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(Please read Instructions on the reverse before completing)

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16. ABSTRACT

The Environmental Protection Agency is assessing the potential for the emissions of dioxin/furans from combustion sources under Tier 4 of the National Dioxin Study. If any of the combustion sources are found to emit dioxins, the secondary purpose of the Tier 4 study is to quantify these emissions and, if possible, related the emissions to combustion parameters.

Carbon regeneration furnaces are 1 of 8 source categories that have been included in the field test program. Carbon regeneration furnaces reactive spent carbon from industrial or municipal water treatment facilities. The spent carbon may contain adsorbed chlorinated compounds.

This report presents the results of an emission test program conducted by Radian during May 28-31, 1985, at an industrial carbon regeneration furnace designated as Site CRF-A. The furnace was selected after an initial information screening and a pretest survey visit. This facility is considered representative of other carbon regeneration furnaces in the United States. Furnace CRF-A regenerates spent carbon from more than 20 plants that use activated carbon for industrial wastewater treatment.

Data presented in the report include dioxin (tetra through octa homologue +2378 TCDD) and furan (tetra through octa homologue +2378 TCDF) results for both stack samples and ash samples. In addition, process data collected during sampling are also presented.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Emissions Combustion Sources Dioxin Furans 2,3,7,8 Tetrachlorodibenzo-p-dioxin Carbon Regeneration Furnace	Air Pollution Emissions Data	

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TABLE K-3. BAGHOUSE OUTLET EXHAUST STACK RISK MODELING PARAMETERS FOR RUN 3, SITE CRF-A

Latitude = 40 29 32
Longitude = 80 04 39
Stack Height (From Grade Level) = 22.5 m
Stack Diameter (ID) = 1.2 m
Flue Gas Flow Rate (Dry Standard) = 428.5 dscmm
Flue Gas Exit Temperature = 440.3 K
Flue Gas Exit Velocity (Actual) = 897.4 mpm

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Hourly Emissions Rate (ug/hr)	Relative Potency Factor	2,3,7,8 - TCDD Equivalent Emissions (mg/yr)
2378 TCDD	ND (4.61E-02)	ND (1.18E+00)	1.000	ND (1.04E+01)
Other TCDD	6.91E-02	1.78E+00	.010	1.56E-01
2378 TCDF	ND (9.22E-02)	ND (2.37E+00)	.100	ND (2.08E+00)
Other TCDF	3.23E-01	8.29E+00	.001	7.27E-02
Penta-CDD	ND (1.15E-01)	ND (2.96E+00)	.500	ND (1.30E+01)
Penta-CDF	ND (1.15E-01)	ND (2.96E+00)	.100	ND (2.59E+00)
Hexa-CDD	2.07E-01	5.33E+00	.040	1.87E+00
Hexa-CDF	1.84E-01	4.74E+00	.010	4.15E-01
Hepta-CDD	2.30E-01	5.92E+00	.001	5.19E-02
Hepta-CDF	1.61E-01	4.15E+00	.001	3.63E-02
Octa-CDD	2.30E-01	5.92E+00	.000	.00E+00
Octa-CDF	2.53E-01	6.52E+00	.000	.00E+00
Net 2378 TCDD Equivalent Atmospheric Loading				2.60E+00

ND = not detected (detection limit in parentheses).
N/A = detection limit not available
ng = 1.0E-09g
ug = 1.0E-06g
mg = 1.0E-03g
Standard conditions: 293 K (20 C) temperature and 1 atmosphere pressure.
8760 operating hours per year

TABLE K-2. BAGHOUSE OUTLET EXHAUST STACK RISK MODELING PARAMETERS FOR RUN 2, SITE CRF-A

Latitude = 40 29 32
Longitude = 80 04 39
Stack Height (From Grade Level) = 22.5 m
Stack Diameter (ID) = 1.2 m
Flue Gas Flow Rate (Dry Standard) = 366.9 dscmm
Flue Gas Exit Temperature = 446.5 K
Flue Gas Exit Velocity (Actual) = 786.7 mpm

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Hourly Emissions Rate (ug/hr)	Relative Potency Factor	2,3,7,8 - TCDD Equivalent Emissions (mg/yr)
2378 TCDD	ND (5.29E-02)	ND (1.16E+00)	1.000	ND (1.02E+01)
Other TCDD	ND (7.94E-02)	ND (1.75E+00)	.010	ND (1.53E-01)
2378 TCDF	ND (1.59E-01)	ND (3.49E+00)	.100	ND (3.06E+00)
Other TCDF	5.29E-01	1.16E+01	.001	1.02E-01
Penta-CDD	1.32E-01	2.91E+00	.500	1.28E+01
Penta-CDF	2.91E-01	6.41E+00	.100	5.61E+00
Hexa-CDD	3.17E-01	6.99E+00	.040	2.45E+00
Hexa-CDF	2.12E-01	4.66E+00	.010	4.08E-01
Hepta-CDD	3.44E-01	7.57E+00	.001	6.63E-02
Hepta-CDF	2.12E-01	4.66E+00	.001	4.08E-02
Octa-CDD	2.91E-01	6.41E+00	.000	.00E+00
Octa-CDF	1.32E-01	2.91E+00	.000	.00E+00
Net 2378 TCDD Equivalent Atmospheric Loading				2.14E+01

ND = not detected (detection limit in parentheses).
N/A = detection limit not available
ng = 1.0E-09g
ug = 1.0E-06g
mg = 1.0E-03g
Standard conditions: 293 K (20 C) temperature and 1 atmosphere pressure.
8760 operating hours per year

TABLE K-1. BAGHOUSE OUTLET EXHAUST STACK RISK MODELING PARAMETERS FOR RUN 1, SITE CRF-A

Latitude = 40 29 32
Longitude = 80 04 39
Stack Height (From Grade Level) = 22.5 m
Stack Diameter (ID) = 1.2 m
Flue Gas Flow Rate (Dry Standard) = 353.7 dscmm
Flue Gas Exit Temperature = 444.0 K
Flue Gas Exit Velocity (Actual) = 745.2 mpm

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Hourly Emissions Rate (ug/hr)	Relative Potency Factor	2,3,7,8 - TCDD Equivalent Emissions (mg/yr)
2378 TCDD	ND (1.79E-01)	ND (3.79E+00)	1.000	ND (3.32E+01)
Other TCDD	5.87E-01	1.25E+01	.010	1.09E+00
2378 TCDF	ND (1.53E-01)	ND (3.25E+00)	.100	ND (2.85E+00)
Other TCDF	5.36E-01	1.14E+01	.001	9.96E-02
Penta-CDD	3.83E-01	8.12E+00	.500	3.56E+01
Penta-CDF	1.53E-01	3.25E+00	.100	2.85E+00
Hexa-CDD	6.12E-01	1.30E+01	.040	4.55E+00
Hexa-CDF	2.81E-01	5.96E+00	.010	5.22E-01
Hepta-CDD	4.59E-01	9.75E+00	.001	8.54E-02
Hepta-CDF	3.32E-01	7.04E+00	.001	6.17E-02
Octa-CDD	4.08E-01	8.66E+00	.000	.00E+00
Octa-CDF	2.30E-01	4.87E+00	.000	.00E+00
Net 2378 TCDD Equivalent Atmospheric Loading				4.48E+01

ND = not detected (detection limit in parentheses).
N/A = detection limit not available
ng = 1.0E-09g
ug = 1.0E-06g
mg = 1.0E-03g
Standard conditions: 293 K (20 C) temperature and 1 atmosphere pressure.
8760 operating hours per year

APPENDIX K

Run-specific Risk Modeling Input Data

TABLE J-2. HOMOLOGUE DISTRIBUTION AT THE OUTLET AT SITE CRF-A

HOMOLOGUE	HOMOLOGUE FRACTION					
	RUN 01		RUN 02		RUN 03	
DIOXINS	MASS	MOLE	MASS	MOLE	MASS	MOLE
2378 TCDD	0	0	0	0	0	0
Other TCDD	0.2396	0.2834	0	0	0.0937	0.1201
Penta-CDD	0.1563	0.1671	0.122	0.1415	0	0
Hexa-CDD	0.25	0.2435	0.2927	0.3093	0.2813	0.2966
Hepta-CDD	0.1875	0.168	0.3171	0.3082	0.3125	0.3032
Octa-CDD	0.1667	0.138	0.2683	0.241	0.3125	0.2801
FURANS						
2378 TCDF	0	0	0	0	0	0
Other TCDF	0.35	0.4093	0.3846	0.4361	0.35	0.4198
Penta-CDF	0.1	0.1053	0.2115	0.2159	0	0
Hexa-CDF	0.1833	0.175	0.1538	0.1423	0.2	0.1958
Hepta-CDF	0.2167	0.1896	0.1538	0.1305	0.175	0.1571
Octa-CDF	0.15	0.1209	0.0962	0.0751	0.275	0.2273

