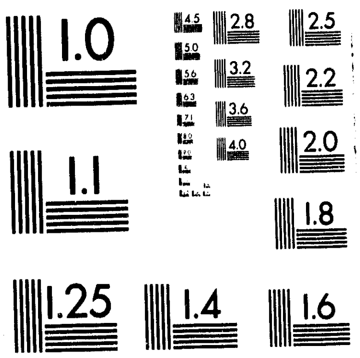
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SAMPLING THE CONTENTS OF HIGH-LEVEL WASTE TANKS (U)

by

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ABSTRACT

Samples were recently retrieved from a HLW storage tank at the DOE Savannah River Site using simple tools developed for this task. The tools are inexpensive and manually operated, require brief tank open times, and minimize radiation doses.

INTRODUCTION

It is planned to recover High-Level Waste (HLW), currently stored in tanks at several DOE weapons complex sites, for processing into stable waste forms and for ultimate geologic disposal. Information about these wastes is needed for recovery operations, reprocessing steps, and formulations for immobilization. Obtaining this information may require taking samples of these wastes as they are currently stored.

The Savannah River Site (SRS) has nearly completed construction and startup testing of its Defense Waste Processing Facility (DWPF). Both sludge and salt will be fed to the DWPF for immobilization in borosilicate glass.

Samples in the early 1980's were used to develop DWPF formulations. No samples of stored SRS salt had been taken for the last twelve years. Personnel familiar with the technique had retired and equipment designs were no longer available. With imminent waste recovery, samples were required to ensure that small amounts of enriched uranium in the waste do not present an accidental criticality risk when water is added to dissolve the salt for processing.

Samples were desired from the tank scheduled for initial processing to answer questions about the potential for an accidental criticality during water addition and salt dissolution.

Unfissioned uranium remaining in SRS enriched fuel assemblies after irradiation in production reactors is recovered by chemical reprocessing at SRS. Most uranium is recovered and recycled into new fuel assemblies. A residual amount is lost to the waste streams sent to underground storage in the SRS tank farms. There, the neutralized waste separates into insoluble sludge which precipitates and a supernate of dissolved salts including cesium and strontium. Traces of uranium occur in sludge and supernate. Supernate is pumped out from above the sludge to produce sludge-only and salt-only tanks.

To conserve space in salt tanks, supernate is evaporated to reduce its volume. Salt crystals form in the tanks. Repeated evaporation further concentrates the salt and a nearly dry, concrete-like hard cake is formed. Several cycles of evaporation mix wastes from different canyon campaigns in one tank.

To recover solid salt, water is added and circulated to dissolve the salt. Addition of water or its circulation might cause relocation of the small quantities of uranium into a critical mass, a highly-unlikely and unwanted occurrence in a waste storage tank. Thus, the amount, enrichment, and solubility of any uranium present needs to be known. Historical records of a tank's contents would be difficult to assemble and probably not too accurate. They also would not indicate solubility.

A technique was developed to obtain a few samples near the surface of the salt - the first layers to be dissolved. Not all the salt could be dissolved at once because the tank is nearly full and very little headroom exists for adding water. At first, dissolution will be in several thin layers until more headroom is recovered. Only a few samples were desired at first. A sampling technique for routine use later is now being developed.

DISCUSSION

Simple Manual Tool Selected

A decision was made to proceed with a simple manual tool to obtain a quick set of data to permit a start on dissolving the tank contents. Other sites have developed sophisticated samplers that can be routinely used. In our case, speed, one-time use, and low cost were guiding principles for this task. The manual labor associated with our sample tool is not envisioned for routine work. Nonetheless, the tool represented a fast solution to a pressing need at SRS.

Other sampling concepts for future uses were developed concurrently and will also be described in this paper.

Tool Design

The tool consisted of a simple inverted cup about 1.5 inches in diameter with a cavity 1.5 to 2.5 inches deep. The cup design is shown in Figure 1. The cup was machined from stainless steel and had a sharp edge on the bottom. The inside bore contained a ledge like a fish hook barb to retain salt that entered the cup. Two slots were milled in the sides of the cup. These slots permitted viewing for successful sample acquisition and also access for a dental pick or small screw driver to assist in sample removal in the shielded analytical cell.

