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WHITEPAPER

A Simple, Revolutionary Approach to Waste Packaging Utilizing Proven Technology

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Historically, removing hazardous waste from gloveboxes involves the use of bags as the primary containment method. This method can prove tedious, repetitive, and time consuming to ensure the process follows all safeguards required to contain the waste and mitigate any breach of containment. Layers of bags, yards of tape, and multiple filters are added to the waste stream in order to transfer the hazardous waste from the glovebox safely into the drum package. Then, finally, it can be shipped and disposed of.

The process to cut, tie, and tape each bag for disposal involves manual effort by multiple operators. Following Administrative Safety Controls, good operators are able to safely perform those tasks; but, since the bag is the only confinement layer, incidents can occur. Operators, in some cases, are also at close proximity to this waste which may increase the risk of radiation exposure. Once the waste is transferred out through these bags, it is nearly impossible to remove packaged waste that may contain higher dosage levels, thus increasing drum disposal costs incurred by the facility. Exceeding the allowable radiation levels, and drums not fully filled, both contribute significantly to excess disposal costs.

Central Research Laboratories (CRL), based in Red Wing Minnesota, has developed the Waste Drum Transfer System (WDTS) building upon the proven technology and containment of the Rapid Transfer Port (RTP) as an alternate, more efficient method of waste transfer. This solution consists of an RTP Alpha port mounted inside a glovebox and Beta assembly unit composed of a drum liner fitted inside a standard 55 gallon drum. The use of the Beta drum liner bypasses the typical use of bags, sleeves or tape

to provide leak tight containment. The process to connect and disconnect a drum from the glovebox is achieved by the self-docking and rotating system controls of the RTP Alpha, all done with only one operator standing in an upright ergonomic position. This system also allows for greater flexibility in available Beta connection options, expanding the overall functionality of the system.

This system can be disconnected and reconnected multiple times to maximize volume containment. This will minimize drum disposal costs and reduce the overall volume of waste output by more efficiently filling the drums. Radiation levels inside each drum can be monitored and adjusted more efficiently by operators utilizing the reconnect option. Minimal As Low As Reasonably Achievable (ALARA) levels are also achievable with this system.

This paper will show how highly efficient packaging and disposal of hazardous waste can be accomplished in a cost-effective manner utilizing the proven RTP technology. Maximized operator productivity and safety, as well as minimized radiation dose exposure, are all attainable through the system's engineered controls.

INTRODUCTION

Typical U.S. methods for removing TRansUranic (TRU) waste from a glovebox entail the use of a plastic bag as the primary containment through what is called a "bagout". Although bagouts are an industry standard and can be performed safely, there have been numerous near misses and exposures to operators and facilities while performing waste removal through bagouts. Successful bag operations require well-trained operators to follow detailed operating procedures. Connecting the bag, removing the old bag stub from the ring, preparing waste items for safe loading, loading the bag, twisting, tying, cutting, and taping the bags is a lengthy and complicated process. In addition to this complexity, the bagout task is often exacerbated by being performed beneath a glovebox, in close proximity to the TRU materials when bagging out to a drum. This makes the ergonomics and ALARA dose aspects of the process unappealing for operators.

The bag-out process can vary somewhat, depending on the application that generates the waste, as well as the type of waste being generated. It commonly requires fully-gowned and respiratory-protected operators to place the actual TRU waste from the glovebox into a vent filtered bag or can to facilitate handling. All sharps must first be taped over to prevent puncture wounds; the bag or can is sealed with tape, passed out into another vent filtered bag, twisted, tied, taped over both cut ends. Then the bag is put into another vent filtered bag inside a drum with a liner in it. By the time the TRU waste makes it into the drum, it is smothered within multiple layers of bags with filters and bulky tied ends.