TABLE J-1. HOMOLOGUE DISTRIBUTION AT THE INLET AT SITE CRF-A

HOMOLOGUE	HOMOLOGUE FRACTION					
	RUN 01		RUN 02		RUN 03	
DIOXINS	MASS	MOLE	MASS	MOLE	MASS	MOLE
2378 TCDD	0.002	0.0025	0.0023	0.0031	0.0058	0.0069
Other TCDD	0.0352	0.0455	0.0409	0.0544	0.2	0.2384
Penta-CDD	0.0772	0.0904	0.0222	0.0267	0.1626	0.1753
Hexa-CDD	0.2307	0.2458	0.1367	0.1498	0.236	0.2316
Hepta-CDD	0.304	0.298	0.2956	0.298	0.2576	0.2326
Octa-CDD	0.3509	0.3178	0.5023	0.468	0.1381	0.1152
FURANS						
2378 TCDF	0.0209	0.024	0.0208	0.024	0.0182	0.0209
Other TCDF	0.2838	0.3271	0.3083	0.356	0.2735	0.3144
Penta-CDF	0.2045	0.2121	0.167	0.1735	0.2445	0.253
Hexa-CDF	0.2427	0.2282	0.2186	0.206	0.2215	0.2079
Hepta-CDF	0.1699	0.1465	0.1983	0.1713	0.1748	0.1504
Octa-CDF	0.0781	0.062	0.087	0.0692	0.0675	0.0535

APPENDIX J

Run-specific Homologue Distributions

TABLE I.1 VALUES OF E_{max} and E_{min} FOR VARIOUS MEASURED CONTROL EFFICIENCIES

Control Device Efficiency (%)		
E_{meas}	E_{max}	E_{min}
100	100	100
95	98.3	85
90	96.7	70
85	95.0	55
80	93.4	40
75	91.7	25
50	83.4	-50
25	75.0	-125
0	66.7	-200
-25	58.4	-275
-50	50.0	-350
-100	33.4	-500
-200	0	-800

$$E_{max} = (200 + E_{meas})/3$$

$$E_{min} = 3E_{meas} - 200$$

and:

$$E_{min} = \frac{C_{in,min} - C_{out,max}}{C_{in,min}} = 1 - \frac{C_{out,max}}{C_{in,min}}$$

$$= 1 - \frac{1.5\ C_{out,meas}}{0.5\ C_{in,meas}}$$

$$= 1 - 3\ (1 - E_{meas})$$

$$E_{min} = 3\ E_{meas} - 2$$

Now, $E_{min} > 0$ positive control (i.e., emissions reduction across the control device)

$$(3E_{meas} - 2) > 0$$

$$E_{meas} > {}^{2}/_{3}$$

Therefore, if E_{meas} is larger than 66.7 percent, the true removal efficiency can safely be assumed to be greater than zero.

And, $E_{max} < 0$ negative control (i.e., emissions increase across the control device)

$$^{2}/_{3} + {}^{1}/_{3}\ E_{meas} < 0$$

$$E_{meas} < -2$$

Therefore, if E_{meas} is less than -200 percent, the true efficiency can safely be assumed to be less than zero.

To summarize:

$E_{meas} > 66.7$ percent	positive control
$-200 < E_{meas} < 66.7$ percent	no definitive conclusions can be drawn
$E_{meas} < 200$ percent	no negative control

APPENDIX I
ERROR ANALYSIS: CONTROL DEVICE EFFICIENCY CALCULATIONS

Objective: Given the analytical uncertainty of the dioxin/furan analyses ($\pm$ 50% accuracy), estimate the uncertainty of the control device efficiency calculations.

Let: $C_{out,meas}$ = the measured concentration of a given dioxin/furan homologue at the outlet location.

$C_{in,meas}$ = the measured concentration of a given dioxin/furan homologue at the inlet location.

$C_{out,max}$ = the maximum possible concentration of the dioxin/furan homologue given the measured value $C_{out,meas}$.

$C_{out,min}$ = the minimum possible concentration of the dioxin/furan homologue given the measured value $C_{out,meas}$.

$C_{in,max}$ = the maximum possible concentration of the dioxin/furan homologue, given the measured value $C_{in,meas}$.

$C_{in,min}$ = the minimum possible concentration of the dioxin/furan homologue, given the measured value $C_{in,meas}$.

E = the removal efficiency of the control device

Assuming $\pm$ 50 percent analytical accuracy:

$$C_{min} = C_{meas} - 0.5\ C_{meas} = 0.5\ C_{meas}$$

$$C_{max} = C_{meas} + 0.5\ C_{meas} = 1.5\ C_{meas}$$

Note that: $$E_{max} = \frac{C_{in,max} - C_{out,min}}{C_{in,max}} = 1 - \frac{C_{out,min}}{C_{in,max}}$$

$$E_{max} = 1 - \frac{0.5\ C_{out,meas}}{1.5\ C_{in,meas}} = 1 - {}^1/_3\ (1 - E_{meas})$$

$$= {}^2/_3 + {}^1/_3\ E_{meas}$$

APPENDIX I

Error Analysis of Control Device Efficiency Calculations

TABLE H-12. SPRAY COOLER INLET DIOXIN/FURAN EMISSIONS DATA FOR RUN 3, SITE CRF-A (Concentrations Corrected to 3% O_2)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm @ 3% oxygen)	Isomer Concentration In Flue Gas (ppt @ 3% oxygen)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	1.44E-01(N/A)	1.08E-02(N/A)	1.44E+00
Other TCDD	5.02E+00(N/A)	3.75E-01(N/A)	5.00E+01
Penta-CDD	4.08E+00(N/A)	2.76E-01(N/A)	4.07E+01
Hexa-CDD	5.92E+00(N/A)	3.64E-01(N/A)	5.90E+01
Hepta-CDD	6.46E+00(N/A)	3.66E-01(N/A)	6.44E+01
Octa-CDD	3.46E+00(N/A)	1.81E-01(N/A)	3.46E+01
Total PCDD	2.51E+01	1.57E+00	2.50E+02
FURANS			
2378 TCDF	1.52E+00(N/A)	1.19E-01(N/A)	1.51E+01
Other TCDF	2.28E+01(N/A)	1.79E+00(N/A)	2.28E+02
Penta-CDF	2.04E+01(N/A)	1.44E+00(N/A)	2.03E+02
Hexa-CDF	1.85E+01(N/A)	1.19E+00(N/A)	1.84E+02
Hepta-CDF	1.46E+01(N/A)	8.57E-01(N/A)	1.45E+02
Octa-CDF	5.63E+00(N/A)	3.05E-01(N/A)	5.62E+01
Total PCDF	8.34E+01	5.70E+00	8.32E+02

NOTE: Isomer concentrations shown are corrected to 3% oxygen.

ND = Not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
8760 operating hours per year

TABLE H-11. SPRAY COOLER INLET DIOXIN/FURAN EMISSIONS DATA FOR RUN 2, SITE CRF-A (Concentrations Corrected to 3% O_2)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm @ 3% oxygen)	Isomer Concentration In Flue Gas (ppt @ 3% oxygen)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	6.12E-02(N/A)	4.58E-03(N/A)	7.31E-01
Other TCDD	1.07E+00(N/A)	8.01E-02(N/A)	1.28E+01
Penta-CDD	5.82E-01(N/A)	3.93E-02(N/A)	6.95E+00
Hexa-CDD	3.58E+00(N/A)	2.20E-01(N/A)	4.28E+01
Hepta-CDD	7.75E+00(N/A)	4.39E-01(N/A)	9.25E+01
Octa-CDD	1.32E+01(N/A)	6.89E-01(N/A)	1.57E+02
Total PCDD	2.62E+01	1.47E+00	3.13E+02
FURANS			
2378 TCDF	1.44E+00(N/A)	1.13E-01(N/A)	1.72E+01
Other TCDF	2.14E+01(N/A)	1.68E+00(N/A)	2.55E+02
Penta-CDF	1.16E+01(N/A)	8.19E-01(N/A)	1.38E+02
Hexa-CDF	1.52E+01(N/A)	9.72E-01(N/A)	1.81E+02
Hepta-CDF	1.37E+01(N/A)	8.09E-01(N/A)	1.64E+02
Octa-CDF	6.03E+00(N/A)	3.27E-01(N/A)	7.20E+01
Total PCDF	6.93E+01	4.72E+00	8.28E+02

NOTE: Isomer concentrations shown are corrected to 3% oxygen.

