**PARTICLE SIZE DISTRIBUTION OF GROUND ITP WASHED
PRECIPITATE FOR ESTIMATING FILTER BOX
RADIOACTIVE CESIUM RELEASE DURING TRANSFER**

by

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To: S. D. Fink, 773-A

From: L.L. Kilpatrick, 676-T *LLK 10/17/93*

**Subject: Particle Size Distribution of Ground ITP Washed Precipitate for
Estimating Filter Box Radioactive Cesium Release During Transfer**

SUMMARY

ITP washed precipitate, that is dried and ground, has a particle size distribution versus cumulative weight fraction curve (Figure 1 and 3) between Powered coal and Filter sand (1, 2). The minimum particle size is about 20 microns.

The washed ITP precipitate dries to a hard cake with random cracks. The chip size depends on cake thickness and the surface it is dried on, such as glass or metal. Chips are generally over one half inch wide and with a few small particles in cracks.

The air velocity to suspend ITP washed solid particles was calculated and plotted (Figure 3).

INTRODUCTION

The amount and size of particles, generated from a failed ITP filter in its containment box, is desired (TTR No. HLE-TTR-93083) by High Level Waste Engineering (HLWE) to estimate, (knowing the vertical air velocity) the airborne particle leakage rate through various leak paths (defects). The Packaging and Transportation Group (P&TG) calculated a permissible A2 leakage (4), in the 2 inch thick containment box lid, while the box is in transit to storage. In storage the box pressure differential will be vented to atmosphere through a HEPA filter.

EXPERIMENTAL

Synthetic washed ITP slurry (200 g) was oven dried, three days at 60°-65°C in a pan (see Table III), to a hard solid that stuck to pan bottom. Between the cracks that formed were a few small particles of unknown size. The solids that were stuck to the pan bottom were pried free and repetitively ground in a mortar and pestle until they all passed through a 40 mesh sieve. This product was then sieved into 50, 80, 100, 170, 200, 325 sieve fractions and the results plotted (Table I, Figure 1).

A portion of the fines passing the 325 sieve were further separated by air floatation in a glass tube with fritted bottom (Figure 2). Increasing amounts of air were passed up through tube that floated out increasing fractions of particles after weighing (Table II, Figure 3).

CONCLUSIONS

- The particle size population of pulverized ITP washed filter solids has a sharply defined boundary (Figures 1 and 3) between Powered coal and Filter sand (1, 2).
- Pulverized dried and ground ITP washed precipitate has very few particles less than 20 microns (Figures 1 and 3). A vertical air velocity of 2.2 ft/min (Figure 2) will disperse ITP particles less than 20 micron.
- Pulverized dried and ground ITP washed precipitate has a 0.5 cumulative weight fraction that solids at about 190 microns. A vertical air velocity of 195 ft/min (Figure 3) would disperse 50% of all particles.
- The weight fraction of small particles of any particular size that can be suspended in air after drying ITP washed precipitate depends on, cake thickness, surface dried on, and thermally-induced air velocity (temperature) in the box.

TABLE I
Cumulative Weight Fraction of Washed Ground ITP Solids
Retained on Sieve
(Mesh Passed - 40, Retained +50, +80, +100, +170, +200, +325)

<u>Sieve Size Range</u>	<u>Wt on Sieve g</u>	<u>Fraction on Sieve</u>	<u>Passed Size Micron</u>	<u>Cumulative Fraction on Sieve</u>	<u>Cal Air Velocity Ft/Min</u>
- 40	0				
-40+50	12.6	0.2880	420	0.288	950
-50+80	9.9	0.2265	297	0.515	475
-80+100	3.2	0.0732	177	0.588	169
-100+170	7.3	0.1670	149	0.755	120
-170+200	4.0	0.0915	88	0.847	42
-200+325	4.5	0.1030	74	0.950	30
-325+X<44	2.2	0.0530	44		10.4

Figure 1

Air Suspension of Washed Ground KTPB Solids
For Estimate of Radioactive Cesium Release
From ITP Filter Box

