EVALUATION OF REMOTE SMEARING OF DWPF CANISTERED WASTE FORMS (U)*

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ABSTRACT

The Savannah River Site (SRS) is evaluating the variables of the remote smearing process for monitoring transferable contamination on the waste glass canisters at the Defense Waste Processing Facility (DWPF). Smearing for transferable contamination is typically done by hand, but in this case, due to the nature of the high level waste within the canisters, remote smearing is required. The effectiveness of the smear pad was determined under varying conditions (distance travelled, force applied, and canister surface), as well as the relative importance of these factors. It was concluded that the remote smear is more reliable than the hand smear.

BACKGROUND

The Defense Waste Processing Facility (DWPF) at the Savannah River Site (SRS) will incorporate high level nuclear waste into borosilicate glass. The glass will be poured into large stainless steel canisters. Decontamination of these canisters will be performed by frit slurry blasting. After frit blasting, the canisters will be smeared to determine the effectiveness of the decontamination process. The smear pad will be monitored for radioactivity to ensure that the level of transferable contamination on the surface of the canister is within acceptable criteria. Cleaned canisters will be stored for future shipment to a federal repository.

Canister Decontamination

The heat from canister filling will produce an oxide layer on the outside surface of the canister. Any radioactive contamination on the canister surface during the filling operation is incorporated into the oxide layer when the canister is being filled. The contaminated layer is removed (to prevent contamination from being spread) before final canister closure and storage using the Canister Decontamination Chamber (CDC). In the CDC, the outside surface of filled canisters is cleaned by a slurry frit blasting process.

If the canister surface temperature is less than 100°C, the canister is lowered into the CDC for decontamination. The oxide layer is removed from the surface of the canister by frit blasting. The CDC has eight spray nozzles that blast the canister with a water and frit mixture (1,2). Each of the sections of the canister that a nozzle cleans is called a zone.

After the canister is decontaminated, it is removed from the cell and smeared. If smearing indicates that a zone (section) of the canister was not sufficiently decontaminated, that zone can be decontaminated again in the CDC.

Smearing

The smear pad is a 3.175 cm (1-1/4 in.) diameter piece of Kraft paper. The area smeared is 100 cm^2. The pad must travel a distance of 31,5 centimeters (12.4 in.) along the surface of the canister to cover this area. For the sides of the canister, the area the smear pad covers is easily determined. However, for the flange, neck, or bottom of the canister, the area the smear pad covers is more difficult to determine.

Acceptance Criteria

The level of transferable radioactive contamination on all external surfaces of each canister cannot exceed the following limits set by the repository program's Waste Acceptance Preliminary Specifications (3).

Alpha radiation: 220 dpm/100 cm^2

Beta and gamma radiation: 2200 dpm/100 cm^2

TESTING METHODOLOGY

The smear test program consisted of two parts: nonradioactive testing and radioactive testing. The nonradioactive testing evaluated the effect of variables of the smearing process. In the radioactive tests, stainless steel surfaces were smeared by hand and by using a remote tool and the differences in results using the two techniques were compared.

Nonradioactive Evaluation of Force, Contact Area, and Tape

The nonradioactive testing evaluated the effect of variables of the smearing process. In the radioactive tests, stainless steel surfaces were smeared by hand and by using a remote tool and the differences in results using the two techniques were compared. The variables were the amount of force applied and the tape type and the tape thickness

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used on the smear pad assembly. The contact area of the smear pad on different canister surfaces was determined.

The study involved taking various parts of the canister and pressing the smear pad assembly against the surface (Fig. 1). The smear pad was placed on a piece of 3-M® double-coated foam tape. Two different types of tape were used, vinyl and urethane.

The tape had a high adhesive side which was attached to a metal disk connected to a force gage (Fig. 2). The canister pieces for this test were made of Plexiglas® (Fig. 3 and 4). As the smear pad was pressed against the outside surface, it is viewed from the other side to determine how the pad conformed to the shape of the canister (Fig. 5, 6, and 7). The percent area of the smear pad that came in contact with the canister versus the pressure applied to the pad for various tape types and thicknesses was measured.