ND = Not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
8760 operating hours per year

TABLE H-10. SPRAY COOLER INLET DIOXIN/FURAN EMISSIONS DATA FOR RUN 1, SITE CRF-A (Concentrations Corrected to 3% O_2)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm @ 3% oxygen)	Isomer Concentration In Flue Gas (ppt @ 3% oxygen)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	6.86E-02(N/A)	5.13E-03(N/A)	7.18E-01
Other TCDD	1.23E+00(N/A)	9.23E-02(N/A)	1.29E+01
Penta-CDD	2.71E+00(N/A)	1.83E-01(N/A)	2.84E+01
Hexa-CDD	8.10E+00(N/A)	4.98E-01(N/A)	8.48E+01
Hepta-CDD	1.07E+01(N/A)	6.04E-01(N/A)	1.12E+02
Octa-CDD	1.23E+01(N/A)	6.44E-01(N/A)	1.29E+02
Total PCDD	3.51E+01	2.03E+00	3.68E+02
FURANS			
2378 TCDF	1.20E+00(N/A)	9.44E-02(N/A)	1.26E+01
Other TCDF	1.63E+01(N/A)	1.28E+00(N/A)	1.71E+02
Penta-CDF	1.18E+01(N/A)	8.32E-01(N/A)	1.23E+02
Hexa-CDF	1.40E+01(N/A)	8.96E-01(N/A)	1.46E+02
Hepta-CDF	9.78E+00(N/A)	5.75E-01(N/A)	1.02E+02
Octa-CDF	4.49E+00(N/A)	2.43E-01(N/A)	4.71E+01
Total PCDF	5.75E+01	3.92E+00	6.02E+02

NOTE: Isomer concentrations shown are corrected to 3% oxygen.

ND = Not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
8760 operating hours per year

TABLE H-9. BAGHOUSE OUTLET DIOXIN/FURAN EMISSIONS DATA FOR RUN 3, SITE CRF-A (Concentrations Corrected to 3% O_2)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm @ 3% oxygen)	Isomer Concentration In Flue Gas (ppt @ 3% oxygen)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	ND (1.30E-01)	ND (9.70E-03)	ND (1.18E+00)
Other TCDD	1.95E-01(N/A)	1.45E-02(N/A)	1.78E+00
Penta-CDD	ND (3.25E-01)	ND (2.19E-02)	ND (2.96E+00)
Hexa-CDD	5.84E-01(N/A)	3.59E-02(N/A)	5.33E+00
Hepta-CDD	6.49E-01(N/A)	3.67E-02(N/A)	5.92E+00
Octa-CDD	6.49E-01(N/A)	3.39E-02(N/A)	5.92E+00
Total PCDD	2.08E+00	1.21E-01	1.90E+01
FURANS			
2378 TCDF	ND (2.60E-01)	ND (2.04E-02)	ND (2.37E+00)
Other TCDF	9.09E-01(N/A)	7.14E-02(N/A)	8.29E+00
Penta-CDF	ND (3.25E-01)	ND (2.30E-02)	ND (2.96E+00)
Hexa-CDF	5.19E-01(N/A)	3.33E-02(N/A)	4.74E+00
Hepta-CDF	4.54E-01(N/A)	2.67E-02(N/A)	4.15E+00
Octa-CDF	7.14E-01(N/A)	3.87E-02(N/A)	6.52E+00
Total PCDF	2.60E+00	1.70E-01	2.37E+01

NOTE: Isomer concentrations shown are corrected to 3% oxygen.

ND = Not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
8760 operating hours per year

TABLE H-8. BAGHOUSE OUTLET DIOXIN/FURAN EMISSIONS DATA FOR RUN 2, SITE CRF-A (Concentrations Corrected to 3% O_2)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm @ 3% oxygen)	Isomer Concentration In Flue Gas (ppt @ 3% oxygen)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	ND (1.31E-01)	ND (9.76E-03)	ND (1.16E+00)
Other TCDD	ND (1.96E-01)	ND (1.46E-02)	ND (1.75E+00)
Penta-CDD	3.27E-01(N/A)	2.21E-02(N/A)	2.91E+00
Hexa-CDD	7.84E-01(N/A)	4.82E-02(N/A)	6.99E+00
Hepta-CDD	8.49E-01(N/A)	4.81E-02(N/A)	7.57E+00
Octa-CDD	7.19E-01(N/A)	3.76E-02(N/A)	6.41E+00
Total PCDD	2.68E+00	1.56E-01	2.39E+01
FURANS			
2378 TCDF	ND (3.92E-01)	ND (3.08E-02)	ND (3.49E+00)
Other TCDF	1.31E+00(N/A)	1.03E-01(N/A)	1.16E+01
Penta-CDF	7.19E-01(N/A)	5.08E-02(N/A)	6.41E+00
Hexa-CDF	5.23E-01(N/A)	3.35E-02(N/A)	4.66E+00
Hepta-CDF	5.23E-01(N/A)	3.07E-02(N/A)	4.66E+00
Octa-CDF	3.27E-01(N/A)	1.77E-02(N/A)	2.91E+00
Total PCDF	3.40E+00	2.35E-01	3.03E+01

NOTE: Isomer concentrations shown are corrected to 3% oxygen.

ND = Not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
8760 operating hours per year

TABLE H-7. BAGHOUSE OUTLET DIOXIN/FURAN EMISSIONS DATA FOR RUN 1, SITE CRF-A (Concentrations Corrected to 3% O_2)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm @ 3% oxygen)	Isomer Concentration In Flue Gas (ppt @ 3% oxygen)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	ND (4.61E-01)	ND (3.45E-02)	ND (3.79E+00)
Other TCDD	1.52E+00(N/A)	1.13E-01(N/A)	1.25E+01
Penta-CDD	9.88E-01(N/A)	6.68E-02(N/A)	8.12E+00
Hexa-CDD	1.58E+00(N/A)	9.73E-02(N/A)	1.30E+01
Hepta-CDD	1.19E+00(N/A)	6.71E-02(N/A)	9.75E+00
Octa-CDD	1.05E+00(N/A)	5.51E-02(N/A)	8.66E+00
Total PCDD	6.32E+00	3.99E-01	5.20E+01
FURANS			
2378 TCDF	ND (3.95E-01)	ND (3.11E-02)	ND (3.25E+00)
Other TCDF	1.38E+00(N/A)	1.09E-01(N/A)	1.14E+01
Penta-CDF	3.95E-01(N/A)	2.80E-02(N/A)	3.25E+00
Hexa-CDF	7.25E-01(N/A)	4.65E-02(N/A)	5.96E+00
Hepta-CDF	8.56E-01(N/A)	5.04E-02(N/A)	7.04E+00
Octa-CDF	5.93E-01(N/A)	3.21E-02(N/A)	4.87E+00
Total PCDF	3.95E+00	2.66E-01	3.25E+01

NOTE: Isomer concentrations shown are corrected to 3% oxygen.

ND = Not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
8760 operating hours per year

TABLE H-6. SPRAY COOLER INLET DIOXIN/FURAN EMISSIONS DATA FOR RUN 3, SITE CRF-A

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Concentration In Flue Gas (ppt)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	8.87E-02(N/A)	6.63E-03(N/A)	1.44E+00
Other TCDD	3.08E+00(N/A)	2.30E-01(N/A)	5.00E+01
Penta-CDD	2.51E+00(N/A)	1.69E-01(N/A)	4.07E+01
Hexa-CDD	3.64E+00(N/A)	2.24E-01(N/A)	5.90E+01
Hepta-CDD	3.97E+00(N/A)	2.25E-01(N/A)	6.44E+01
Octa-CDD	2.13E+00(N/A)	1.11E-01(N/A)	3.46E+01
Total PCDD	1.54E+01	9.66E-01	2.50E+02
FURANS			
2378 TCDF	9.31E-01(N/A)	7.32E-02(N/A)	1.51E+01
Other TCDF	1.40E+01(N/A)	1.10E+00(N/A)	2.28E+02
Penta-CDF	1.25E+01(N/A)	8.86E-01(N/A)	2.03E+02
Hexa-CDF	1.14E+01(N/A)	7.28E-01(N/A)	1.84E+02
Hepta-CDF	8.96E+00(N/A)	5.27E-01(N/A)	1.45E+02
Octa-CDF	3.46E+00(N/A)	1.87E-01(N/A)	5.62E+01
Total PCDF	5.12E+01	3.50E+00	8.32E+02

NOTE: Isomer concentrations shown are at as-measured oxygen conditions.