Fig 2

TABLE II
Air Suspension of Washed and Ground KTPB Solids
Tube Tare 39.7516 g. Tube + Beaker Tare 143.1331 g
Temp 40 °C

<u>Total</u> <u>grams</u>	<u>Solids</u> <u>grams</u>	<u>mL/min</u>	<u>Air</u> <u>ft/min</u>	<u>Suspended</u> <u>Calc micron</u>
143.317	0.184	5.9	0.0493	3.01
143.319	0.186	24.5	0.2046	6.12
143.316	0.183	57	0.4760	9.33
143.317	0.184	104	0.8685	12.58
143.320	0.184	154	1.2861	15.30
143.318	0.185	206	1.7203	17.69
143.319	0.186	259	2.1629	19.83
143.319	0.186	314	2.6222	21.83
143.323	0.190	370	3.0899	23.69
143.322	0.189	426	3.5575	25.41
143.308	0.175	500	4.175	27.52
143.289	0.156	1000	8.351	38.65
143.182	0.0489	1500	12.53	47.59
143.146	0.0129	2000	16.702	54.92

**CUMULATIVE WEIGHT FRACTION ITP SOLIDS RETAINED IN VERTICAL TUBE
VS MEASURED AIR VELOCITY TO SUSPEND CALCULATED SIZE PARTICLE (1.20 gm/L)
(ADDED ITP SOLIDS THAT PASSED 325 MESH SCREEN < 44 MICRON)**

FIGURE 3

TABLE III
LABORATORY PREPARATION
ITP WASHED SLURRY - 10 wt% KTPB

Assumes soluble salts dissolved in 0.9 L filtrate contained in 1 L slurry
 Add chemicals in following order to 400 g H₂O. Dilute final mixture to 1 L/(1038 g).

<u>CHEMICAL</u>	<u>MOLARITY</u>	<u>MOL. WEIGHT (g)</u>	<u>Wt. TO ADD (g)</u>
KOH	0.290	56	16.24
Al(NO ₃) ₃ •9H ₂ O	0.0031	375	1.17
NaNO ₃	0.0105	85	0.90
NaNO ₂	0.0693	69	4.80
Na ₂ CO ₃ •1H ₂ O	0.0017	123	0.22
Na ₂ SO ₄	0.0014	142	0.20
NaTPB (.55M, 1.045 sg)	0.290	342	551.0

Supernate density = 1.0213, Slurry density = 1.0375 g/L

Density KTPB (Solid) = 1.21 g/L

KTPB Solids in mixture = 0.1038 kg/L

Total Solids = 0.129 kg/L

Total Solids = 12.43 wt%

REFERENCES

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2. Perry., J. H. "Chemical Engineers' Handbook", 4th ed., Chap. 8, McGraw-Hill, New York, 1963
3. Marks Handbook (1978), 8th Ed pp 18-10
4. SRT-PTG-93-0075, Maurer R.S., ITP Filter A2 and Heat Generation Calculations.

An A2 is the amount of material in a package, if spilled by accident, that would cause a 5 R committed effective dose equivalent OR 50 R to an organ OR 15 R to the lens of the eye after 30 minutes exposure BASED ON CERTAIN ACCIDENT SCENARIOS considering all pathways. The DOT leak rate of 10-6 A2/hr under NORMAL Conditions of Transport could give 10 to 1000 mRem annual exposure based on 20% of 2000 hrs in the vicinity of the package.

For the seal weld of the ITP filter box, The Packaging and Transportation Group estimates a 10-5 A2/hr rather than the 10-6 A2/hr DOT value PROVIDING we administratively limit personnel exposures to 40 hr/yr (increasing exposure rate by a factor of 10 but cutting exposure time by a factor of 10 from 20% of 2000 hrs).

Table A-1 of 10CFR71 lists the A2 values in terms of Curies for each radionuclide as well as the specific activity in Curies/gram. The filter box FDC lists the quantity of each of the isotopes that the box is to be designed for.

QUALITY ASSURANCE

All work was conducted according to the SRTC Quality Assurance Program. Data for these tests are in Laboratory Notebook DPSTN-3063.

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