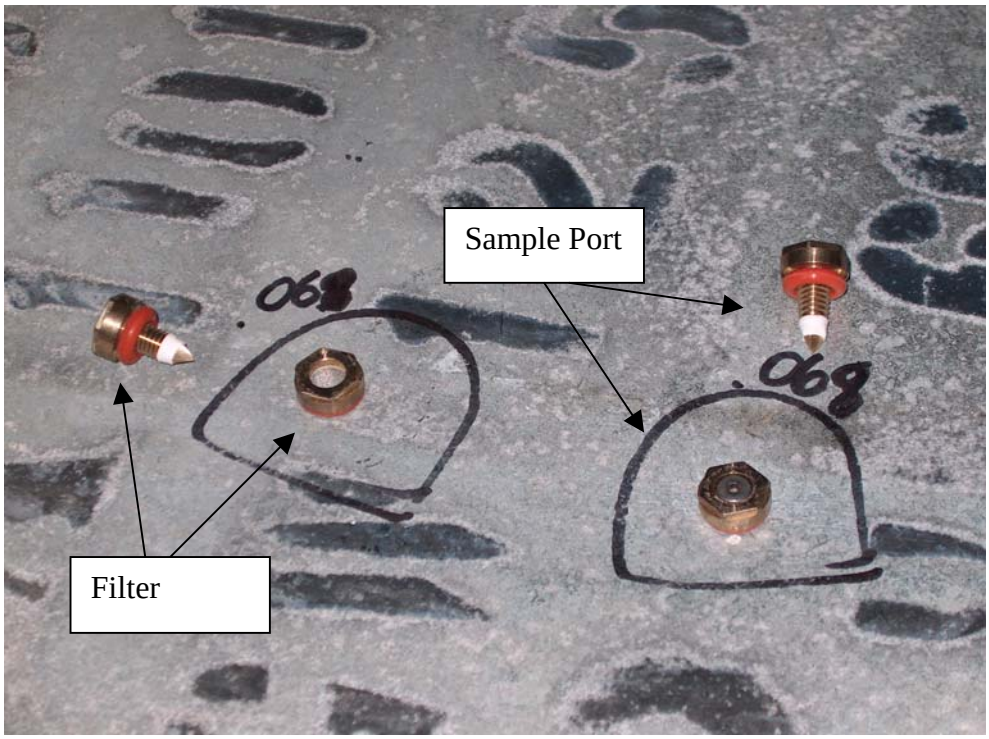

Fig. 2. Dart sample ports and filters as used at Hanford.

First, none of the dart filters were approved filters for shipment to WIPP. At the request of the Hanford TRU Program, NFT performed diffusivity testing on their dart filter, and subsequently qualified the filter under the WIPP program. The second issue was installing the darts into the drum lids. These drums were manufactured over two decades, and the thickness of the lids varies considerably. This inconsistency in lid thickness is significant because the operating pressure of the dart mechanism is based on the thickness of the drum lid. Reliable methods are necessary to determine the thickness of drum lids.

Numerous tests on the thickness of the drum lids were done using an ultrasonic micrometer. These tests showed that thickness could even vary spatially on a single drum lid. Because many drums were too thick for the design pressure of the dart system, NFT redesigned their filter and sample port darts to allow them to penetrate the thicker lids. Figure 3 shows a drum lid that was used for many of these tests.

Fig. 3. Many tests were conducted to insure that the Dart system could penetrate the lids.

Repackaging is no longer required for drums that originally lacked a filter or sample port, as a result of this testing and the efforts of Hanford and NFT personnel to get the dart filter approved and to perfect the filter and sample port installation methods. The Hanford TRU Program is currently darting and sampling approximately 80 drums per week, with plans to nearly double the throughput in 2005.

HEAT-SEALED BAG RELIEF

Much of the Hanford waste comes from processes that used a heat-sealed polyethylene or polyvinylchloride bag when packaging glovebox waste. This bagout method provided excellent contamination control; unfortunately, the heat sealed bags violated the WIPP prohibition on sealed containers greater than four liters in volume. Real-time radiography cannot verify whether the bags are heat sealed or not. Drums from these processes were guilty by association. Prior to heat-sealed bag relief, all such drums were processed through a glovebox where the bags were slit to render them compliant.

