Behavior of Mercury in the Formic Acid Vent Condenser-Interim Report

by

J. R. Zamecnik

Westinghouse Savannah River Company

Savannah River Site

Aiken, South Carolina 29808

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Westinghouse Savannah River Company
Savannah River Site
Aiken, SC 29808

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APPROVALS

Management Approvals:

E. W. Holtzscheiter 10/12/94
E. W. Holtzscheiter, Manager, Defense Waste Processing Technology, SRTC

David A. Crowley 10/11/94
D. A. Crowley, Manager, Large Scale Experimentation Group, DWPT, SRTC

Technical Review:

T. L. Fellingner 10/12/94
T. L. Fellingner, Large Scale Experimentation Group, DWPT, SRTC

Author:

J. R. Zamecnik 10-11-94
J. R. Zamecnik, Large Scale Experimentation Group, DWPT, SRTC

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BACKGROUND

The performance of the DWPF Formic Acid Vent Condenser is the subject of DWPF Technology Issue 4.2 "Behavior of Mercury in the FAVC." The Formic Acid Vent Condenser (FAVC) is a chilled water condenser with a High Efficiency Mist Eliminator (HEME) and is designed to cool to 10°C the offgas from the Sludge Receipt and Adjustment Tank (SRAT), Slurry Mix Evaporator (SME), Melter Feed Tank (MFT), Recycle Collection Tank (RCT), and the Precipitate Reactor Bottoms Tank (PRBT). By cooling to 10°C, water vapor is removed such that it will not condense downstream in the Process Vessel Vent Header, and the mercury content should be reduced to saturation at 10°C. Mercury emissions from DWPF are limited by an environmental permit;¹ in this permit it is assumed that the mercury concentration exiting the FAVC does not exceed saturation at the exit temperature (which is assumed to be 10°C except during peak NO_x evolution).

To determine if the mercury content of the offgas exiting the FAVC will be at or below saturation, measurements of the mercury concentration in the offgas were performed during the BL1 and PX6 runs of the IDMS. During BL1, the concentration of mercury at the inlet to the FAVC was also measured. These tests were conducted without the HEME.

The performance of the FAVC with the HEME and with the ammonia scrubber will be tested during the PX7 run of the IDMS.

SUMMARY

The concentrations of mercury at the FAVC inlet and exit were measured during the BL1 and PX6 runs of the Integrated DWPF Melter System (IDMS) with the HEME bypassed and without the ammonia scrubber. The results show that mercury concentrations of approximately 2.6-12.7 (mean = 6.2) times saturation occur at the FAVC exit. The concentration of mercury at the SRAT condenser exit was found to be 10 times the saturation value.

FAVC exit mercury concentrations of 6.2 times saturation would result in DWPF emitting up to 438 lb/yr of mercury at 100% attainments, which is in excess of the permit limit of 175 lb/yr. However, operation of the FAVC with the HEME should reduce the mercury emissions. The addition of the ammonia scrubbers should also reduce the mercury emissions since the nitric acid used to scrub ammonia should also scrub mercury.

EXPERIMENTAL

The concentration of mercury in the offgas was measured by extracting samples from the offgas system. These samples were passed through impingers (bubblers) to absorb the mercury. The gas samples were first passed through two impingers containing 2 M NaOH to remove most of the NO_x. It was then passed through three impingers

containing 1.5-4 (w/v)% KMnO_4 in 10 (v/v)% H_2SO_4 . The use of KMnO_4 in H_2SO_4 has been described as the most effective method for absorbing elemental mercury, mercury compounds (except organomercury compounds), and particulate mercury. The mercury is oxidized to form Hg^{+2} . A removal efficiency of 90-96% for a single impinger and 99% for two or more impingers has been reported.^{2,3,4,5,6}

In the presence of oxidizing gases such as SO_2 or NO_x , pretreatment of the gas sample is necessary to preserve the absorbing ability of the $\text{KMnO}_4/\text{H}_2\text{SO}_4$ absorbent.³ For SO_2 , the use of acidic H_2O_2 is recommended. Caustic (NaOH) may also be used, but it will absorb some of the mercury present and convert it to HgO . However, for this work, caustic was used since the impingers containing the caustic were also analyzed for mercury.