ND = Not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
8760 operating hours per year

TABLE H-5. SPRAY COOLER INLET DIOXIN/FURAN EMISSIONS DATA FOR RUN 2, SITE CRF-A

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Concentration In Flue Gas (ppt)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	4.95E-02(N/A)	3.70E-03(N/A)	7.31E-01
Other TCDD	8.66E-01(N/A)	6.47E-02(N/A)	1.28E+01
Penta-CDD	4.70E-01(N/A)	3.18E-02(N/A)	6.95E+00
Hexa-CDD	2.90E+00(N/A)	1.78E-01(N/A)	4.28E+01
Hepta-CDD	6.26E+00(N/A)	3.54E-01(N/A)	9.25E+01
Octa-CDD	1.06E+01(N/A)	5.57E-01(N/A)	1.57E+02
Total PCDD	2.12E+01	1.19E+00	3.13E+02
FURANS			
2378 TCDF	1.16E+00(N/A)	9.15E-02(N/A)	1.72E+01
Other TCDF	1.73E+01(N/A)	1.36E+00(N/A)	2.55E+02
Penta-CDF	9.36E+00(N/A)	6.62E-01(N/A)	1.38E+02
Hexa-CDF	1.23E+01(N/A)	7.86E-01(N/A)	1.81E+02
Hepta-CDF	1.11E+01(N/A)	6.54E-01(N/A)	1.64E+02
Octa-CDF	4.88E+00(N/A)	2.64E-01(N/A)	7.20E+01
Total PCDF	5.60E+01	3.82E+00	8.28E+02

NOTE: Isomer concentrations shown are at as-measured oxygen conditions.

ND = Not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
8760 operating hours per year

TABLE H-4. SPRAY COOLER INLET DIOXIN/FURAN EMISSIONS
DATA FOR RUN 1, SITE CRF-A

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Concentration In Flue Gas (ppt)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	5.12E-02(N/A)	3.82E-03(N/A)	7.18E-01
Other TCDD	9.21E-01(N/A)	6.88E-02(N/A)	1.29E+01
Penta-CDD	2.02E+00(N/A)	1.37E-01(N/A)	2.84E+01
Hexa-CDD	6.04E+00(N/A)	3.71E-01(N/A)	8.48E+01
Hepta-CDD	7.95E+00(N/A)	4.50E-01(N/A)	1.12E+02
Octa-CDD	9.18E+00(N/A)	4.80E-01(N/A)	1.29E+02
Total PCDD	2.62E+01	1.51E+00	3.68E+02
FURANS			
2378 TCDF	8.95E-01(N/A)	7.04E-02(N/A)	1.26E+01
Other TCDF	1.22E+01(N/A)	9.57E-01(N/A)	1.71E+02
Penta-CDF	8.77E+00(N/A)	6.21E-01(N/A)	1.23E+02
Hexa-CDF	1.04E+01(N/A)	6.68E-01(N/A)	1.46E+02
Hepta-CDF	7.29E+00(N/A)	4.29E-01(N/A)	1.02E+02
Octa-CDF	3.35E+00(N/A)	1.82E-01(N/A)	4.71E+01
Total PCDF	4.29E+01	2.93E+00	6.02E+02

NOTE: Isomer concentrations shown are at as-measured oxygen conditions.

ND = Not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
8760 operating hours per year

TABLE H-3. BAGHOUSE OUTLET DIOXIN/FURAN EMISSIONS DATA FOR RUN 3, SITE CRF-A

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Concentration In Flue Gas (ppt)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	ND (4.61E-02)	ND (3.44E-03)	ND (1.18E+00)
Other TCDD	6.91E-02(N/A)	5.16E-03(N/A)	1.78E+00
Penta-CDD	ND (1.15E-01)	ND (7.78E-03)	ND (2.96E+00)
Hexa-CDD	2.07E-01(N/A)	1.28E-02(N/A)	5.33E+00
Hepta-CDD	2.30E-01(N/A)	1.30E-02(N/A)	5.92E+00
Octa-CDD	2.30E-01(N/A)	1.20E-02(N/A)	5.92E+00
Total PCDD	7.37E-01	4.30E-02	1.90E+01
FURANS			
2378 TCDF	ND (9.22E-02)	ND (7.25E-03)	ND (2.37E+00)
Other TCDF	3.23E-01(N/A)	2.54E-02(N/A)	8.29E+00
Penta-CDF	ND (1.15E-01)	ND (8.15E-03)	ND (2.96E+00)
Hexa-CDF	1.84E-01(N/A)	1.18E-02(N/A)	4.74E+00
Hepta-CDF	1.61E-01(N/A)	9.49E-03(N/A)	4.15E+00
Octa-CDF	2.53E-01(N/A)	1.37E-02(N/A)	6.52E+00
Total PCDF	9.22E-01	6.04E-02	2.37E+01

NOTE: Isomer concentrations shown are at as-measured oxygen conditions.

ND = Not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
8760 operating hours per year

TABLE H-2. BAGHOUSE OUTLET DIOXIN/FURAN EMISSION DATA FOR RUN 2, SITE CRF-A

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Concentration In Flue Gas (ppt)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	ND (5.29E-02)	ND (3.95E-03)	ND (1.16E+00)
Other TCDD	ND (7.94E-02)	ND (5.93E-03)	ND (1.75E+00)
Penta-CDD	1.32E-01(N/A)	8.94E-03(N/A)	2.91E+00
Hexa-CDD	3.17E-01(N/A)	1.95E-02(N/A)	6.99E+00
Hepta-CDD	3.44E-01(N/A)	1.95E-02(N/A)	7.57E+00
Octa-CDD	2.91E-01(N/A)	1.52E-02(N/A)	6.41E+00
Total PCDD	1.08E+00	6.32E-02	2.39E+01
FURANS			
2378 TCDF	ND (1.59E-01)	ND (1.25E-02)	ND (3.49E+00)
Other TCDF	5.29E-01(N/A)	4.16E-02(N/A)	1.16E+01
Penta-CDF	2.91E-01(N/A)	2.06E-02(N/A)	6.41E+00
Hexa-CDF	2.12E-01(N/A)	1.36E-02(N/A)	4.66E+00
Hepta-CDF	2.12E-01(N/A)	1.24E-02(N/A)	4.66E+00
Octa-CDF	1.32E-01(N/A)	7.17E-03(N/A)	2.91E+00
Total PCDF	1.38E+00	9.54E-02	3.03E+01

NOTE: Isomer concentrations shown are at as-measured oxygen conditions.

ND = Not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
8760 operating hours per year

TABLE H-1. BAGHOUSE OUTLET DIOXIN/FURAN EMISSIONS
DATA FOR RUN 1, SITE CRF-A

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Concentration In Flue Gas (ppt)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	ND (1.79E-01)	ND (1.33E-02)	ND (3.79E+00)
Other TCDD	5.87E-01(N/A)	4.38E-02(N/A)	1.25E+01
Penta-CDD	3.83E-01(N/A)	2.59E-02(N/A)	8.12E+00
Hexa-CDD	6.12E-01(N/A)	3.77E-02(N/A)	1.30E+01
Hepta-CDD	4.59E-01(N/A)	2.60E-02(N/A)	9.75E+00
Octa-CDD	4.08E-01(N/A)	2.13E-02(N/A)	8.66E+00
Total PCDD	2.45E+00	1.55E-01	5.20E+01
FURANS			
2378 TCDF	ND (1.53E-01)	ND (1.20E-02)	ND (3.25E+00)
Other TCDF	5.36E-01(N/A)	4.21E-02(N/A)	1.14E+01
Penta-CDF	1.53E-01(N/A)	1.08E-02(N/A)	3.25E+00
Hexa-CDF	2.81E-01(N/A)	1.80E-02(N/A)	5.96E+00
Hepta-CDF	3.32E-01(N/A)	1.95E-02(N/A)	7.04E+00
Octa-CDF	2.30E-01(N/A)	1.24E-02(N/A)	4.87E+00
Total PCDF	1.53E+00	1.03E-01	3.25E+01

NOTE: Isomer concentrations shown are at as-measured oxygen conditions.