With this information, the best pressure and pad thickness were determined. The tests were planned so that the data generated were statistically defensible by allowing the variables to be random and complete for all the ranges.

Fig. 1. Smear pad assembly.

Fig. 2. Force gage.

Nonradioactive Determination of the Smear Pad Holder Tape

The effect of the type of tape (vinyl versus urethane) was determined. High Tack - Low Tack 3-M® tape was used to hold the smear pad onto the foam tapes. The high tack side of the tape was adhered to the foam tape, and the low tack tape adhered to the smear pad. The advantage of the low tack tape was that the smear pad could be easily removed. The tape could also be used repeatedly without losing its adhesive qualities.

Vinyl tape was preferred over urethane. Vinyl tape required the least amount of force for the maximum contact area with the canister surface. The optimum vinyl tape thickness was 0.635 cm (1/4 in.). This tape was sturdy enough not to twist or tear, but was thin and soft enough to conform optimally to most of the canister surfaces. Urethane tape was much stiffer, and more durable than vinyl tape, but it required too much force to conform to the tighter radii of the canister.

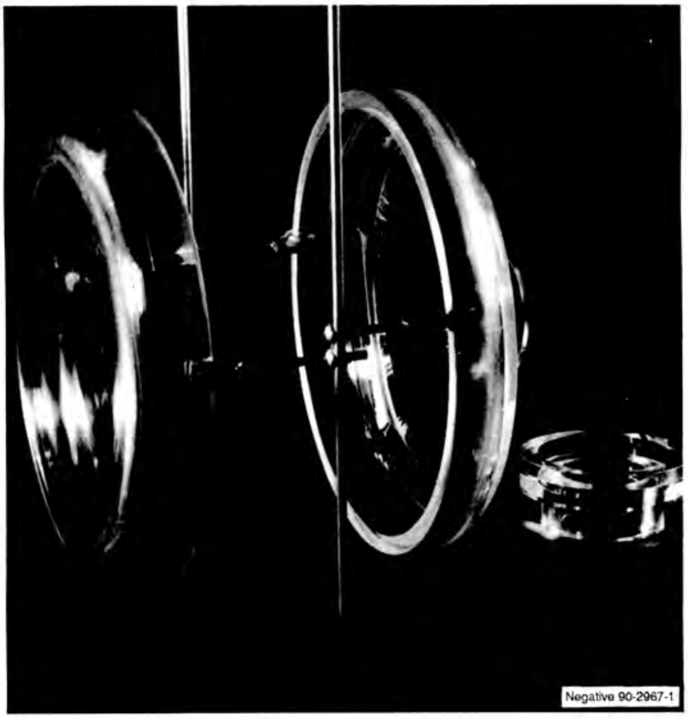

Fig. 3. Plexiglas pieces (full bottom view).