The analysis of the impinger samples was performed by Vapor Generation Apparatus (VGA) (cold vapor) atomic absorption (AA) spectroscopy by the DWPT laboratory at TNX. The caustic impinger solutions were treated with acidic permanganate to oxidize all the mercury to Hg^{+2} and then the mercury was reduced to elemental Hg by hydroxylamine before measurement on the AA. The $\text{KMnO}_4/\text{H}_2\text{SO}_4$ impinger solutions were also treated with hydroxylamine before measurement on the AA.

RESULTS AND DISCUSSION

Sampling for mercury at the exit of the FAVC (without the HEME or ammonia scrubber) was conducted during the BL1 (6/90) and PX6 (12/93) runs of the IDMS. In the BL1 run, sampling at the FAVC inlet was also performed. The BL1 run used the formic acid flowsheet, whereas the PX6 run used the nitric acid flowsheet. Sampling in BL1 was performed during the formic acid reflux period, during which most of the mercury is stripped from the sludge. In PX6, sampling was done during the Precipitate Hydrolysis Aqueous (PHA) addition. Sampling during nitric acid addition was not performed since mercury is not evolved during this phase.

The concentrations of mercury in the samples taken during BL1 and PX6 are shown in Figures 1 and 2, respectively. The data show that for some of the samples (BL1 Set 1, PX6 Set 5), all of the mercury was probably removed in the impingers since the amount of mercury in the last impinger was essentially zero. For most of the others, it appears that not all the mercury was absorbed. However, the amount of mercury in the offgas was probably not more than about 10% higher than measured. The lower than expected efficiency for the PX6 samples was probably caused by using too high a gas sampling rate. Nonetheless, the results are adequate for determining the effectiveness of mercury removal.

Figure 1. Concentrations of Mercury in BL1 Impinger Samples.

Figure 2. Concentrations of Mercury in PX6 Impinger Samples.

Figure 3. Mercury Concentration at the FAVC Exit.

The total amount of mercury absorbed by the impinger train was calculated from the analyses of the individual impingers. This information combined with the volume of gas sampled was then used to determine the concentration of mercury in the gas sample (see Appendix A). Figure 3 shows the concentration of mercury measured and the concentration of mercury that would have existed if the gas had been saturated with mercury at the FAVC exit temperature.

The data clearly show that the concentration of mercury exiting the FAVC (without HEME or ammonia scrubbers) is greater than the amount that would be found if the vapor were saturated, indicating that the vapor was supersaturated with mercury (or supercooled with respect to mercury). The HEME and ammonia scrubber may further reduce the mercury concentration if the supersaturated mercury is present as a mist.

Table 1 shows the condenser exit temperatures, measured and saturation concentrations, and the amount of supercooling of the offgas with respect to the measured mercury concentration. Lee⁷ predicts that the vapor exiting a condenser will be supersaturated with mercury if the inlet vapor is supercooled. Lee also predicts that if the inlet relative humidity of water is less than saturation, the outlet vapor will be even more supersaturated with mercury. The FAVC inlet molar relative humidities for BL1 and PX6 were approximately 80% and 60-75%. The data below show that supercooling occurs at both the exits of the SRAT condenser and the FAVC.

The ratio of the measured mercury to saturation mercury concentrations at the FAVC exit averaged 6.2. The calculation of the projected mercury emissions from the Chemical

Process Cell is 21.2-59.0 lb/yr.¹ If the mercury concentration were 6.2X that assumed, the emissions from the CPC would be 131-366 lb/yr, which would exceed the permit level of 175 lb/yr.

Table 1. Measured and Saturation Mercury Concentrations.