ND = Not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
8760 operating hours per year

APPENDIX H

Run-specific Dioxin/Furan Emissions Data

RADIAN CORPORATION

BAGHOUSE DUST - PROCESS SAMPLE

SCC No.	Sample
DQ003110	Baghouse Dust, Run 01
DQ003117	Baghouse Dust, Run 02
DQ003126	Baghouse Dust, Run 03

REACTIVATED CARBON - PROCESS SAMPLE

SCC No.	Sample
DQ003112	Reactivated Carbon, Run 01
DQ003119	Reactivated Carbon, Run 02
DQ003128	Reactivated Carbon, Run 03

2. The spent carbon feed and ambient air train components are Priority #2 samples. The samples should be held at Troika pending the results of the Priority #1 samples.

SPENT CARBON FEED - PROCESS SAMPLE

SCC No.	Sample
DQ003111	Spent carbon feed, Run 01
DQ003118	Spent carbon feed, Run 02
DQ003127	Spent carbon feed, Run 03

If any questions arise concerning this sample shipment, please contact either Winton Kelly or Robert Jongleux at Radian Corporation at (919) 541-9100.

Sincerely,

Bob Jongleux

TEST TEAM LEADER

cc: E. Hanks/EPA/AMTB
A. Miles/Radian
Radian Field File - RTP/PPK

Progress Center/3200 E. Chapel Hill Rd./Nelson Hwy./P.O. Box 13000/Research Triangle Park, N.C. 27709/(919)541-9100
Progress Center/3200 E. Chapel Hill Rd./Nelson Hwy./P.O. Box 13000/Research Triangle Park, N.C. 27709/(919)541-9100

RADIAN CORPORATION

Radian Run # 09-MM5-BI-03 (Total of 6 train components)

SCC No.	Container	Fraction
DQ003124	1	Filter
DQ003124	2#	Probe Rinse
DQ003124	3	Back Half/Coil Rinse
DQ003124	4*	Condensate
DQ003124	5	Impinger Solution
DQ003124	6	XAD Module

Radian Run # 09-MM5-BO-03 (Total of 6 train components)

SCC No.	Container	Fraction
DQ003125	1	Filter
DQ003125	2#	Probe Rinse
DQ003125	3	Back Half/Coil Rinse
DQ003125	4*	Condensate
DQ003125	5	Impinger Solution
DQ003125	6	XAD Module

AMBIENT XAD TRAIN

Radian Run #09-AMB-A

SCC No.	Container	Fraction
DQ003120	1	Probe Rinse
DQ003120	2	XAD Module

LABORATORY PROOF BLANK

SCC No.	Container	Fraction
DQ003107	1	Filter
DQ003107	2	Probe Rinse, Back Half/Coil Rinse and Impinger Soln.
DQ003107	3	XAD Module

REAGENT BLANKS

SCC No.	Sample
DQ003121	HPLC grade water blank
DQ003122	Acetone blank
DQ003123	Methylene chloride blank

RADIAN
CORPORATION

Radian Run # 09-MM5-BO-01 (Total of 6 train components)

SCC No.	Container	Fraction
DQ003109	1	Filter
DQ003109	2*#	Probe Rinse
DQ003109	3	Back Half/Coil Rinse
DQ003109	4*	Condensate
DQ003109	5	Impinger Solution
DQ003109	6	XAD Module

Radian Run # 09-MM5-BI-02 (Total of 6 train components)

DQ003113	1	Filter
DQ003113	2*#	Probe Rinse
DQ003113	3	Back Half/Coil Rinse
DQ003113	4*	Condensate
DQ003113	5	Impinger Solution
DQ003113	6	XAD Module

Radian Run # 09-MM5-BO-02 (Total of 6 train components)

DQ003114	1	Filter
DQ003114	2*#	Probe Rinse
DQ003114	3	Back Half/Coil Rinse
DQ003114	4*	Condensate
DQ003114	5	Impinger Solution
DQ003114	6	XAD Module

Radian Run # 09-MM5-BI-FBL (Total of 6 train components)

DQ003115	1	Filter
DQ003115	2#	Probe Rinse
DQ003115	3	Back Half/Coil Rinse
DQ003115	4	Condensate
DQ003115	5	Impinger Solution
DQ003115	6	XAD Module

Radian Run # 09-MM5-BO-FBL (Total of 6 train components)

DQ003116	1	Filter
DQ003116	2#	
DQ003116	3	Back Half/Coil Rinse
DQ003116	4	Condensate
DQ003116	5	Impinger Solution
DQ003116	6	XAD Module

Progress Center/3200 E. Chapel Hill Rd./Nelson Hwy./P.O. Box 13000/Research Triangle Park, N.C. 27709/(919)541-9100

RADIAN
CORPORATION

May 31, 1985

U.S. EPA ECC Toxicant Analysis Center
Building 1105
Bay St. Louis, MS 39529

Attention: Danny McDaniel

Subject: Tier 4 - Analysis Instructions

Dear Sir:

The objective of this letter is to clarify instructions and priorities for individual samples from specific Tier 4 combustion sites. This instruction letter is No. 13 and pertains to EPA Site No. 09 (CRF-A).

The Episode No. is 2674, and SCC numbers assigned to this site were numbers DQ003100 through DQ003199.

SCC numbers DQ003101 through DQ003106 have been assigned to Troika for internal QA/QC purposes. SCC numbers DQ003107 through DQ003138 have been assigned to samples included in this shipment. All remaining SCC numbers are unused.

The sample shipment for EPA Site No. 09 (CRF-A) consists of 5 boxes containing 77 samples of 66 components. The boxes were shipped under Federal Express, Airbill Nos. 770332695 and 289783406.

Instructions for extraction and analysis follow.

1. Priority #1 samples include the sample train components, the baghouse dust, reactivated carbon samples, the lab proof blank, and the reagent blanks. These samples require immediate extraction and analysis.

MM5 TRAIN SAMPLES (* indicates more than one sample per component).
(# indicates H_2O in addition to acetone and $MeCl_2$ in rinse)

Radian Run # 09-MM5-BI-01 (Total of 6 train components)

SCC No.	Container	Fraction
DQ003108	1	Filter
DQ003108	2*#	Probe Rinse
DQ003108	3	Back Half/Coil Rinse
DQ003108	4*	Condensate
DQ003108	5	Impinger Solution
DQ003108	6*	XAD Module

Progress Center/3200 E. Chapel Hill Rd./Nelson Hwy./P.O. Box 13000/Research Triangle Park, N.C. 27709/(919)541-9100

APPENDIX G

Sample Shipment Letter

Project Participants

Radian Corporation, Research Triangle Park, NC

Winton Kelly	Field Test Engineer
Robert Jongleux	Test Crew Leader
Dave Savia	CEM Operator
Debra Benson	Sample Recovery
James McReynolds	Sampler
Gary Henry	Sampler
Carol Jamgochian	Sampler
Lee Garcia	Sampler
Mike Hartman	Sampler

Environmental Protection Agency
Hazardous Waste Environmental Research Facility, Cincinnati, OH

Ivars Licis

APPENDIX F

Project Participants

TABLE E-4. HCl LABORATORY ANALYTICAL DATA FOR BAGHOUES OUTLET

TIER 4 DIOXIN
HCL - SITE 09

Site #	Field #	Sample Wt.(gm)	Analysis mg/l	Blank Corrected Total mg in Sample
09-HCL-01-F	PI-4	~1	—	—
09-HCL-01-PR	5 +4	386.3	3	1.16
09-HCL-01-IR	6	910.8	1	0.91
09-HCL-FBL-F	29	~1	—	—
09-HCL-FBL-PR	30 + 29	167.1	<1	—
09-HCL-FBL-IR	31	440.6	<1	—
09-HCL-02-F	47	~1	—	—
09-HCL-02-PR	48 + 47	357.9	6 ~~days~~ (6)**	2.15
* 09-HCL-02-IR	49 + 50	1372.6	1	1.37
09-RBL-NaOH	78	99.8	<1	—
09-HCL-03-F	79	~1	—	—
09-HCL-03-PR	80 + 79	199.0	5	1.00
09-HCL-03-IR	81	1299.4	1	1.30

Site #	Field #	Wt.(gm)	PPM/of Audit	mg/l	mg/in sample
09-HCL-Audit #1	105	164.4	500	510 ~~days~~ (510)**	83.84
09-HCL-Audit #2	106	151.7	100	100 ~~days~~ (101)**	15.24
09-HCL-Audit #3	107	186.4	5000	4910 ~~days~~ (4930)**	917.09
09-HCL-Audit #4	108	169.7	1000	974 ~~days~~ (984)**	166.14
09-HCL-Audit #5	109	193.4	5000	4910 ~~days~~ (4890)**	947.66

