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CESIUM DETERMINATION FOR THE DWP OFF-GAS SYSTEM PERFORMANCE TEST

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ABSTRACT

In an effort to determine the cesium decontamination factors (DF's) of the Defense Waste Processing Facility (DWPF) melter off-gas system at the Savannah River Site, the system was verified during an off-gas performance test. The off-gas performance test occurred during the DWPF Waste Qualification Campaigns, WP-16 and WP-17. The verification of the off-gas system, which eliminated the need for a startup test involving a radioactive cesium addition, was based on the analysis of nonradioactive cesium across the first and second stage High Efficiency Particulate Air (HEPA) filters.

The amount of cesium on the first and second stage HEPA filters was determined by leaching samples from each HEPA filter with nitric acid and analyzing the leachate using Inductively Coupled Plasma - Mass Spectrometry (ICP-MS). The ICP-MS method has been demonstrated to be sufficiently sensitive to measure small quantities of cesium on filters. Based on the cesium results of the HEPA filter, cesium DF's were calculated. The DF's indicated that the DWPF HEPA filters performed better than the design basis.

In addition to the HEPA filters, a determination of the cesium concentration in the melter feed, the canister glass and the off-gas condensate was made. These analyses provided information on cesium flow through the DWPF. This paper will focus on the methods used in the determination of nonradioactive cesium and the calculation of the DF's for the DWPF melter off-gas system.

I. INTRODUCTION

The performance of the Defense Waste Processing Facility (DWPF) melter off-gas system was verified during the Waste Qualification Campaigns, WP-16 and WP-17. Clean High Efficiency Particulate Air (HEPA) filters were installed prior to glass filling of the fifth canister in the WP-16 campaign. Upon completion of the WP-17 campaign, the filters were removed from the off-gas system and transported to the Savannah River Technology Center (SRTC) for cesium analysis.

The analysis of the HEPA filters for cesium required that the samples first be ultrasonically leached in dilute acid. The resulting leachates were analyzed using Inductively Coupled Plasma Mass Spectroscopy (ICP-MS). Similar methods have previously been used.¹ Along with the HEPA filters, SRTC analyzed the DWPF sludge, the canister glass and the off-gas condensate for cesium.

The decontamination factor (DF) for the melter off-gas system up to the first stage HEPA filter was approximated as the ratio of the amount cesium fed to the melter to the amount of cesium collected on the first stage HEPA filter. The DF of the first HEPA filter was the ratio of cesium on the first filter to the cesium on the second filter. Calculation of these DF's based on a non-radioactive test, showed that the off-gas system exceeded the design basis and eliminated the need for a melter test with radioactive cesium.

II. CESIUM IN THE DWPF SLUDGE, GLASS AND CONDENSATE

Five feed batches were produced during the off-gas performance test. The amount of cesium in the simulated sludge and precipitate was

determined by dissolving the sample and analyzing the solution by Atomic Absorption (AA). The percent cesium in the sample was multiplied by the total volume fed. The result of 87.9 lbs was the total amount of cesium fed to the melter during the off-gas performance test.

During the off-gas performance test, twenty-four canisters were filled with glass. Fifteen of these canisters were filled during WP-16 and nine were filled during WP-17. A sample of glass from each of these canisters was submitted for analysis. The glass samples were dissolved and the resulting leachate was analyzed by Atomic Absorption (AA). The results of the glass samples were multiplied by the amount of glass poured and resulted in a total of 63 lbs of cesium.

DWPF sampled the condensate from the off-gas condensate tank (OGCT). Samples taken on seven separate days were sent to SRTC for analysis by AA. The cesium values were averaged and then multiplied by the total volume of condensate transferred out of the OGCT. A total of approximately 4.5 lbs of cesium was found in the off-gas condensate.

A quick calculation of the material balance does not appear to be very good. However, there are several explanations. First, the samples from the OGCT were taken intermittently and may not have included all batches transferred from the OGCT. Second, other components of the off-gas system were not analyzed for cesium content. Third, redundant back-up off-gas system was used during the off-gas performance test, but the condensate from this system was not sampled or analyzed. If these sources for cesium had been considered, the material balance would have been much better.

