THE LOW-LEVEL WASTE HANDLING CHALLENGE AT THE FEED MATERIALS PRODUCTION CENTER

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ABSTRACT

The management of low-level wastes from the production of depleted uranium at the Feed Materials Production Center presents an enormous challenge. The recovery of uranium from materials contaminated with depleted uranium is usually not economical. As a result, large volumes of wastes are generated. The Westinghouse Materials Company of Ohio has established an aggressive waste management program. Simple solutions have been applied to problems in the areas of waste handling and waste minimization. The success of this program has been demonstrated by the reduction of low-level waste inventory at the Feed Materials Production Center.

INTRODUCTION

The Feed Materials Production Center (FMPC) is a Department of Energy (DOE) facility that produces high purity uranium metal used in the fabrication of fuel and target element cores used in DOE reactors. This facility is managed and operated by the Westinghouse Materials Company of Ohio (WMCO).

In FY 1987, the FMPC produced approximately 33,000 drum equivalents (explained later) of waste. At the end of FY 1987 the backlog of stored waste was estimated to be 77,000 drum equivalents. The handling of these large waste volumes necessitated the formation of the waste operations group (1) which is dedicated to the packaging and final disposition of low-level wastes. The goals of this group are defined in terms of the reduction of the on site low-level waste inventory to the levels of current generation and minimization of waste while reducing the cost of accomplishing these tasks.

This paper provides brief descriptions of the process of making uranium and of the wastes resulting from the FMPC operation. A general description of the waste packages used with highlights on the success of the packages for fine particles and contaminated trash are provided. The FMPC method for quantifying waste volumes in drum equivalents is explained. Waste minimization efforts and their importance are summarized, along with a discussion of some of the future plans of the FMPC waste management program.

PROCESS DESCRIPTION

There are nine production plants responsible for the various processes involved in producing uranium metal. The major portion of this is dedicated to the production of depleted uranium (less than 0.7% U^{235}). A simplified flow chart of the entire operation is shown in Fig. 1.

Feed materials for the processes come from both on site and off site sources. These include uranium bearing residues, oxides, scrap metal, and other uranium compounds. Impure scrap materials are digested in nitric acid. The uranium is extracted with a tributyl phosphate and kerosene solution and then back extracted to yield a uranyl nitrate solution (UNH). The UNH is calcined to produce uranium trioxide (UO_3). This UO_3 is then reduced to uranium dioxide (UO_2) which is reacted with anhydrous hydrogen fluoride to yield uranium tetrafluoride (UF_4). Uranium hexafluoride (UF_6), received from an off site source, is reacted with hydrogen to also produce UF_4. The UF_4 is reacted with magnesium metal (Mg) and reduced to uranium metal. This metal, referred to as a derby, is then remelted to yield an ingot. The ingot is subsequently extruded into rods or tubes. The extruded metal is machined to the final dimensions required for assembly into reactor fuel or target elements.

CHARACTERIZATION OF WASTES

Uranium production at the FMPC results in the generation of large quantities of waste. It is usually not economically feasible to recover depleted uranium from scrap materials. Therefore, virtually anything contaminated with depleted uranium, that cannot be economically decontaminated, becomes a waste. Contaminated wastes at the FMPC can be traced to over seventy different sources. For simplicity and ease in their management, FMPC wastes have been categorized as described below.