* Two sample bottles required for Impinger contents

** Lab. duplicates

TABLE E-3. COMPOUND-SPECIFIC DIOXIN PRECURSOR DATA FOR SITE CRF-A FEED SAMPLES

Precursor Compounds	Precursor Concentration, ug/g (ppm)			
	Spent Carbon Feed Samples			
	Run 1	Run 2	Run 3	Average
Base Neutrals Fraction				
Chlorinated Benzenes:				
Dichlorobenzenes	0.01	0.02	0.02	0.02
Trichlorobenzenes	1.70	0.14	6.27	2.70
Tetrachlorobenzenes	0.05	ND	0.34	0.13
Pentachlorobenzenes	ND	ND	ND	ND
Hexachlorobenzenes	ND	ND	ND	ND
Total Chlorinated Benzenes	1.76	0.16	6.63	2.85
Chlorinated Biphenyls:				
Chlorobiphenyls	ND	ND	ND	ND
Dichlorobiphenyls	ND	ND	ND	ND
Trichlorobiphenyls	ND	ND	ND	ND
Tetrachlorobiphenyls	ND	ND	ND	ND
Pentachlorobiphenyls	ND	ND	ND	ND
Hexachlorobiphenyls	ND	ND	ND	ND
Heptachlorobiphenyls	ND	ND	ND	ND
Octachlorobiphenyls	ND	ND	ND	ND
Nonachlorobiphenyls	ND	ND	ND	ND
Decachlorobiphenyls	ND	ND	ND	ND
Total Chlorinated Biphenyls	ND	ND	ND	ND
Acids Fraction				
Chlorinated Phenols:				
Dichlorophenols	ND	ND	ND	ND
Trichlorophenols	ND	ND	ND	ND
Tetrachlorophenols	ND	ND	ND	ND
Pentachlorophenols	ND	ND	ND	ND
Total Chlorinated Phenols	ND	ND	ND	ND

ND = not detected.

TABLE E-2. DIOXIN/FURAN LABORATORY ANALYTICAL DATA FOR SPRAY COOLER INLET

ANALYTICAL DATA INPUT MATRIX FOR SITE CRF-A (INLET)
(picograms per sample train)

Species	RUN 01 Value	RUN 01 DL	RUN 02 Value	RUN 02 DL	RUN 03 Value	RUN 03 DL
2378 TCDD	200.00	.00	200.00	.00	400.00	.00
Other TCDD	3600.00	.00	3500.00	.00	13900.00	.00
2378 TCDF	3500.00	.00	4700.00	.00	4200.00	.00
Other TCDF	47600.00	.00	69800.00	.00	63200.00	.00
Penta-CDD	7900.00	.00	1900.00	.00	11300.00	.00
Penta-CDF	34300.00	.00	37800.00	.00	56500.00	.00
Hexa-CDD	23600.00	.00	11700.00	.00	16400.00	.00
Hexa-CDF	40700.00	.00	49500.00	.00	51200.00	.00
Hepta-CDD	31100.00	.00	25300.00	.00	17900.00	.00
Hepta-CDF	28500.00	.00	44900.00	.00	40400.00	.00
Octa-CDD	35900.00	.00	43000.00	.00	9600.00	.00
Octa-CDF	13100.00	.00	19700.00	.00	15600.00	.00

Value = amount detected in MM5 sample train.
DL = detection limit of GC/MS analysis.

TABLE E-1. DIOXIN/FURAN LABORATORY ANALYTICAL DATA FOR BAGHOUSE OUTLET SAMPLES

ANALYTICAL DATA INPUT MATRIX FOR SITE CRF-A (OUTLET)
(picograms per sample train)

Species	RUN 01 Value	RUN 01 DL	RUN 02 Value	RUN 02 DL	RUN 03 Value	RUN 03 DL
2378 TCDD	.00	700.00	.00	200.00	.00	200.00
Other TCDD	2300.00	.00	.00	300.00	300.00	.00
2378 TCDF	.00	600.00	.00	600.00	.00	400.00
Other TCDF	2100.00	.00	2000.00	.00	1400.00	.00
Penta-CDD	1500.00	.00	500.00	.00	.00	500.00
Penta-CDF	600.00	.00	1100.00	.00	.00	500.00
Hexa-CDD	2400.00	.00	1200.00	.00	900.00	.00
Hexa-CDF	1100.00	.00	800.00	.00	800.00	.00
Hepta-CDD	1800.00	.00	1300.00	.00	1000.00	.00
Hepta-CDF	1300.00	.00	800.00	.00	700.00	.00
Octa-CDD	1600.00	.00	1100.00	.00	1000.00	.00
Octa-CDF	900.00	.00	500.00	.00	1100.00	.00

Value = amount detected in MM5 asmple train.
DL = detection limit of GC/MS analysis.

APPENDIX E

Laboratory Analytical Data

DRY GAS METER CALIBRATION DATA

(English Units) Pretest ☐ Post Test ☒

Date 6/11/85 **Barometric Pressure, Bp =** 29.67

Meter Box # 10 **Dry Gas Meter #** 10

Orifice manometer setting, ΔH, in. H_2O	Manometer Pressure Of Wet Test Meter ΔHw	Gas volume wet test meter V_w, ft^3	Gas volume dry gas meter V_d, ft^3	Temperature: Wet test: Meter t_w, °F	Temperature: Dry gas meter: Inlet t_{di}, °F	Temperature: Dry gas meter: Outlet t_{do}, °F	Temperature: Dry gas meter: Average t_d, °F	Time θ, Min. .00	Y	ΔH@
1.25	.6	3.068 12.363	42.632 52.039	76,75 76,76	85 94	74 78			.9953	
1.25	.6	12.363 20.682	52.039 60.459	77,76 76,76	93 97	78 82			1.0029	
1.25	.6	20.682 29.352	60.459 69.235	76,76 77,77	96 99	82 84			1.0076	

Avg. 1.0019

Y

$$\frac{V_w\left(P_b - \frac{\Delta H_w}{13.6}\right)\left(t_d + 460\right)}{V_d\left(P_b + \frac{\Delta H}{13.6}\right)\left(T_w + 460\right)}.$$

ΔH@

$$\frac{0.0317\ \Delta H}{P_b\left(t_d + 460\right)}\left[\frac{(t_w + 460)\ \theta}{V_w}\right]^2$$

$\frac{9.295 \times 29.63 \times 542.8}{9.407 \times 29.76 \times 535.8} \times .9987 =$ .9953	
$\frac{8.319 \times 29.63 \times 547.5}{8.42 \times 29.76 \times 536.3} \times .9987 =$ 1.0029	
$\frac{8.67 \times 29.63 \times 550.3}{8.776 \times 29.76 \times 536.5} \times .9987 =$ 1.0076	

Y = Ratio of accuracy of wet test meter to dry test meter. Tolerance = ±0.01.

ΔH@ = Orifice pressure differential that gives 0.75 cfm of air at 70°F and 29.92 inches of mercury, in. H_2O. Tolerance = ±0.15.

Post test tolerance must be within ± 0.05 and within a range of 0.10

Meter Leak Check Front ✓ Back ✓

Pitot Leak Check ____

Electrical Check ✓

Calibrating technician [signature]

Remarks

DRY GAS METER CALIBRATION DATA

(English Units) Pretest ☒ Post Test ☐

Date 3/22/85 Barometric Pressure, Bp = 29.76

Meter Box # #10 Dry Gas Meter # #10

Orifice manometer setting, ΔH, in. H_2O	Manometer Pressure Of Wet Test Meter ΔHW	Gas volume wet test meter V_w, ft^3	Gas volume dry gas meter V_d, ft^3	Temperature: Wet test Meter t_w, °F	Temperature: Dry gas meter Inlet t_{di}, °F	Temperature: Dry gas meter Outlet t_{do}, °F	Temperature: Dry gas meter Average t_d, °F	Time θ, Min. .00	γ	ΔH@
.5	.3	61.649 66.607	71.257 76.340	76.76 77.76	86 91	82 85		11.95	.9898	1.63
1.0	.48	67.045 73.668	76.783 82.935	77.76 77.77	91 95	84 87		10.44	.9968	1.68
2.0	.75	77.007 87.007	86.917 97.037	76.78 76.77	86 97	82 85		12.89	1.0010	1.86
3.0	1.05	87.436 97.439	97.465 107.555	78.76 78.76	97 103	84 88		10.37	1.0094	1.79
								Avg.	.9993	1.74