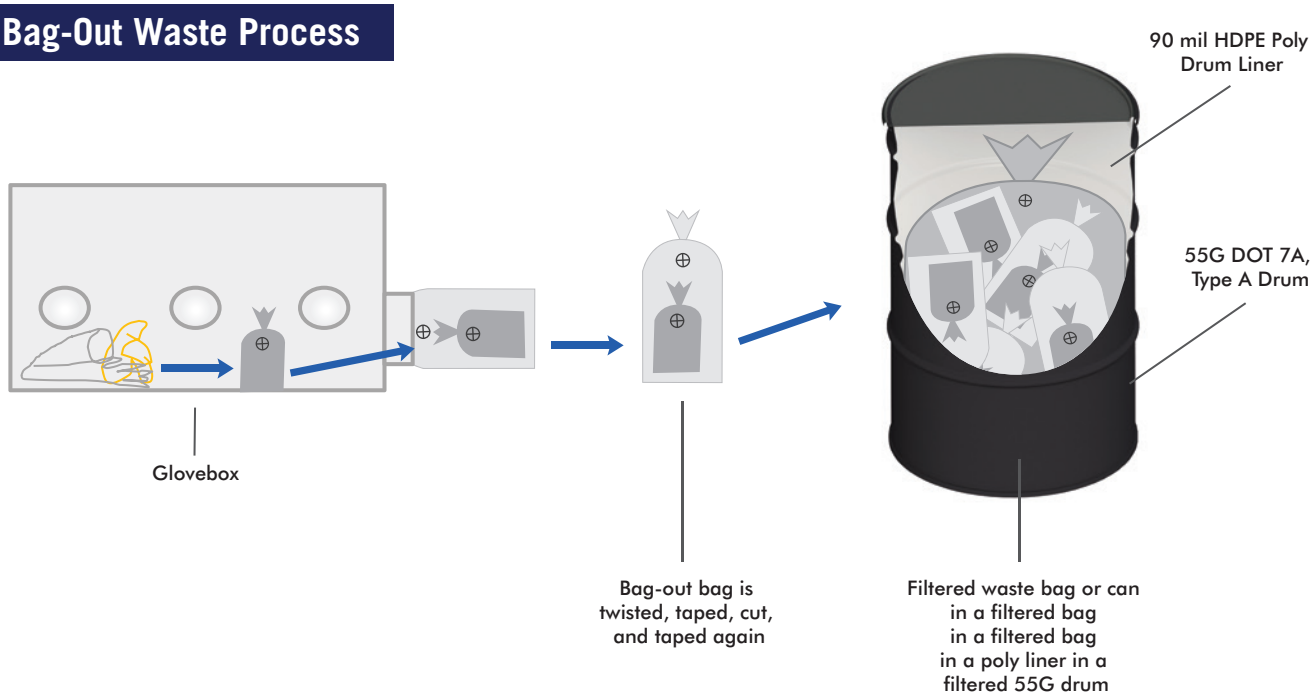
Bag out drums are often only partially filled due to; safety requirements, packaging requirements, and operational requirements. In many cases, taking up 25-30% of the space in the drum (Fig. 1.). The final bag-out process can take 20-30 minutes to perform.

ADDRESSING THE BAG OPERATIONS PACKAGING PROBLEMS

Waste bag-out operations, though they can be performed safely, pose many issues to the TRU waste handling and disposal process. Among these are operator and facility safety, operational time implications, excess waste volume, and increased costs to ship to a waste repository. Though these are complex issues, there is an engineered solution which addresses them all very effectively.

Fig. 1

Bag-Out Waste Process



The Central Research Laboratories Waste Drum Transfer System™

CRL worked with DOE sites to adapt CRL's proven Rapid Transfer Port (RTP) technology to solve the problems in the previous TRU waste handling and packaging process. Replacing current bag operations with Rapid Transfer Port operations greatly improves operator and facilities safety. This engineered operation reduces operator exposure and avoids contamination issues by minimizing and simplifying the transfer operation. A self-docking feature allows the drum to be aligned and docked to the Alpha Port, all with the push of a button. Connecting and disconnecting a container can be achieved in less than one (1) minute by one (1) operator using this system. The RTP transfer solution also eliminates all bag and tape waste from the transfer process by utilizing only drum liners. This significantly reduces operations cost and final TRU waste volume.

The RTP is made up of an interlocking Alpha flange and door on the Glovebox (Fig. 2.), which can only open if the Beta flange and door on the sealed container are fully connected. Once connected, the double doors (Alpha and Beta) can be opened into the glovebox so materials can be safely transferred into or out of the container. The container cannot be removed when the doors are open (due to interlocks) so containment cannot be breached. As these operations can occur with no risk of breaching containment, operators and facilities are fully protected from α and β contamination.

The CRL Waste Drum Transfer System™ (WDTS) is a large version of the CRL RTP Alpha flange coupled with an 18.5 inch opening Beta flange on a 55 gallon drum container designed to fit precisely into a standard DOT 7A, Type A drum during transfer operations (Fig. 3.). The Polyethylene or Stainless Steel Beta drum liner container with a NucFil filter in the Beta door is equivalent to the DOT 7A, Type A 55 gallon drum with a rigid polyethylene liner and lid with a filter having a hydrogen release rate at least equivalent to a 0.3-in. hole.