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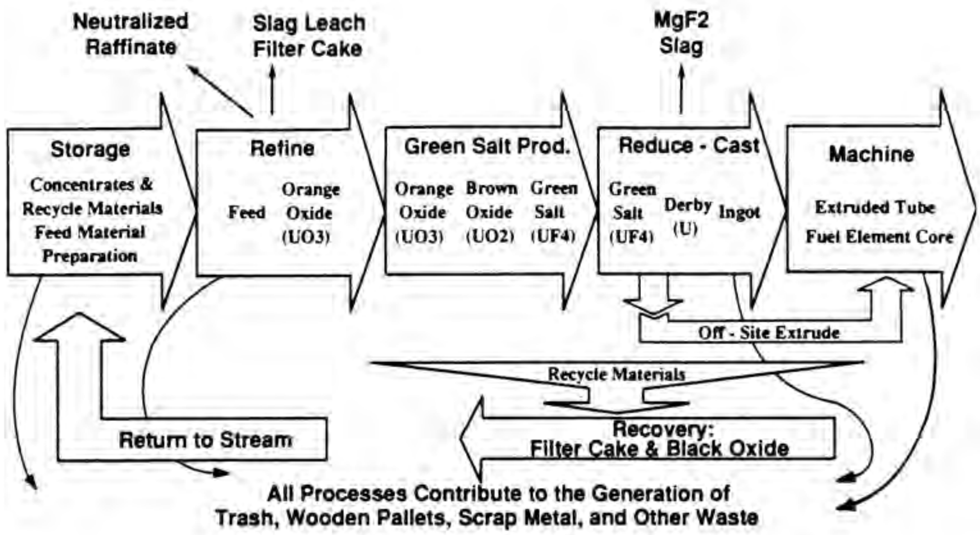

Fig. 1. The FMPC Uranium Production Process Including Significant Wastes.

Non-recoverable process residues

Process residues refer to wastes that are directly produced from the various FMPC processes. These account for the largest volume of waste. Magnesium fluoride (MgF_2) contaminated with depleted uranium (less than 0.7% U^{235}) comprises the largest FMPC waste stream· This MgF_2 is generated when UF_4 is reacted with Mg to produce the depleted uranium derbies. The second largest waste comes from the neutralized filter cake produced when MgF_2 containing enriched uranium (greater than 0.7% U^{235}) is processed through the refinery to recover the uranium. Other process wastes include waste generated during the recovery of uranium from other refinery feed materials, sump sludge, process spills and dust collector residues.

Refuse metal

All nine production plants, along with support facilities such as the garage and maintenance shops, generate recoverable scrap metal which is set aside for the DOE metals management program (2), and refuse metal which is packaged for disposal. The primary source of refuse metal is irreparable equipment from plant machinery or vehicles, and unusable metal drums.

Scrap wood

Contaminated scrap wood is generated throughout the production area. The largest portion of this is made up of irreparable wooden pallets used for material handling in the plants.

Contaminated trash

This is comprised mostly of paper, cardboard, rags, plastic and other miscellaneous trash which became contaminated with uranium within the process area.

Other wastes

The waste materials described above account for the largest volume of FMPC waste. There are other wastes which at present represent lesser volumes such as waste oil, Resource Conservation and Recovery Act (RCRA) regulated wastes, construction rubble, and asbestos.

PACKAGING OF WASTES

The handling, preparation and packaging of FMPC wastes are overseen by regulations such as those stipulated by the Code of Federal Regulations (40 CFR, 49 CFR), RCRA, the EPA and other governing laws. FMPC wastes are classified as either Limited Quantity (LQ) or Low Specific Activity materials as defined in the Federal Regulations (3). These classifications permit the use of strong tight packages for containing FMPC wastes. There are no specific test requirements. However, there is a performance requirement that the packages do not release any radioactive material to the environment.

Initial packaging of waste is done by the waste generator who also verifies that the package does not contain any prohibited materials. A number of steps such as sample analysis, waste package certification, and the completion of appropriate paperwork have to be done prior to shipment of waste packages.

The most commonly utilized wasted packages at the FMPC are DOT 17H 55-gallon drum and wooden boxes made out of 3/4 inch plywood on 2 inch by 4 inch framing members. The 55-gallon drum is used primarily for process residues while the wooden boxes are used for other wastes such as refuse metal, dirt, and construction rubble. Boxes made out of sheet metal are used for some specialized applications.

