GET IT OUT NOW! REUSABLE, EFFICIENT AND LOW COST CONTAINERS FOR SPENT RESIN

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ABSTRACT

Commercial Nuclear Power Plant liquid radwaste systems historically have required the processing of approximately 24,000 cu. ft. of spent resin each year. With the advent of thermal and other types of off-site treatment, dewatering to burial site criteria is becoming unnecessary. Bulk dewatering and shipment to the off-site processor is all that is required. This creates the need for re-usable containers, which are filled and dewatered at the utility, shipped for resin extraction at the processor, and refurbished for reuse.

For the utility, the bulk dewatering of containers is a major task. For the off-site processor, extraction of the dewatered resin is a major task. The GTS Duratek team has designed a re-usable container that caters to the needs of both the utility and the processor. This design has significantly reduced dewatering times at Carolina Power and Light (an iron oxide loaded powdered resin) and provides a large container opening, without intrusive internals, for easy extraction of resin at the off-site processor. All of this has been accomplished at virtually the same lifecycle cost of a typical, single use container.

This technical paper will discuss the design basis for this new approach to dewatering spent ion exchange resin and reusing containers.

INTRODUCTION

Commercial Boiling Water Reactors (BWRs) use to require the processing of approximately 24,000 cu. ft. of radioactive spent resin each year. Typically the resin was solidified and packaged within carbon steel containers for disposal. In 1982, in order to comply with waste form requirements, most Nuclear Power Plants began to use high integrity containers (HIC's) for the packaging of resin. These HIC's were simply dewatered to meet burial site criteria rather than solidified which significantly saved disposal volumes and, most importantly, disposal costs.

In the late 1980's and into the early 1990's many BWRs began replacing septa in condensate and radwaste vessels with filters to reduce waste generation from precoat. This caused a reduction in the amount of spent resin requiring disposal; however, it increased the amount of iron oxide in the waste. This created a difficult-to-dewater matrix. In fact, the dewatering of HIC's began to take up to several weeks depending on the waste characteristics. Over same time period, many hardware and procedural changes, at the NPPs have improved the efficiency of treatment and volume reduction but it still continues to be a major labor and dose expense.

With the advent of thermal treatment of resin at off-site facilities, dewatering to meet burial site criteria at the utility is becoming unnecessary. Bulk dewatering in preparation for shipment to the thermal processors is all that is required in order to ship the container to the processor. This created the need for re-usable containers, which are dewatered at the utility, shipped for resin extraction, and refurbished for reuse.

For the utility, the bulk dewatering of re-usable containers is still a major task. For the processor, extraction of the dewatered resin is a major task. The Duratek team has designed a re-usable container that caters to the needs of both the utility and the processor. The Duratek design has reduced dewatering times at Carolina Power and Light from two weeks to a few days and provides a large opening without intrusive internals thereby allowing easy extraction. All of this has been accomplished at virtually the same cost of previously used containers.

DESIGN BASIS DESCRIPTION

The design basis of the Duratek re-usable container focused on the following key objectives:

- Reusable container and internals: The container material shall be stainless steel to provide an easily decontaminated surface both inside and outside. This will reduce dose during maintenance and refurbishment activities. The internal filters, filter headers and attachment brackets shall be stainless steel to provide longevity and an easily decontaminated surface.

- Reduce current bulk dewatering time at the utility: Fabric filters and poly cartridges work well for dewatering to burial site criteria but, in general, they are slow. Well point type filters provide larger filter openings and therefore faster filtration. As material builds and packs on both types of filter media the well points continue to allow higher flow rates while others tend to blind.

- Container shell shall be compatible with a variety of existing fill head and lift mechanism designs: Many different fill heads and lift mechanisms exist throughout the industry. Fill heads vary from requiring specific fill plates in order to mate with the container prior to any processing while others require a drum opening to provide a positive seal. Apart from the standard sling lift, many grapple designs exist. Given the wide variety the Duratek container can be built to any lift mechanism or fill head requirement.

- Container internals shall be flexible enough to dewater a wide range of waste forms: The internals are comprised of four headers, two at the fifty-percent full mark and two at the bottom. The suction can be through the individual headers meaning four suction lines or can be combined to provide a bottom and side suction. The headers are easily removed (requires entrance) and may be replaced with headers that provide more filter area. Individual filters may be replaced with longer filters or a variety of combinations. For instance, replacing the standard eight 18" filters in the bottom headers with 36" filters can double the filter area.

- Reduce current extraction time of the waste at the processor: The large opening of the container allows a variety of extraction methods. The filters and manifolds mounted around the internal circumference allow for an unobstructed path to the bottom of the container. Due the rapid processing at the utility, the resin is not as compact as it would be when dewatering to burial site criteria, and therefore it is much easier to extract with a sluice wand. In addition the filters may be backflushed to allow flowability and a spray ball mounted in the top of the container provides a constant wash down of walls and filter mounts.

- Fabrication costs shall be as low as possible. (The generator should not have to pay for conveniences at the processor): The standard container with standard lift mechanism is slightly more expensive than a typical carbon steel container with powdex dewatering internals. Special options equate to a higher cost and are typically requested to meet customer specific requirements. The stainless container can be reused many times over without build up of contamination or excessive corrosion.