Sample	Mean Temp. (°C)	Mercury Measured (mg/m ³)	Mercury at Saturation (mg/m ³)	Mercury <u>Measured</u> Saturation	Saturation Temp. (°C)	Supercooling (°C)
FAVC Out:						
BL1 Set 1	11.07 ^a	77.5	6.1	12.7	43.0	31.9
BL1 Set 2	8.05 ^a	36.0	4.9	7.3	32.9	24.3
PX6 Set 1	13.48 ^b	31.5	7.5	4.2	30.9	17.4
PX6 Set 2	9.62 ^b	22.0	5.3	4.2	26.6	17.0
PX6 Set 3	7.42 ^b	12.3	4.4	2.8	19.5	12.0
PX6 Set 4	7.86 ^b	38.5	4.6	8.4	33.7	25.8
PX6 Set 5	10.95 ^b	24.3	6.0	4.1	27.7	16.8
SRATC Out:						
BL1 Set 1	36.8	539.6 ^c	49.4	10.9	73.0	36.2
BL1 Set 2	30.77	285.3 ^c	31.2	9.1	62.4	31.7

^a calculated from FAVC HEME exit temperature (210TT) using offgas temperature models (see Appendix A).⁸

^b measured FAVC tube exit temperature (170TT).

^c calculated from FAVC inlet measurement and offgas flowrates (see Appendix A).

However, none of the data given here was taken with the offgas flowing through FAVC HEME. Use of the HEME would be expected to improve mercury removal if the mercury exists as a mist. Also, the ammonia scrubbers on the SRAT and SME, which operate with pH 1-3 nitric acid, should remove some mercury from the offgas.

CONCLUSIONS

1. The Formic Acid Vent Condenser, without a HEME, does not reduce the concentration of mercury to saturation at the condenser exit temperature.
2. The SRAT (or SME) condenser also does not reduce the concentration of mercury to saturation at the condenser exit temperature.
3. Supercooling of mercury in the condenser exit vapor occurs as predicted by Lee.

RECOMMENDATIONS

1. Perform an IDMS run with the FAVC HEME in place to determine its effect on mercury removal.

The PX7 run will be done with the HEME in place. The FAVC exit offgas will be sampled and analyzed for mercury.

2. Determine whether the ammonia scrubbers will remove mercury.

In PX7, the vapor exiting the scrubber will be sampled and analyzed for mercury.

3. The gas sampling rate should be approximately 0.1 cfm so that the absorber efficiency approaches 99%.

This rate will be used during PX7.

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8. Zamecnik, J. R., *The Effect of Nitric Oxide Oxidation on the DWPF Formic Acid Vent Condenser (FAVC) Exit Temperature (U)*, WSRC-RP-92-1174, October 29, 1992.

APPENDIX

SATURATION VAPOR PRESSURE OF MERCURY

$$p_{\text{Hg}}^{\text{sat}} = \exp\left(18.072 - \frac{7079.256}{T + 265.47}\right)$$

where $p_{\text{Hg}}^{\text{sat}}$ = torr

$T \equiv ^\circ\text{C}$

ANALYSIS OF MERCURY SAMPLING DATA

See attached sheets.

ESTIMATION OF FAVC TUBE EXIT TEMPERATURE

For the BL1 data, the FAVC HEME exit temperature was calculated by using models developed to predict the temperature rise in the FAVC due to NO oxidation (see reference 8):

$$T_{\text{HEME}} = 2.9171[\text{NO}_x]^{0.5681} + 3.7210 \beta [\text{NO}_x]^{0.3331} + T_{\text{amb}} + T_c + T_{\text{app}}$$

where T_{HEME} = FAVC HEME exit temperature ($^\circ\text{C}$)

T_c = average cooling water temperature (inlet & outlet) ($^\circ\text{C}$)

T_{app} = approach temperature ($^\circ\text{C}$) ≈ 1.6

T_{amb} = temperature rise from tube exit to HEME exit due to ambient heat conduction ($^\circ\text{C}$)

$[\text{NO}_x]$ = concentration of NO_x at FAVC exit (mol %)

β = bypassing factor (= 0 if HEME bypassed; = 1 if HEME not bypassed)

The predicted and measured FAVC HEME exit temperatures are shown in Figure A-1. Since the data fit well, estimation of the tube exit temperature using the models was deemed appropriate.