Several samples were obtained with this technique - one in March 1993 and three more in July 1993. The first cup used was 1.5 inches deep. For the July series, more material was desired and 2.5 inch deep cups were used.

The cup was fixed on a piece of galvanized conduit with a quick release pin. The pin permits separation of the cup from the handle. The pin was protected from the impact forces of driving the cup into the salt by use of an anvil on the cup top (to mate with a bar in the conduit handle) to receive the impact blows.

Only the cup was sent to the laboratory for analysis of the salt sample obtained. The handle remained at the site of the job for later decontamination or disposal.

The handle consisted of two pieces of conduit, each five feet long. They were joined by a standard screwed conduit coupling. The overall length was planned to reach the top layer of salt from above the tank top. The short segments of handle were planned to permit ready disposal in waste boxes that were limited to five foot long pieces of waste.

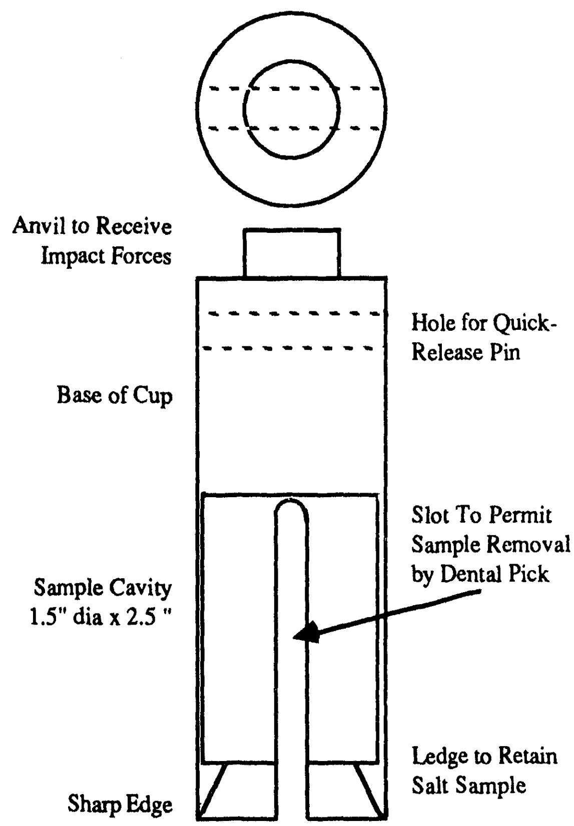

Fig. 1. Sample Cup

Job Preparations

Preparations for the job included the erection of a contamination control hut, with an entrance air lock, over the riser opening in the waste tank through which access to the salt would be obtained. The hut was set up using tubelock scaffold pieces for the frame and sheets of heavy plastic taped to the frame for walls, floor, and roof.

The floor around the riser opening was covered with absorbent paper in case any salt or supernate contamination were to be spilled during the operation.

A small shielded cask called a doorstop was present inside the hut ready to receive the sample. The cask has a 2.5" diameter by 5.5" deep cavity, depleted uranium shielding, and is constructed of stainless steel. The lid is held on with four dogs and matching ears. Three casks were used for the July samples.

Personnel

Four personnel were used inside the hut for this job. Two were operators to do the sampling task. The other two were Health Protection inspectors to monitor and control the job.

Various other personnel serving several assistance functions were available outside the hut.

Procedure

The riser plug was removed from the tank top using a mobile crane and a disposable choker to reach through a slit in the roof of the hut. The plug was bagged temporarily and set aside inside the hut during the sampling.

The cup, pinned to the handle, was inserted through the open tank top and hammered down into the salt until marks on the handle showed it had been driven far enough to fill the cup.

The handle and cup were withdrawn into plastic sleeving to contain loose radioactivity. After a partial lift, the top section of handle (conduit) was unscrewed from the rest of the tool, sealed in its plastic sleeve, and set aside in the hut for later disposal.