γ

$$\frac{V_w\left(Pb - \frac{\Delta Hw}{13.6}\right)\left(td + 460\right)}{Vd\left(Pb + \frac{\Delta H}{13.6}\right)\left(Tw + 460\right)}$$

ΔH@

$$\frac{0.0317\ \Delta H}{Pb\ (td + 460)}\left[\frac{(tw + 460)\ \theta}{Vw}\right]^2$$

$\frac{4.958 \times 29.74 \times 546 \times .9987}{5.083 \times 29.8 \times 536.3}$	= .9898	$\frac{.0317 \times .5}{29.76 \times 546}\left(\frac{536.3 \times 11.95}{4.958}\right)^2$ =	1.63
$\frac{6.023 \times 29.72 \times 549.3 \times .9987}{6.152 \times 29.83 \times 536.8}$	= .9968	$\frac{.0317}{29.76 \times 549.3}\left(\frac{536.8 \times 10.44}{6.023}\right)^2$ =	1.68
$\frac{10 \times 29.7 \times 547.5 \times .9987}{10.12 \times 29.91 \times 536.8}$	= 1.0010	$\frac{.0317 \times 2}{29.76 \times 547.5}\left(\frac{536.8 \times 12.89}{10}\right)^2$ =	1.86
$\frac{10.003 \times 29.68 \times 553 \times .9987}{10.09 \ 29.98 \times 537}$	1.0094	$\frac{.0317 \times 3}{29.76 \times 553}\left(\frac{537 \times 10.37}{10.003}\right)^2$ =	1.79

γ = Ratio of accuracy of wet test meter to dry test meter. Tolerance = ±0.01.

ΔH@ = Orifice pressure differential that gives 0.75 cfm of air at 70°F and 29.92 inches of mercury, in. H_2O. Tolerance = ±0.15.

Post test tolerance must be within ± 0.05 and within a range of 0.10

Meter Leak Check Front ✓ Back ✓

Calibrating technician flg

Pitot Leak Check ✓

Electrical Check ✓

Remarks

DRY GAS METER CALIBRATION DATA

(English Units) Pretest ☐ Post Test ☒

DGM γ = .9987

Date 6/11/85 Barometric Pressure, Bp = 29.67

Meter Box # 9 Dry Gas Meter # 9

Orifice manometer setting, ΔH, in. H_2O	Manometer Pressure ~~Wet Test~~ Meter ΔW DGm	DGm Gas volume ~~wet test~~ meter V_w, ft^3	Gas volume dry gas meter V_d, ft^3	DGm Temperature ~~Wet test~~ Meter t_w, °F	Dry gas meter Inlet t_{di}, °F	Dry gas meter Outlet t_{do}, °F	Dry gas meter Average t_d, °F	Time θ, min.	γ	ΔH@
.5	.32	75.102 100.087	11.590 16.641	71,71 72,72	80 88	72 73		12.38	.9962	1.73
1.0	.50	0.371 9.596	16.930 26.317	72,72 73,73	91 105	74 78		16.24	1.0045	1.72
1.8	.75	10.541 20.335	27.281 37.302	73,74 74,73	104 113	79 83		12.93	1.0086	1.72
3.0	1.1	20.715 33.981	37.695 51.285	74,73 74,73	113 123	83 87		13.74	1.0109	1.75
							ΔH@	Avg.	1.0050	1.73

$$\gamma = \frac{V_w\left(P_b - \frac{\Delta H_w}{13.6}\right)(t_d + 460)}{V_d\left(P_b + \frac{\Delta H}{13.6}\right)(T_w + 460)}$$

$$\Delta H@ = \frac{0.0317\,\Delta H}{P_b\,(t_d + 460)}\left[\frac{(t_w + 460)\,\theta}{V_w}\right]^2$$

$\frac{4.985 \times 29.65 \times 538.3}{5.051 \times 29.71 \times 531.5} \times .9987 = .9962$	$\frac{.0317 \times .5}{29.67 \times 538.3}\left(\frac{531.5 \times 12.38}{4.985}\right)^2 = 1.73$
$\frac{9.225 \times 29.63 \times 547}{9.387 \times 29.74 \times 532.5} \times .9987 = 1.0045$	$\frac{.0317}{29.67 \times 547}\left(\frac{532.5 \times 16.24}{9.225}\right)^2 = 1.72$
$\frac{9.794 \times 29.61 \times 554.8}{10.021 \times 29.8 \times 533.5} \times .9987 = 1.0086$	$\frac{.0317 \times 1.8}{29.67 \times 554.8}\left(\frac{533.5 \times 12.93}{9.794}\right)^2 = 1.72$
$\frac{13.266 \times 29.59 \times 558.8}{13.59 \times 29.89 \times 533.5} \times .9987 = 1.0109$	$\frac{.0317 \times 3}{29.67 \times 558.8}\left(\frac{533.5 \times 13.74}{13.266}\right)^2 = 1.75.$

γ = Ratio of accuracy of wet test meter to dry test meter. Tolerance = ±0.01.

ΔH@ = Orifice pressure differential that gives 0.75 cfm of air at 70°F and 29.92 inches of mercury, in. H_2O. Tolerance = ±0.15.

Post test tolerance must be within ± 0.05 and within a range of 0.10

Meter Leak Check Front ✓ Back ✓

Pitot Leak Check ____

Electrical Check ____

Calibrating technician [signature]

Remarks

DRY GAS METER CALIBRATION DATA

(English Units) Pretest ☒ Post Test ☐

DGM Y = .9987

Date 3/14/85 Barometric Pressure, Bp = 29.67

Meter Box # 9 Dry Gas Meter # ______

Orifice manometer setting, ΔH, in. H_2O	DGM Manometer Pressure Of ~~Wet Test~~ Meter ΔHW	DGM Gas volume ~~wet test~~ meter V_w, ft^3	Gas volume ~~dry gas~~ meter V_d, ft^3	Temperature: DGM ~~Wet~~ test Meter t_w, °F	Temperature: Dry gas meter Inlet t_{di}, °F	Temperature: Dry gas meter Outlet t_{do}, °F	Temperature: Dry gas meter Average t_d, °F	Time θ, Min. .00	Y	ΔH@
.5	.3	85.321 90.437	17.807 23.023	72,71 72,71	79 89	73 75		13.12	0.9914	1.84
1.0	.43	90.623 100.628	23.216 33.446	72,71 73,72	92 105	75 80		18.54	1.0027	1.89
2.0	.75	0.889 10.839	33.661 43.909	73,72 73,72	106 120	80 84		13.00	1.0100	1.85
3.0	1.0	11.510 20.121	44.493 53.430	73,72 73,72	119 122	84 87		9.50	1.0075	1.96
								Avg.	1.0029	1.89

Y

$$\frac{V_w\left(Pb - \frac{\Delta Hw}{13.6}\right)(td + 460)(\gamma_{DGM})}{Vd\left(Pb + \frac{\Delta H}{13.6}\right)(Tw + 460)}$$

ΔH@

$$\frac{0.0317\ \Delta H}{Pb\ (td + 460)}\left[\frac{(tw + 460)\theta}{Vw}\right]^2$$

$\frac{5.116 \times 29.65 \times 539 \times .9987}{5.216 \times 29.71 \times 531.5} = .9914$	$\frac{0.0317(0.5)}{29.67(539)}\left[\frac{(531.5)(13.12)}{5.116}\right]^2 = 1.84$
$\frac{10.005 \times 29.64 \times 548 \times .9987}{10.23 \times 29.74 \times 532} = 1.0027$	$\frac{0.0317(1.0)}{29.67(548)}\left[\frac{(532)(18.54)}{10.005}\right]^2 = 1.89$
$\frac{9.970 \times 29.61 \times 557.5 \times .9987}{10.248 \times 29.82 \times 532.5} = 1.0100$	$\frac{0.0317(2.0)}{29.67(557.5)}\left[\frac{532.5(13.00)}{9.970}\right]^2 = 1.85$
$\frac{8.611 \times 29.6 \times 563 \times .9987}{8.737 \times 29.89 \times 532.5} = 1.0075$	$\frac{0.0317(3.0)}{29.67(563)}\left[\frac{532.5(9.50)}{8.611}\right]^2 = 1.96$

γ = Ratio of accuracy of wet test meter to dry test meter. Tolerance = ±0.01.