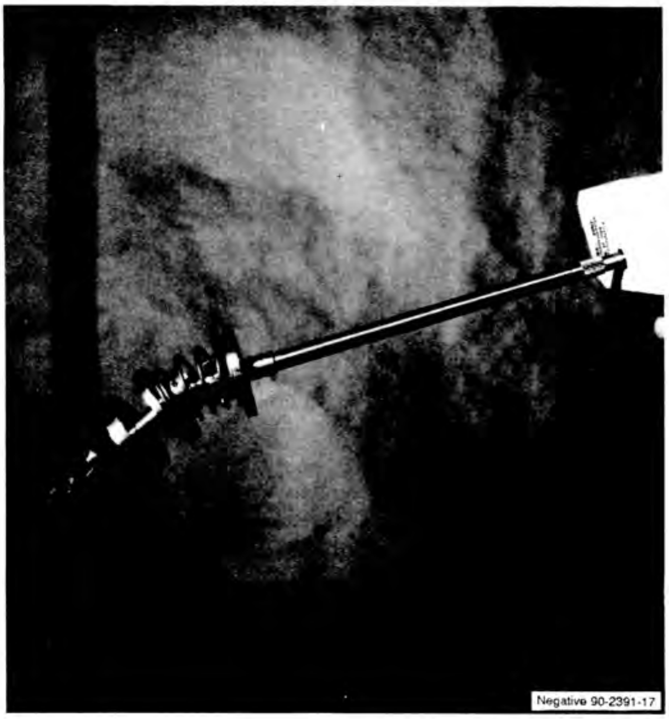

Fig. 5. Smear tool contacting plexiglas bottom.

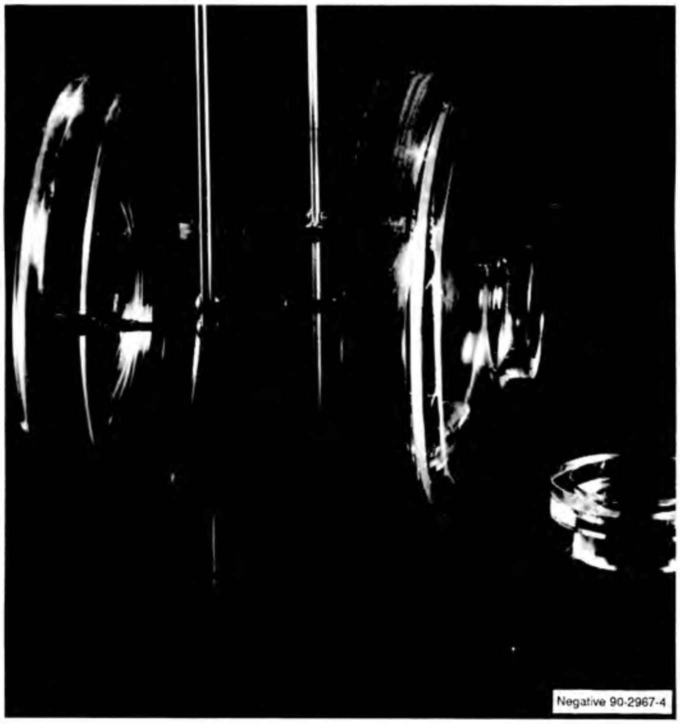

Fig. 4. Plexiglas pieces (full top view).

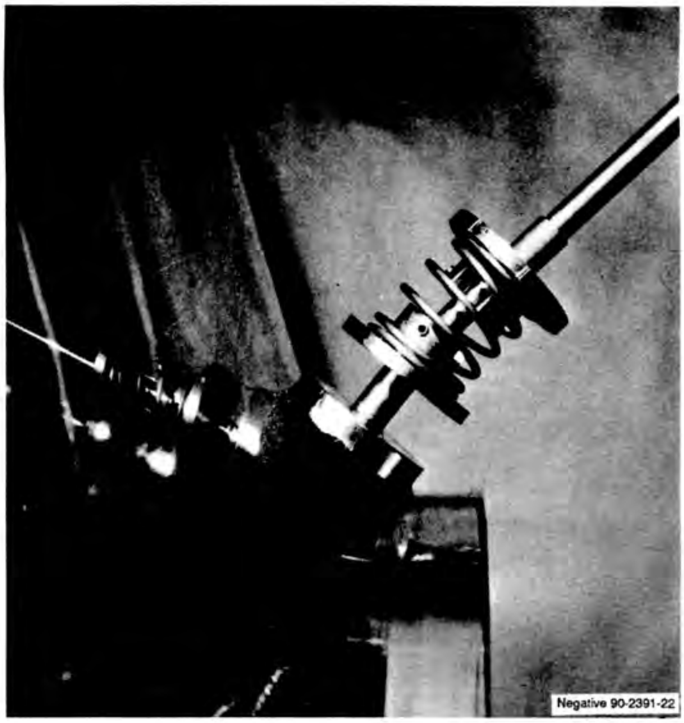

Fig. 6. Smear tool contacting plexiglas top.