Then the remaining handle section and cup were withdrawn from the waste tank. The plastic sleeving was drawn down over the bottom of the cup and sealed. Radiation readings of the sample cup at contact were taken as soon as the cup was above the tank opening. The presence of salt was visually confirmed.

The pin was pulled to separate the cup from the bottom section of handle. The sleeving between the handle and cup was twisted, taped and cut to seal them into two separate pouches. The cup with the sample of salt now in it was placed in the small cask and sent to shielded cells for analytical work. The sleeved tool handle was set aside with the other one for disposal as the job was being cleaned up.

Radiation Data

The four men inside the contamination control hut were supplied with special whole body dosimeters that were collected immediately after the task and read soon thereafter. The total job dose for all four employees was 7 mrem. Finger dosimeters were also used.

The radiation fields were 400 mRad/hr and 400 mR/hr over the open hole in the waste tank. Once the sample had been removed from the tank and was no longer shielded by the tank structure, its radiation field at contact (5 cm.) was 1,000 mRad/hr and 1,000 mR/hr.

Job Duration

The times achieved while doing this job in March are given in the table below:

Final job preplan	10:00 am
Lunch	11:30 am
Job site preplan	12:30 pm
Start riser plug lift	1:20 pm
Insert tool down to salt	1:25 pm
Sample retrieved, in cask	1:30 pm
Riser plug reinserted	1:45 pm
Hut cleanup done	2:30 pm

Other Tool Concepts

Several other concepts were considered during the development of this tool. These are discussed briefly here for readers who might wish to incorporate the ideas to solve a sampling need at their site.

The first determination that needs to be made is what type of sample is to be retrieved. The differences between liquid, solid, and dissolved solids need to be recognized when developing sample retrieval concepts. When that cross-cut has been made, the type of samplers that might be designed is narrowed and conceptual work may proceed.

Auger A simple auger, or drill bit, in a shroud to contain the cored material, might be used. The auger would be rotated while the shroud, or sleeve, remained stationary. This device will retrieve solids and may also produce some liquid adherent to or interstitial with the solid.

Hydraulic Mining A tube inserted into the waste with a flow of water (it is assumed that water addition to the waste is acceptable) down the tube offers the chance to dissolve the salt (or other material) and retrieve a solution by bringing it up another passage within the sampling housing. Liquid samples may thus be obtained at the top of the hydraulic mining tube. A third passage in the housing is needed to return the stream to the waste tank, assuming it is not acceptable to release the solution outside the tank.

Hydraulic Slurries A variation on the above concept utilizes a flow rate and velocities high enough to suspend non-soluble particles so that samples of a slurry may be obtained.

Filtered Slurry Rather than reverse the flow to bring a slurried sample to the top of the housing, one might place a filter at the bottom of the housing and trap only the non-soluble constituents, letting the solution merely pass into the waste tank. The filter is then recovered and processed in the analytical laboratory.

Core Drilling A standard, commercially available core drill might be used to drill through the salt leaving a core inside the hollow drill string. If the drill string is rotated and lowered using a drive on the outside diameter of the tube rather than the top, the string could remain open at the top for insertion and removal of the sample holder. A wire-line, core-barrel sampler could then be used to retrieve the segments of core. Those steps would then be rather like the technique used for initial samples described earlier in this paper. Merely lift the sampler into a plastic sleeve, seal it, and place it in a shielded cask for transport to the laboratory.

CONCLUSION

Samples were easily obtained on a short time scale to satisfy a pressing need for information at Savannah River. Data on fissile content in the salt of one waste tank were needed before processing of that tank could begin. The data will be used to resolve concerns about the slight potential for an accidental criticality to occur while processing and recovery of this salt waste is done.

SUMMARY

This work should interest other sites with similar sampling needs. When data from highly radioactive materials can be obtained simply, inexpensively, and with low radiation doses, there is an obligation to share the information. At SRS, this technique provided vital information concerning an unknown factor that otherwise might have interfered with waste processing.

ACKNOWLEDGMENT

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