- Refurbishment costs (dose, labor and equipment) shall be as low as possible: Refurbishment consists of a filter flow test, removal of all waste material, pressure test and replacement of any non-conforming components. Refurbishment shall take as little as a few hours depending on the number non-conforming items.

DESIGN SUMMARY

Two stainless steel headers provide top and bottom dewatering capability (See FIG. 1 for the Bottom Header and FIG. 3 for the Top Header). The headers are removable for repair/replacement and are capable of being fitted with a variety of filter sizes and quantities. A typical container for dewatering powdered resin would contain 2,200 to 2,700 sq. inches of filter surface area but has the capability to contain well over 11,000 sq. inches of surface area. The types of filter media can be selected based on the waste characteristics and are easily installed and removed. The standard filters are stainless steel, back-flushable, reusable filters (See FIG. 3). These standard filters have improved dewatering time at Carolina Power and Light from two weeks to approximately two days. The CP&L waste is powdered resin with high iron oxide content typical of a BWR.

The basic container design includes slings as the standard lift mechanism. The top portion of the container can be modified to include a variety of grapple lift mechanisms and the lid is sized to provide space for adapters to fit various fill plate sizes and fill heads. The standard internals utilize two suction lines but are easily adaptable to four suctions in order to conform to many existing procedures.

The large opening (See FIG. 2) allows space for the processor to use a number of extraction methods. The filter manifolds are installed on the outside diameter thereby avoiding intrusive internals and other filter media hampering removal (See FIG. 1 and 4).


Fig. 1. Container Internals, Bottom Header


Fig. 2. Container Opening

Fig. 3. Container Internals, Top Header

Fig. 4. Container Internals, Suction Hoses

EXPERIENCE

Dewatering at Brunswick, unloading the resin at the processor and refurbishing the containers at Duratek has provided data that has proven a successful reusable container design. Many of the past problems have been resolved and these observations are summarized as follows:

- Processing time at Brunswick has been reduced

  THEN: Processing one container took up to a couple of weeks

  NOW: Processing one container takes a couple of days

  SIGNIFICANCE: Productivity improvement with dose and cost reduction

- Refurbishment time or turn-around time

  THEN: Four to five containers in a three to four week period using at least three personnel

  NOW: Four to five containers in a one to two week period using one person

  SIGNIFICANCE: Increased productivity. One-sixth the labor required to complete the same tasks. In addition, the above equates to a reduction in dose.

- In-coming Dose Rate at Duratek

  THEN: Dose rates up to 6 R/hr on contact

  NOW: Dose rates up to 1.5 R/hr on contact

  SIGNIFICANCE: The resin processor is able to remove more waste material from the new container resulting in lower incoming dose rates. This lowers over all dose to Duratek and off-site processor personnel.

- Waste Volume left behind (unable to be removed) by processor

  THEN: 7.5 cu. ft. of resin and 7.5 cu. ft. of DAW

  NOW: less than 0.5 cu. ft. of resin and zero cu. ft. DAW

  SIGNIFICANCE: Secondary waste disposal cost reduction of 30:1

- Outgoing Dose Rate from Duratek (post refurbishment)

  THEN: Hot spots as high as 6 R/hr. It was possible to get contact dose rates down to 2 mR/hr hr but it required significant dose and time expense as well as the generation of at least 21 cu ft of liquid waste from pressure washing.

  NOW: Hot spots as high as 15 mR/hr. Contact dose rates are routinely dropped to less than 2 mR/hr with a flush and pressure wash which generates 3.5 cu. ft. of liquid waste.

  SIGNIFICANCE: Dose rate reduction at Duratek and the utility receiving the refurbished container. Transportation cost reduction for refurbished containers.

- Refurbishment Material Cost Reduction

  THEN: High

  NOW: material costs have decreased an average of $600 per container

  SIGNIFICANCE: Typical refurbishing consists of filter replacement, sling replacement, gaskets, etc. The cost decrease results in less cost to the customer.

CONCLUSIONS

Experience with the new reusable container design thus far has been extremely favorable and allows for the following conclusions:

- The dewatering time at the customer site has decreased significantly:

  The container has only been used at CP&L Brunswick. Dewatering times there have been reduced from two weeks to a few days. The reduction in man hours and man rem has resulted in significant savings to the company both in dose and productivity.

- The time to remove resin at the processor site has decreased significantly:

  The large opening, lack of interference through the waste matrix and the low lower waste density has allowed the processor to remove waste faster. Removal time has been reduced from several days to several hours. Efficiency has increased, in that more waste is removed at the processor's site and less shipped to Duratek.

- Time and effort to refurbish the container for reuse has decreased significantly:

  Refurbishment time per container is on the order of several hours. The container is flushed clean and filter flow tests are performed. Damaged filters and gaskets are replaced and hose connections verified. A pressure test on the container is verified by QA and the container is prepared for shipment. Secondary waste, dose rates (both in coming and outgoing) and costs, in general, have been reduced significantly.