The FAVC tube exit temperature was estimated as:

$$T_{\text{tube}} = 2.9171[\text{NO}_x]^{0.5681} + T_c + T_{\text{app}}$$

where T_{tube} = FAVC tube exit temperature ($^\circ\text{C}$)

T_c = average cooling water temperature (inlet & outlet) ($^\circ\text{C}$)

T_{app} = approach temperature ($^\circ\text{C}$) = 1.6

$[\text{NO}_x]$ = concentration of NO_x at FAVC exit (mol %)

The predicted FAVC tube exit temperature is also shown in Figure A-1.

Figure A-1. Measured and Predicted FAVC Temperatures

PX6-DF-HG-SAMPLE1

IDMS RUN: PUREX 6
 COMMENTS: MERCURY SAMPLING SET1

DATE: 12/7/93
 TIME: 13:55 PM - 19:00 PM

WASHED SAMPLE:

		IDMS # ID-RUN-IMPI-				
		7420	7421	7422	7423	7424
		NaOH	NaOH	KMnO4	KMnO4	KMnO4
Empty bottle	g	38.76	39.13	38.10	38.24	39.05
Sample + wash water	g	413.28	498.34	178.25	112.01	88.95
Weight of sample	g	374.52	459.21	140.15	73.77	49.90
Approx. density of sample	g/ml	1.10	1.10	1.10	1.10	1.10
Volume of sample	ml	340.5	417.5	127.4	67.1	45.4
Conc of Hg	mg/liter (ppm)	132.0	125.0	100.0	71.4	75.2
Hg collected	mg	44.9	52.2	12.7	4.8	3.4
% of total collected	%	38.07	44.20	10.79	4.06	2.89
Total Hg collected	mg	118.1				

DRY GAS SAMPLE:

Gas Volume cu ft 132.50

MEASURED MERCURY CONCENTRATION:

Hg concentration	ug/ft3	891.06
Hg concentration	g/m3	0.0315
Hg concentration	ppm by vol	3.690 (assuming 1 atm pressure)
Saturation temp	°C	30.90
Subcooling of Hg	°C	17.42

MERCURY CONCENTRATION AT SATURATION (PROCESS BASIS) :

Average Temperature °C 13.48

Hg concentration	ug/ft3	213.3
Hg concentration	g/m3	0.0075
Hg concentration	ppm by vol	0.883

PX6-DF-HG-SAMPLE2

IDMS RUN: PUREX 6

COMMENTS: MERCURY SAMPLING SET2

DATE: 12/7/1993 - 12/8/93

TIME: 19:10 PM - 00:15 AM

WASHED SAMPLE:

IDMS # ID-RUN-IMPI-

		7425	7426	7427	7428	7429
		NaOH	NaOH	KMnO4	KMnO4	KMnO4
Empty bottle	g	38.84	39.01	38.81	38.75	38.93
Sample + wash water	g	225.93	254.33	312.51	268.77	270.36

Weight of sample	g	187.09	215.32	273.70	230.02	231.43
Approx. density of sample	g/ml	1.1	1.1	1.1	1.1	1.1
Volume of sample	ml	170.1	195.7	248.8	209.1	210.4

Conc of Hg	mg/liter (ppm)	87.2	75.4	169.0	81.1	62.7
------------	----------------	------	------	-------	------	------

Hg collected	mg	14.83	14.76	42.05	16.96	13.19
% of total collected	%	14.57	14.50	41.31	16.66	12.96

Total Hg collected	mg	101.79
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DRY GAS SAMPLE:

Gas Volume	cu ft	163.20
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MEASURED MERCURY CONCENTRATION:

Hg concentration	ug/lit	623.72
Hg concentration	g/m3	0.0220
Hg concentration	ppm by vol	2.548 (assuming 1 atm pressure)
Saturation temp	°C	26.59
Subcooling of Hg	°C	16.97

MERCURY CONCENTRATION AT SATURATION (PROCESS BASIS) :

Average Temperature	°C	9.62
---------------------	----	------

Hg concentration	ug/lit	151.5
Hg concentration	g/m3	0.0053
Hg concentration	ppm by vol	0.619

PX6-DF-HG-SAMPLE3

IDMS RUN: PUREX 6
 COMMENTS: MERCURY SAMPLING SET 3

DATE: 12/8/93
 TIME: 00:23 AM - 5:30 AM

WASHED SAMPLE:

		IDMS # ID-RUN-IMPI- ----				
		7430	7431	7432	7433	7434
		NaOH	NaOH	KMnO4	KMnO4	KMnO4
Empty bottle	g	38.49	38.40	38.18	38.56	38.49
Sample + wash water	g	226.61	238.24	285.43	293.21	238.52
Weight of sample	g	188.12	199.84	247.25	254.65	200.03
Approx. density of sample	g/ml	1.1	1.1	1.1	1.1	1.1
Volume of sample	ml	171.0	181.7	224.8	231.5	181.8
Conc of Hg	mg/liter (ppm)	137.0	28.7	78.9	88.8	43.8
Hg collected	mg	23.43	5.21	17.73	20.56	7.96
% of total collected	%	31.28	6.96	23.68	27.45	10.63
Total Hg collected	mg	74.90				

DRY GAS SAMPLE:

Gas Volume cu ft 215.60

MEASURED MERCURY CONCENTRATION:

Hg concentration	ug/ft3	347.40	(assuming 1 atm pressure)
Hg concentration	g/m3	0.0123	
Hg concentration	ppm by vol	1.408	
Saturation temp	°C	19.46	
Subcooling of Hg	°C	12.04	

MERCURY CONCENTRATION AT SATURATION (PROCESS BASIS) :

Average Temperature °C 7.42

Hg concentration	ug/ft3	124.0
Hg concentration	g/m3	0.0044
Hg concentration	ppm by vol	0.503

PX6-DF-HG-SAMPLE4

IDMS RUN: PUREX 6

COMMENTS: MERCURY SAMPLING SET 4

DATE: 12/8/93

TIME: 06:15 AM - 11:20 AM

WASHED SAMPLE:

IDMS # ID-RUN-IMPI-

		7435	7436	7437	7438	7441
		NaOH	NaOH	KMnO4	KMnO4	KMnO4
Empty bottle	g	39.08	38.46	38.20	38.65	38.15
Sample + wash water	g	220.04	276.65	264.13	337.97	218.54
Weight of sample	g	180.96	238.19	225.93	299.32	180.39
Approx. density of sample	g/ml	1.1	1.1	1.1	1.1	1.1
Volume of sample	ml	164.5	216.5	205.4	272.1	164.0
Conc of Hg	mg/liter (ppm)	86.2	32.5	467.0	301.0	82.0
Hg collected	mg	14.18	7.04	95.92	81.90	13.45
% of total collected	%	6.67	3.31	45.14	38.55	6.33
Total Hg collected	mg	212.49				

DRY GAS SAMPLE:

Gas Volume cu ft 195.00

MEASURED MERCURY CONCENTRATION:

Hg concentration	ug/ft3	1089.68	
Hg concentration	g/m3	0.0385	
Hg concentration	ppm by vol	4.424	(assuming 1 atm pressure)
Saturation temp	°C	33.68	
Subcooling of Hg	°C	25.82	

MERCURY CONCENTRATION AT SATURATION (PROCESS BASIS) :

Average Temperature °C 7.86

Hg concentration	ug/ft3	129.1
Hg concentration	g/m3	0.0046
Hg concentration	ppm by vol	0.524

PX6-DF-HQ SAMPLE5

IDMS RUN: PUREX 6

COMMENTS: MERCURY SAMPLING SET 5

DATE: 12/8/93

TIME: 11:37 AM - 16:35 PM

WASHED SAMPLE:

		IDMS # ID-RUN-IMPI- _____				
		7442	7443	7444	7445	7446
		NaOH	NaOH	KMnO4	KMnO4	KMnO4
Empty bottle	g	38.15	38.82	38.87	38.47	38.77
Sample + wash water	g	262.54	255.35	286.40	258.90	260.55
Weight of sample	g	224.39	216.53	247.53	220.43	221.78
Approx. density of sample	g/ml	1.1	1.1	1.1	1.1	1.1
Volume of sample	ml	204.0	196.8	225.0	200.4	201.6
Conc of Hg	mg/liter (ppm)	83.0	22.4	391.0	14.0	1.0
Hg collected	mg	16.931	4.409	87.986	2.805	0.204
% of total collected	%	15.07	3.93	78.32	2.50	0.18
Total Hg collected	mg	112.34				