Re-packaging Legacy TRU Wastes and Continued Packaging of Generated TRU Waste

The CRL Waste Drum Transfer System's drum liner becomes the only confinement layer inside the drum, effectively minimizing the total number of drums containing TRU waste that go to a waste repository in both Legacy waste re-packaging and Generated waste streams.

Fig. 2

Rapid Transfer Port

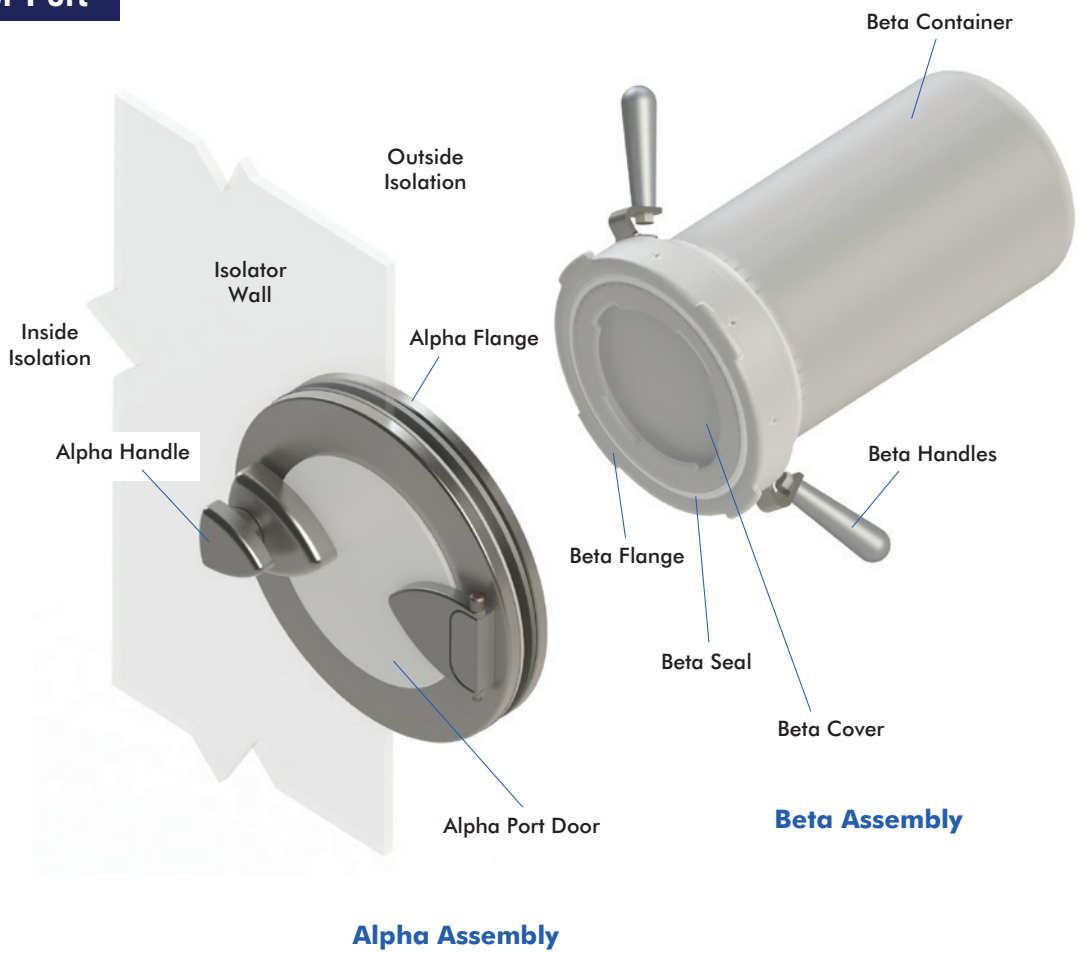
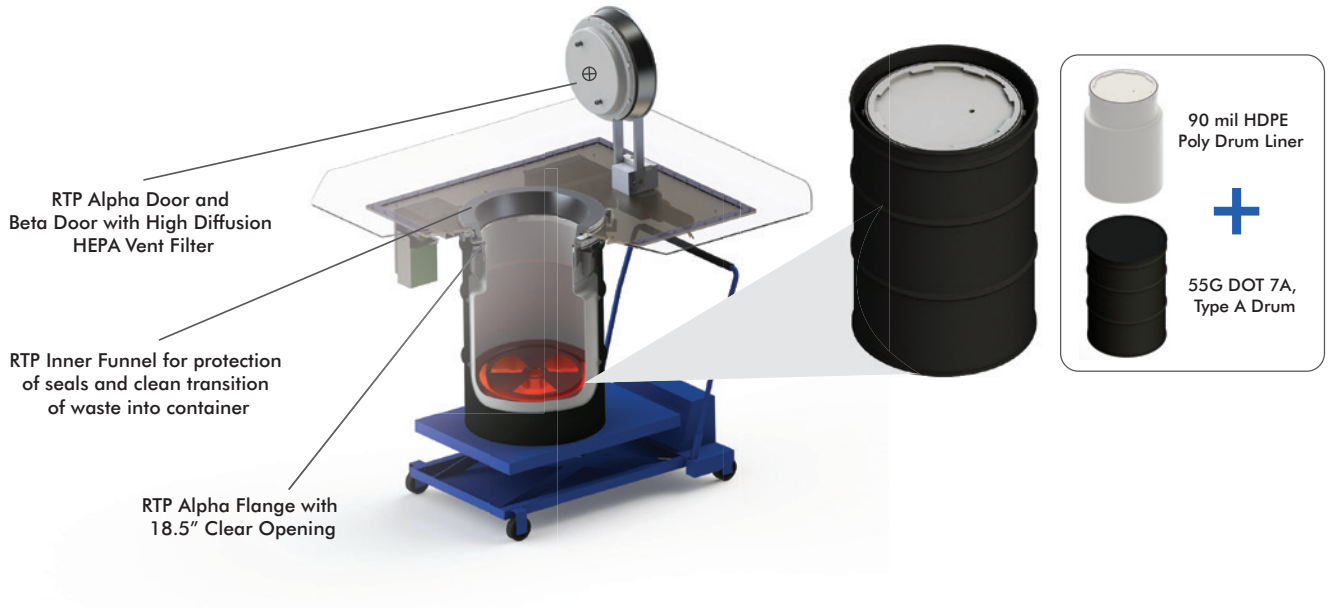