Nonradioactive Determination of the Required Force and Contact Area

Different forces are required to make the smear pad conform to various canister surfaces. The eight different canister surfaces range from a 2.2 cm (7/8 in.) radius to a 61 cm (24 in.) radius. Other sections of the canister are flat. As a result of this range of surface shapes, a wide range of forces were needed so that the smear pad could achieve maximum contact area with each canister surface.

Using the preferred vinyl tape, a force between 8.9 N and 44.5 N (2 lb and 10 lb) will cause the pad to obtain maximum contact area with the various shapes of the canister.

The maximum contact area for many of the tapes was 100% when they pressed against the various canister surface shapes. However, when the smear pad and tape were pressed against the tighter radii it was not possible to achieve 100% contact. In these cases, the force required to get the maximum contact area was recorded, and the approximate contact area was estimated.

Using the preferred vinyl tape, 100% contact area could be obtained for every canister surface shape except one (Fig. 8). This one was where the canister top head converges to the canister neck. A 60% contact area was obtainable for this area (Fig. 9).

Nonradioactive Carbon Paper and Ink Tests

Carbon paper was smeared to compare the achievable contact area of hand smears and remote smears. Smearing of carbon paper attached to the outside surface of the canister dirtied the smear pad in the areas of contact. Parts of a canister were covered with ink and smeared to further evaluate the contact area of a hand smear versus a remote smear.

Using the the preferred vinyl tape, the contact area of a hand smear was an average of 63% over the different shapes of the canister. The contact area of a remote smear averaged 94%. This showed that the maximum contact area was obtained by remote smearing techniques.

Radioactive Comparison of Hand Versus Remote Smears

The difference between hand held smears and smears made using the smear tool (Fig. 10) was determined in radioactive tests.

Radioactive contamination was applied to various type 304L stainless steel canister pieces. A canister that had

Fig. 7. Smear tool contacting plexiglas neck.

Fig. 8. 100% contact.

Fig. 9. 60% contact.

Fig. 10. Smear tool.

never been heated (never glass filled) was cut into 164 pieces. A 0.05 mL portion of raw sludge in H_2O was placed on each piece and the pieces were placed in a 600°C furnace for one hour. This caused the sludge to be incorporated into the oxide film that formed on the canister pieces. Each canister piece then emitted approximately 25 mR/hr. The contaminated pieces were smeared using the smear tool and by hand.

At the time this report was written, approximately 30 of the 164 canister specimens had been tested. These specimens included all the different canister shapes. At least one hand and one remote smear were taken from each shape. The remote smear picked up about 5% more alpha and about 10% more beta/gamma transferrable radiation than the hand smear.

Radioactive Evaluation of the Effect of Area Smeared

Evaluation of the effect of the area smeared (the distance the smear pad travels along the surface) was performed. Contaminated stainless steel was smeared for various distances. This was done to determine the effect of surface area smeared on the results of the smear test.

This series of tests was carried out by smearing the waste-glass melter cell walls in the high level caves at SRL. These walls are type 304L stainless steel (the same material as the canister). (The contamination on these walls is expected to be representative of that which will be found on the canisters.)

Several smears were taken using a smear disk with the preferred vinyl tape and the Kraft paper smears. Smears were taken for 15, 30.5, and 46 centimeters (6, 12, and 18 in.). The surface that was smeared was flat, so 100% contact was made between the smear pad and the cell wall.

The results showed that distance smeared is approximately proportional to the amount of contamination that transfers to the smear pad.

CONCLUSION

- A remote smear is more reliable than a hand smear.
- The area smeared is approximately proportional to the amount of contamination picked up by the smear.

PROGRAM

- The remaining canister specimens being used to compare remote and hand smears will be contaminated and smeared.
- Radioactive testing will be done to determine what effect force has in removing transferable contamination.

REFERENCES

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