DRY GAS SAMPLE:

Gas Volume cu ft 163.50

MEASURED MERCURY CONCENTRATION:

Hg concentration	ug/ft3	687.07	
Hg concentration	g/m3	0.0243	
Hg concentration	ppm by vol	2.820	(assuming 1 atm pressure)
Saturation temp	°C	27.72	
Subcooling of Hg	°C	16.77	

MERCURY CONCENTRATION AT SATURATION (PROCESS BASIS) :

Average Temperature °C 10.95

Hg concentration	ug/ft3	170.6
Hg concentration	g/m3	0.0060
Hg concentration	ppm by vol	0.700

BL1-DF-HG-FR1-IN

IDMS RUN: BL1
 COMMENTS: FORMIC REFLUX 1 FAVC IN

DATE: 6/20/90
 TIME: 22:00-23:00

WASHED SAMPLE:

		IDMS # ID-RUN-IMPI-				
		3378	3379	3380	3381	3382
		NaOH	NaOH	KMnO4	KMnO4	KMnO4
Empty bottle	g	68.80	68.40	69.80	69.00	68.60
Sample + wash water	g	662.70	438.60	303.00	538.20	404.30
Weight of sample	g	427.3	414.1	545.3	480.7	358.9
Approx. density of sample	g/ml	1.10	1.10	1.10	1.10	1.10
Volume of sample	ml	388.5	376.5	495.7	437.0	326.3
Conc of Hg	mg/liter (ppm)	31.30	4.30	39.00	0.26	0.05
Hg collected	mg	12.2	1.6	19.3	0.1	0.0
% of total collected	%	36.58	4.87	58.16	0.34	0.05
Total Hg collected	mg	33.2				

DRY GAS SAMPLE:

Gas Volume cu ft 3.70

MEASURED MERCURY CONCENTRATION AT FAVC INLET:

Hg concentration	ug/ft3	8983.97
Hg concentration	g/m3	0.3173
Hg concentration	ppm by vol	40.227 (assuming 1 atm pressure)
Saturation temp	°C	64.20

MERCURY CONCENTRATION AT SRAT CONDENSER EXIT:

SRATC extd flow / Total flow		0.588
Hg concentration	ug/ft3	15278.86
Hg concentration	g/m3	0.5396
Hg concentration	ppm by vol	68.413
Saturation temp	°C	72.95
Subcooling of Hg	°C	36.15

MERCURY CONCENTRATION AT SATURATION (SRAT CONDENSER EXIT) :

Average Temperature	°C	36.80
Hg concentration	ug/ft3	1397.6
Hg concentration	g/m3	0.0494
Hg concentration	ppm by vol	6.258

BL1-DF-HG-FR2-IN

IDMS RUN: BL1
 COMMENTS: FORMIC REFLUX 2 FAVC IN

DATE: 6/21/90
 TIME: 01:00-02:00

WASHED SAMPLE:

		IDMS # ID-RUN-IMPI-				
		3395	3396	3397	3398	3399
		NaOH	NaOH	KMnO4	KMnO4	KMnO4
Empty bottle	g	68.80	68.70	68.50	68.40	69.10
Sample + wash water	g	474.70	500.90	480.70	593.80	347.70
Weight of sample	g	427.3	414.1	545.3	480.7	358.9
Approx. density of sample	g/ml	1.10	1.10	1.10	1.10	1.10
Volume of sample	ml	388.5	376.5	495.7	437.0	326.3
Conc of Hg	mg/liter (ppm)	5.80	1.01	26.40	1.43	0.55
Hg collected	mg	2.3	0.4	13.1	0.6	0.2
% of total collected	%	13.63	2.30	79.20	3.78	1.09
Total Hg collected	mg	16.5				

DRY GAS SAMPLE:

Gas Volume: cu ft 5.10

MEASURED MERCURY CONCENTRATION AT FAVC INLET:

Hg concentration	ug/ft3	3240.16	(assuming 1 atm pressure)
Hg concentration	g/m3	0.1144	
Hg concentration	ppm by vol	14.226	
Saturation temp	°C	48.64	

MERCURY CONCENTRATION AT SRAT CONDENSER EXIT:

SRATC exit flow / Total flow		0.401
Hg concentration	ug/ft3	8080.20
Hg concentration	g/m3	0.2853
Hg concentration	ppm by vol	35.477
Saturation temp	°C	62.44
Subcooling of Hg	°C	31.67

MERCURY CONCENTRATION AT SATURATION (SRAT CONDENSER EXIT) :

Average Temperature	°C	30.77
Hg concentration	ug/ft3	884.9
Hg concentration	g/m3	0.0312
Hg concentration	ppm by vol	3.885

BL1-DF-HQ-FR1-OUT

IDMS RUN: BL1
 COMMENTS: FORMIC REFLUX 1 FAVC OUT

DATE: 6/20/90
 TIME: 22:00-23:00

WASHED SAMPLE:

		IDMS # ID-RUN-IMPI-				
		3385	3386	3387	3388	3389
		NaOH	NaOH	KMnO4	KMnO4	KMnO4
Empty bottle	g	69.00	68.70	69.30	68.90	68.90
Sample + wash water	g	490.90	492.10	565.80	533.60	301.20
Weight of sample	g	421.90	423.40	496.50	464.70	232.30
Approx. density of sample	g/ml	1.1	1.1	1.1	1.1	1.1
Volume of sample	ml	383.5	384.9	451.4	422.5	211.2
Conc of Hg	mg/liter (ppm)	13.59	2.20	17.10	0.11	0.04
Hg collected	mg	5.212	0.847	7.718	0.046	0.008
% of total collected	%	37.68	6.12	55.80	0.34	0.06
Total Hg collected	mg	13.8				

DRY GAS SAMPLE:

Gas Volume cu ft 6.30

MEASURED MERCURY CONCENTRATION:

Hg concentration	ug/ft3	2195.62
Hg concentration	g/m3	0.0775
Hg concentration	ppm by vol	9.015 (assuming 1 atm pressure)
Saturation temp	°C	43.01
Subcooling of Hg	°C	31.94

MERCURY CONCENTRATION AT SATURATION (PROCESS BASIS) :

Average Temperature °C 11.07 estimated

Hg concentration	ug/ft3	172.4
Hg concentration	g/m3	0.0061
Hg concentration	ppm by vol	0.708

BL1-DF-HG-FR2-OUT

IDMS RUN: BL1
 COMMENTS: FORMIC REFLUX 2 FAVC OUT

DATE: 6/21/90
 TIME: 01:00-02:00

WASHED SAMPLE:

IDMS # ID-RUN-IMPI-

		3402	3403	3404	3405	3406
		NaOH	NaOH	KMnO4	KMnO4	KMnO4
Empty bottle	g	68.90	68.40	68.60	68.20	68.60
Sample + wash water	g	496.20	482.50	613.90	548.90	427.50
Weight of sample	g	427.3	414.1	545.3	480.7	358.9
Approx. density of sample	g/ml	1.10	1.10	1.10	1.10	1.10
Volume of sample	ml	388.5	376.5	495.7	437.0	326.3
Conc of Hg	mg/liter (ppm)	1.99	2.74	4.46	3.16	5.03
Hg collected	mg	0.8	1.0	2.2	1.4	1.6
% of total collected	%	10.98	14.66	31.42	19.62	23.32
Total Hg collected	mg	7.0				

DRY GAS SAMPLE:

Gas Volume cu ft 6.90

MEASURED MERCURY CONCENTRATION:

Hg concentration	ug/ft3	1019.93
Hg concentration	g/m3	0.0360
Hg concentration	ppm by vol	4.152 (assuming 1 atm pressure)
Saturation temp	°C	32.90
Subcooling of Hg	°C	24.25

MERCURY CONCENTRATION AT SATURATION (PROCESS BASIS) :

Average Temperature °C 8.65 estimated

Hg concentration	ug/ft3	138.7
Hg concentration	g/m3	0.0049
Hg concentration	ppm by vol	0.565