Fig. 3

CRL Waste Drum Transfer System™

An Engineered RTP TRU Waste Solution

To mount directly in Glovebox floor in the lab or used in a Waste Management Area Glovebox



By installing the WDTS into the floor of a repackaging glovebox, old legacy waste drums can be repackaged without the additional material waste of Bag-out operations. In most cases reducing the number of re-packaged daughter drums significantly. For generated waste, the WDTS can either be installed into operating glovebox lines or in a Waste Management area where smaller RTPs (e.g. 270mm dia.) and Beta containers can be used for safely shuttling waste between the operations gloveboxes and the WDTS glovebox in the Waste Management area (Fig. 4.).

Based on eliminating Bag-out operations materials from the waste stream alone, the WDTS effectively decreases the numbers of drums to ship the same TRU waste to a repository. TRU waste can be directly transferred to this final waste drum without the use of bags, tape, or any other added packaging materials. This change could reduce final WIPP waste volume by at least 20% due to the removal of bags and tape from the process. Because the filtered drum liner is the only layer of confinement in the drum, and the liner uses a High Hydrogen Diffusion Coefficient filter, the drum's ability to avoid the buildup of potentially flammable gasses for most waste types is higher than bagged waste drums. Also, the higher diffusivity filter will allow drums to achieve Drum Age Criteria more quickly, thereby minimizing the time between when the drum is closed, and when it can be characterized by Flammable Gas Analysis (FGA). The use of the stainless steel Beta container qualifies packaging of inorganic material to the maximum Decay Heat Limit and Fissile Gram Equivalent allowable for a drum. For higher wattage (i.e. Pu238 contaminated) large item inorganic debris waste, the fissile content per drum can be maximized, greatly reducing the number of drums being processed and sent to a repository.

The WDTS drum out process also allows for more efficient operation processes. A self-docking feature allows the drum to be aligned and docked to the Alpha Port. Only a manual button control system is needed to connect and disconnect the drum to the Alpha Port. Minimal operator effort is needed to attached and dock this system. It can be performed by one (1) operator in a completely upright, ergonomic position in less than one (1) minute. The WDTS also minimizes operator ALARA dose with both time and distance, and no respiration protection is required with this system.