The DOE's Carlsbad Field Office (CBFO) recognized Hanford's dilemma based on a similar situation at Argonne National Laboratory East. Washington TRU Solutions was asked to develop changes to the TRAMPAC that would state the conditions under which heat-sealed bags would be allowed. Since sealed containers are prohibited based on the potential for hydrogen to accumulate inside, the critical parameter in approving heat-sealed bags became the surface area of the bag, and the ability of hydrogen to permeate through the bag. Hanford personnel developed extensive knowledge about the bagout process: mocking up a typical bagout port and typical waste items, measuring the distance between seals, and determining the surface area of the sealed bag.

Calculations performed for TRAMPAC revision 19C show that the typical Hanford heat-sealed bag, with a surface area of more than 390 square inches, is acceptable for shipping, because it no longer meets the definition of a WIPP-prohibited article (CH-TRAMPAC, Section 2.8.1). While these calculations were derived based on specific Hanford waste, the relief for heat-sealed bags larger than 390 square inches is available for any waste destined to WIPP. The specifics can be found in Appendix 6.13 of the CH-TRAMPAC.

In just the next two years, the Hanford Site will process approximately 6,000 drums that potentially contain heat-sealed bags. A rough estimate for the cost to remediate a drum in the glovebox is $1,000 per drum. Since each of these 6,000 drums potentially required being remediated in a glovebox, the cost avoidance over the next two years is as much as $6M. Further, thousands of drums of a similar pedigree will be processed after 2007, resulting in additional cost avoidance.

HYDROGEN/METHANE TESTING

The TRAMPAC imposes limits on decay heat for TRU waste destined for disposal at WIPP. The decay heat limits are designed to ensure that hydrogen concentration in the TRUPACT, and the innermost layer of confinement, remains below 5% by volume, assuming the TRUPACT remains closed for 60 days. The TRAMPAC provides two alternative methods for determining decay heat limits, an analytical method and a test method. The analytical method very conservatively assigns a decay heat limit using a constant (4824.42) divided by the effective "G" value (a worst-case gas-generation rate based on the material parameter) and the resistance factor (determined by the number and types of confinement layers). The "G" value and resistance factor are assigned to a waste type by WIPP during TRUCON code approval. Due to a

combination of gram-loading and multiple (up to six) layers of confinement, a majority of Hanford drums exceed the decay heat limit for the analytical method.

The test method allows a less conservative calculation based on the results of head space gas sampling. The test method determines the gas/VOC concentrations in the innermost layer based on the measured concentrations in the headspace. Initially, using the test method failed to qualify all the Hanford waste because the detection limits on hydrogen and methane were originally set too high. Hanford's analytical laboratory increased the sensitivity of the analysis, allowing the detection limit to be lowered, and thus allowing the qualification of additional waste.

In the next two years, Hanford TRU Program will process approximately 4,000 drums that exceed the decay heat limit based on the analytical category. Implementation of hydrogen/methane testing and use of the test category will allow these drums to be qualified without repackaging to reduce the layers of confinement. Again, using a rule-of-thumb figure of $1,000 per drum for glovebox repackaging yields a potential cost avoidance of $4M over the next two years, with additional savings in the years to follow.

CONCLUSIONS

Taken together, the innovations associated with the dart filter/septum, the heat-sealed bag relief and certification under the test category allow thousands of waste containers to be shipped to WIPP without the need for hazardous and expensive repackaging.

REFERENCES

1. TRUPACT-II Authorized Methods for Payload Control (TRAMPAC), Washington TRU Solutions, LLC, Carlsbad, NM, Revision 19C, April 2003.

2. Contact Handled Transuranic Waste Authorized Methods for Payload Control (CH-TRAMPAC) Washington TRU Solutions, LLC, Carlsbad, NM, Revision 1, July 2004.

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