Packaging of waste containing fine particles

Waste packaging criteria state that packages shall contain no more than one weight percent of less-than-10-micrometer-diameter, and no more than 15 weight percent of less-than-200-micrometer-diameter particles (4). Virtually all of the FMPC process wastes fall into this category. Additional processing to immobilize these wastes yields undesirable results such as, prohibitive costs or the introduction of prohibited materials into the packages. An aqueous-based dust suppressant was originally used on magnesium fluoride. This presented a serious problem since the water in the dust suppressant reacted with residual uranium and magnesium metals to produce hydrogen in the packages. Residual uranium and magnesium metals are also found in other FMPC process wastes posing the possibility of similar problems. These factors necessitated the development of a 48/55-gallon package.

A 48-gallon jug head drum is placed into a 55-gallon 17-H drum prior to being filled. As shown in Fig. 2, a plastic sleeve is placed over the annulus to prevent residues from entering that area during filling. Once filled the plastic sleeve is carefully folded into the 48-gallon drum which is then covered and secured with a locking ring. The 55-gallon 17-H drum is then covered and secured with a bolt ring which is torqued to 45-55 ft.-lb. This type of packaging has proven to be a very effective and inexpensive way of containing waste with fine particles.

Baled trash package

Contaminated trash such as scrap paper, cardboard, clothing, plastic and other "soft" items are compacted into a bale weighing approximately 700 pounds. The sides of the bale are buttressed with cardboard. The entire package is tightly secured with wire. It is then placed into an inexpensive nylon reinforced plastic bag which is secured with pressure sensitive tape. A wooden pallet is place at both the top and bottom, secured with two metal bands, lending stability and ease of handling to the package (see Fig. 3).

Fig. 2. 48/55 Gallon Drum Waste Package for Fine Particles.

This package is currently being used successfully for the transportation of contaminated trash to the disposal site. It represents a significant breakthrough in the FMPC waste handling program. Previously, trash was disposed of in wooden boxes and 55-gallon drums both of which are more expensive than the baled trash package. In addition to being less expensive, the baled trash package is very easy to handle using traditional material handling equipment. The compaction of trash coupled with the use of a plastic bag, which adds a negligible amount of volume to the overall waste package, provide significant waste minimization. This translates into savings on waste disposal costs.

QUANTIFYING WASTE VOLUMES IN DRUM EQUIVALENTS

As described earlier, the FMPC has over seventy different low-level waste sources. Representations of these volumes has sometimes caused confusion. The drum equivalent was adopted as a dimensionless volumetric measure which can be easily visualized by both technical and non-technical persons. This concept is very similar to the measurement of oil in barrels used in the petroleum industry. The 55-gallon drum (7.4 cubic feet) is used as the basis for this unit of measure. All waste packages and waste volumes can be represented in terms of 55-gallon drum equivalents or DE's. Diverse types of waste such as refuse metal, process residues and wooden pallets are all quantified in drum equivalents.

For example:

85-gallon drum = 85/55 = 1.55 DE

30-gallon drum = 30/55 = 0.55 DE

6 ft^3 of waste = 6.0/7.4 = 0.81 DE

This unit of measurement has been accepted by the DOE and proves to be a very effective in areas such as measuring our performance and quantifying our waste minimization effort. Figure 4 gives an example of how drum equivalents are used to aid in tracking FMPC waste generation and shipment information.

WASTE MINIMIZATION

Waste minimization is fast becoming a major issue in the DOE complex. This is evidenced in the draft revision of DOE order 5820.2 chapter III and the 1984 RCRA amend-

Fig. 3. Baled Trash Package Ready for Shipment to Disposal Site.