Cost Effectiveness

There are many costs involved in preparing a drum of TRU waste for shipment to a waste repository. Included in these costs are packaging, characterization, VOC testing, RTR review, and documentation to name a few. An estimated variable cost for characterizing a single TRU waste drum for is approximately $13,000, and that cost does not include the fixed facilities or equipment costs. Considering the CRL filtered drum container (~$1,200), cost more than a standard drum liner and filtered bags (~$180), and considering the reduction in quantity of drums entering the TRU waste disposal process of packaging, characterizing, certifying, documenting, shipping, receiving, verification and disposal, the CRL WDTS significantly reduces TRU waste disposal costs.

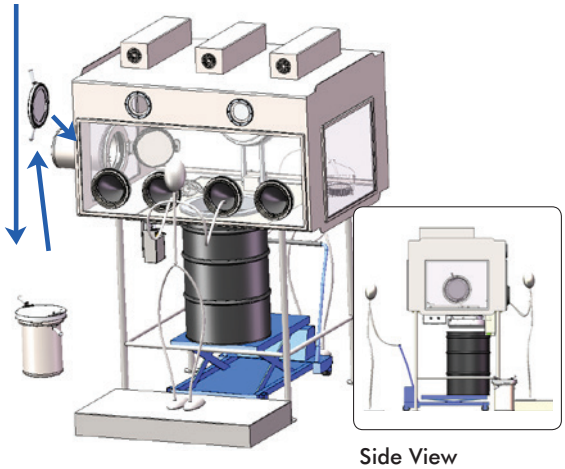
Another important cost advantage to the WDTS is its ability to be reconnected. If CH-TRU waste becomes RH-TRU waste after a more detailed survey, the drum can be docked again and reconfigured. This will further lower drum disposal costs as well as the overall volume of waste output by more efficiently filling the drums.

Fig. 4

Generated TRU Waste Handling

Operations Glovebox

Remote Drum System Glovebox



Side View

1. Shuttle Container is connected to the Operations Glovebox, the Double Doors are opened, and the waste is placed into the container. The Double Doors are closed, the Shuttle Container is removed, and the container's protective cover is installed

2. Shuttle Container, full of waste, is carried to the Remote Drum System Glovebox.

3. The container's protective cover is removed. The False Container is removed from the Remote Drum System Glovebox flange, and the Shuttle Container is connected to the flange.

4. The drum's container is connected to the Drum System flange. The Double Doors are opened to the drum and the shuttle, to complete the fast yet safe transfer of waste from the Operations box to the final Waste Drum.

   Drums can be safely disconnected and re-connected as often as needed until full, Decay Heat Limit, or FGE is reached. Polyethylene and Stainless Steel Drum Containers can be used to maximize the Decay Heat Limit and in turn, maximize drum loading for both Organic and Inorganic Waste types.

CONCLUSION

The allotted space at the U.S. waste repositories is limited. Current bag-out operations inefficiencies are wasting much of this valuable space and the process can put operators at risk. Use of the CRL Waste Drum Transfer System for TRU waste packaging is a major step forward toward helping the USDOE effectively reduce the number of drums required to dispose of its remaining TRU waste within the repositories. Although the WDTS filtered drum containers price is significantly higher than the price of bag-out materials, the WDTS's significant reduction in the number of TRU waste drums to be processed and shipped to the repositories will reduce the National TRU Waste Programs Cost for each eliminated drum. Increased speed and operational safety of the waste packaging process can also provide major cost savings over time. By utilizing this simple, yet revolutionary approach, facilities will be able to more efficiently use the remaining space in a cost effective manner, while maximizing operator productivity and safety.

REFERENCES

1. WIPP Space Faces TRU Waste Disposal Limits; The Volume Reducing Solution-WM-18365, S.D. Chunglo CRL, P. Carson LANL, Mar. 2017

ABOUT THE AUTHOR:

Rob Weber is the Projects and Proposals Manager for Central Research Laboratories (CRL) in Red Wing, Minnesota. He has been with CRL for over 30 years, having held various positions in Product Engineering, Sales/Customer Service, and Quality Assurance. He can be reached at rweber@crlsolutions.com. CRL possesses more than 70 years of innovation experience in the development of remote-handling systems, including Telemanipulators, Transfer Systems, Glove Ports and Waste Drum Transfer Systems. CRL solutions promote operator safety and efficiency when performing various tasks in nuclear and life science applications around the world.

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