III. CESIUM IN THE DWPF HEPA FILTERS

Although the ICP-MS was previously used to detect cesium on filter paper samples,¹ it had not been tested on the HEPA filter itself. Therefore, samples were taken from the HEPA filters previously used in the DWPF. The analytical methods were refined using these samples. A clean HEPA filter was also obtained for testing. Samples of this filter were spiked with a cesium solution and the percent recovery was determined to be approximately 90%

efficient. Although the clean HEPA filter was not identical to the DWPF HEPA filter, it was made by the same manufacturer and was used to provide an estimate of the cesium background.

A total of twenty-two samples were removed from the primary HEPA filter. Figure 1 contains the results as a function of sample location for the air inlet side of the filter. Samples removed from the air outlet side of the filter were approximately equivalent to the results shown in Figure 1. Since the HEPA filter is folded, the particulates are expected to accumulate on the front and back of each fold. The results presented here, therefore, can be considered conservative since only the front and back of each fold were sampled.

				80			
			51	40		48	
				69			
	51	50	46	41	42	60	43
				45			
			62	48		54	
				57			

Figure 1 - Sample Results (in micrograms/gram of filter paper) for the First Stage HEPA filter - Air Inlet

Averaging the analyses for the entire primary filter results in a value of 0.0058 wt% cesium. This value was multiplied by the weight of the entire HEPA filter to obtain the number of grams of cesium on the HEPA filter, which was calculated to be 0.199 g. The weight of the HEPA filter was based on measurements and discussions with the manufacturer and was estimated to be approximately 3400 grams.

Twelve samples were removed from the secondary HEPA filter. The results and sample locations for the air inlet side of the filter are given in Figure 2. Three samples removed from the air outlet side of the filter contained no more than 0.3 mg/g of cesium. The average cesium value for these samples was 0.000035 wt%. Conversion of this number results in 0.0012 g of cesium on the secondary HEPA filter. A sample of a blank HEPA filter was submitted along with

the samples and was essentially equivalent to the secondary HEPA filter samples.

0.2	0.4	0.8
0.2	0.2	0.4
0.5	0.4	0.3

Figure 2 - Sample Results (in micrograms/gram of filter paper) for the Second Stage HEPA filter - Air Inlet

IV. CESIUM DECONTAMINATION FACTORS (DF'S)

The DF of the melter off-gas system up to the first stage HEPA filter was approximated as the ratio of cesium fed to the melter (87.9 lbs) to the amount of cesium found on the first HEPA filter (0.199 g). Converting the units leads to a DF of 2×10^5 . The design basis DF is 2×10^4 , indicating that the DWPF off-gas system up to the first stage HEPA filter was performing better than design.

The DF for the off-gas system through the first stage HEPA filter was also calculated during the DWPF off-gas system performance test. This DF was approximated as the ratio of cesium fed (87.9 lbs) to the amount of cesium found on the second stage HEPA filter (0.0012 g). Since the amount found on the second HEPA filter was essentially background, indicating that very little cesium passed through the first HEPA filter, this DF calculation can be considered conservative. This conservative DF through the first HEPA filter of 3.4×10^7 is still greater than the design basis DF of 4×10^6 .

CONCLUSIONS

The measured cesium DF's for the DWPF melter off-gas system showed that the system functioned better than the design basis. These results were obtained using methods developed to detect non-radioactive cesium. Consequently,

a planned radioactive cesium test was eliminated, reducing the overall costs and accelerating the schedule for radioactive operations.

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REFERENCES

1. J. R. Zamecnik, D. H. Miller, and J. T. Carter, "Measurement of Cesium Emissions During the Vitrification of Simulated High-Level Radioactive Waste", WSRC-MS-92-251, Proceedings of the 22nd DOE/NRC Nuclear Air Cleaning Conference, NUREG/CP-0130, Vol. 1, (1993).