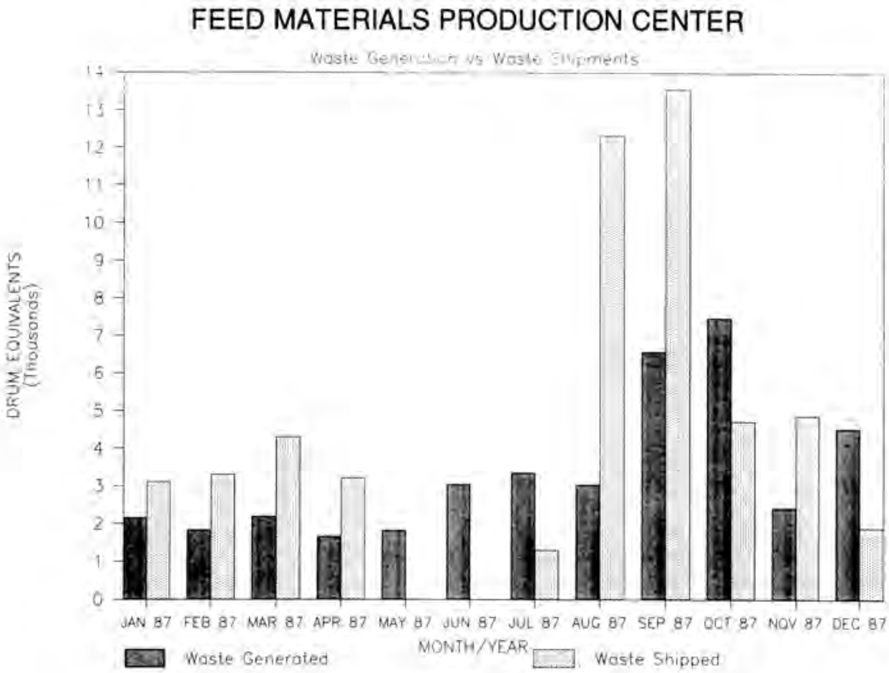

Fig. 4. Using Drum Equivalents to Track Performance.

ments (5,6). Recognizing the enormous benefits to be derived, WMCO has assumed an aggressive posture towards waste minimization (7). Waste minimization at the FMPC has been focused in the areas of waste compaction, waste segregation, recycling of material, volume reduction, and substitution of materials. Reference 7 provides a detailed discussion of the FMPC waste minimization program. A brief summary of these efforts is discussed here.

Trash is compacted into bales significantly reducing the disposal volume. Reduction in waste volume is also achieved by thermally processing sump sludges and other process wastes to remove water again reducing disposal volume.

Waste segregation is another area where the FMPC has made significant progress. A simple program has been set up to radiologically monitor trash in non-process areas, which has had no known contact with radioactive material. This includes office trash, supplies and packaging material. This trash, once verified to be non-contaminated, is disposed of at a sanitary land fill reducing by 25% the volume of trash previously treated as contaminated.

Other significant waste minimization efforts at the FMPC include substitution of water-based paint for oil-based paint which required RCRA regulated paint thinner, and the reconditioning and reuse of drums. In general, waste minimization has played and continues to play an important part in reducing waste disposal costs at the FMPC.

FUTURE PLANS FOR FMPC WASTE PROGRAM

Future FMPC waste handling efforts will concentrate on reducing waste backlog to levels of current generation. Research into technologies with the potential for minimizing wastes is currently being done. Plans are also being made to focus attention on less technical waste minimization efforts. One of these is the replacement of wooden pallets with more durable plastic pallets. It is hoped that this will reduce the volume of broken pallets requiring disposal. Also planned is the establishment of a charge-back system for directly charging the waste generators with the costs of handling their wastes. the idea behind this proposed program is that waste generators will have an incentive for minimizing their wastes when faced with having to allocate part of their budgets for waste handling costs. The current plan is to model this charge-back program after a similar system established at the DOE Oak Ridge facility (8).

CONCLUSION

FMPC's waste management program is young and vibrant. The initial success of the program has been proven by a reduction in waste backlog from over 90,000 DE's to 77,000 DE's while also shipping the 33,000 DE's which were generated in FY 1987. Waste minimization and simple solutions to challenges encountered have played and will continue to play an important role.

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