ΔH@ = Orifice pressure differential that gives 0.75 cfm of air at 70°F and 29.92 inches of mercury, in. H_2O. Tolerance = ±0.15.

Post test tolerance must be within ± 0.05 and within a range of 0.10

Meter Leak Check Front ✓ Back ✓

Calibrating technician [signature]

Pitot Leak Check ____

Electrical Check ✓

Remarks

DRY GAS METER CALIBRATION DATA

(English Units) Pretest ☐ Post Test ☒

Date 6/12/85 Barometric Pressure, Bp = 29.40

Meter Box # 7 Dry Gas Meter # 7

	Orifice manometer setting, ΔH, in. H_2O	Manometer Pressure Of Wet Test Meter ΔHW	Gas volume wet test meter V_w, ft^3	Gas volume dry gas meter V_d, ft^3	Temperature: Wet test Meter t_w, °F	Temperature: Dry gas meter Inlet t_{di}, °F	Temperature: Dry gas meter Outlet t_{do}, °F	Temperature: Dry gas meter Average t_d, °F	Time θ, min.	Y	ΔH@
13:09.4	1.9	.77	83.066 92.723	70.106 79.672	73,74 73,74	88 95	76 78			1.0216	
6:27	1.9	.77	92.723 104.803	79.672 91.681	73,74 73,74	94 100	79 82			1.0264	
13:14.7	1.9	.77	104.803 114.503	91.681 101.413	74,74 74,74	99 101	82 84			1.0224	

ΔH@ Avg. 1.0235

Y

$$\frac{V_w\left(P_b - \frac{\Delta H_w}{13.6}\right)\left(t_d + 460\right)}{V_d\left(P_b + \frac{\Delta H}{13.6}\right)\left(T_w + 460\right)}$$

ΔH@

$$\frac{0.0317\ \Delta H}{P_b\left(t_d + 460\right)}\left[\frac{\left(t_w + 460\right)\theta}{V_w}\right]^2$$

$\frac{9.657 \times 29.34 \times 544.3}{9.566 \times 29.54 \times 533.5} \times .9987 = 1.0216$	
$\frac{1208 \times 29.34 \times 548.8}{12009 \times 29.54 \times 533.5} \times .9987 = 1.0264$	
$\frac{9.7 \times 29.34 \times 554.5}{9.732 \times 29.54 \times 534} \times .9987 = 1.0224$	

Y = Ratio of accuracy of wet test meter to dry test meter. Tolerance = ±0.01.

ΔH@ = Orifice pressure differential that gives 0.75 cfm of air at 70°F and 29.92 inches of mercury, in. H_2O. Tolerance = ±0.15.

Post test tolerance must be within ± 0.05 and within a range of 0.10

Meter Leak Check Front ______ Back

Pitot Leak Check ______

Electrical Check ______

Remarks

Calibrating technician flg

DRY GAS METER CALIBRATION DATA

(English Units) Pretest ☒ Post Test ☐

Date 5/9/85 Barometric Pressure, Bp = 30.00

Meter Box # 7 Dry Gas Meter #

Orifice manometer setting, ΔH, in. H_2O	Manometer Pressure Of Wet Test Meter ΔHW	DGM Gas volume meter V_w, ft^3	Gas volume dry gas meter V_d, ft^3	DGM Temperature: Meter t_w, °F	Dry gas meter: Inlet t_{di}, °F	Dry gas meter: Outlet t_{do}, °F	Dry gas meter: Average t_d, °F	Time θ, Min. .00	Y	ΔH@
.5	.3	41.754 47.025	57.929 63.286	74, 74 75, 74	79 85	78 79		13.17	.9917	1.74
1.0	.48	47.596 59.219	63.861 75.691	76, 75 77, 75	86 96	81 83		21.09	.9986	1.83
2.0	.8	59.967 68.825	76.452 85.475	75, 75 78, 76	95 103	83 86		11.58	1.0023	1.88
3.0	1.1	69.181 78.738	85.840 95.561	76, 75 77, 75	103 112	85 87		10.17	1.0102	1.85
								Avg.	1.0007	1.83

$$Y = \frac{V_w\left(P_b - \frac{\Delta H_w}{13.6}\right)(t_d + 460)}{V_d\left(P_b + \frac{\Delta H}{13.6}\right)(T_w + 460)}$$

$$\Delta H@ = \frac{0.0317\ \Delta H}{P_b\ (t_d + 460)}\left[\frac{t_w + 460\ \theta}{V_w}\right]^2$$

$\frac{5.271 \times 29.98 \times 540.3 \times .9987}{5.357 \times 30.04 \times 534.3} = .9917$	$\frac{.0317 \times .5}{30 \times 540.3}\left(\frac{534.3 \times 13.17}{5.271}\right)^2 = 1.743$
$\frac{11.623 \times 29.96 \times 546.5 \times .9987}{11.83 \times 30.07 \times 535.8} = .9986$	$\frac{.0317}{30 \times 546.5}\left(\frac{535.8 \times 21.09}{11.623}\right)^2 = 1.828$
$\frac{8.858 \times 29.94 \times 551.8 \times .9987}{9.023 \times 30.15 \times 536} = 1.0023$	$\frac{.0317 \times 2}{30 \times 551.8}\left(\frac{536 \times 11.58}{8.858}\right)^2 = 1.880$
$\frac{9.557 \times 29.92 \times 556.8 \times .9987}{9.721 \times 30.22 \times 535.8} = 1.0102$	$\frac{.0317 \times 3}{30 \times 556.8}\left(\frac{535.8 \times 10.17}{9557}\right)^2 = 1.851$

Y = Ratio of accuracy of wet test meter to dry test meter. Tolerance = ±0.01.

ΔH@ = Orifice pressure differential that gives 0.75 cfm of air at 70°F and 29.92 inches of mercury, in. H_2O. Tolerance = ±0.15.

Post test tolerance must be within ± 0.05 and within a range of 0.10

Meter Leak Check Front ✓ Back ✓ Calibrating technician [signature]

Pitot Leak Check ✓

Electrical Check ✓

Remarks

DRY GAS METER CALIBRATION DATA

(English Units) Pretest ☐ Post Test ☒

Date 6/19/85 Barometric Pressure, Bp = 29.60

Meter Box # 6 Dry Gas Meter # 6

Orifice manometer setting, ΔH, in. H_2O	Manometer Pressure Of Wet Test Meter ΔH_w	DGM Gas volume ~~wet test~~ meter V_w, ft^3	Gas volume dry gas meter V_d, ft^3	Temperature: DGM ~~Wet test~~ Meter t_w, °F	Temperature: Dry gas meter Inlet t_{di}, °F	Temperature: Dry gas meter Outlet t_{do}, °F	Temperature: Dry gas meter Average t_d, °F	Time θ, min.	Y	$\Delta H@$
		82.893	97.852	73,73	89	75				
.85	.47	88.676	103,691	73,73	99	79			1.0092	
		88.676	103,691	73,73	99	79				
.85	.47	94.743	109,894	74,73	107	86			1.0094	
		94.743	109.894	74,73	107	86				
.85	.47	100.051	115,378	74,73	111	90			1.0059	
								$\Delta H@$ Avg.	1.0092	

Y

$$\frac{V_w\left(P_b - \frac{\Delta H_w}{13.6}\right)\left(t_d + 460\right)}{V_d\left(P_b + \frac{\Delta H}{13.6}\right)\left(T_w + 460\right)}$$

$\Delta H@$

$$\frac{0.0317\ \Delta H}{P_b\left(t_d + 460\right)}\left[\frac{(t_w + 460)\ \theta}{V_w}\right]^2$$

$\frac{5.783 \times 29.57 \times 545.5}{5.837 \times 29.66 \times 533} \times .9987 = 1.0092$	
$\frac{6.067 \times 29.57 \times 552.8}{6.203 \times 29.66 \times 533.3} \times .9987 = 1.0094$	
$\frac{5.308 \times 29.57 \times 558.3}{5.484 \times 29.66 \times 533.5} \times .9987 = 1.0089$	

Y = Ratio of accuracy of wet test meter to dry test meter. Tolerance = ±0.01.

$\Delta H@$ = Orifice pressure differential that gives 0.75 cfm of air at 70°F and 29.92 inches of mercury, in. H_2O. Tolerance = ±0.15.

Post test tolerance must be within ± 0.05 and within a range of 0.10

Meter Leak Check Front ✓ Back

Pitot Leak Check ____

Electrical Check ____

Remarks

Calibrating technician flg

DRY GAS METER CALIBRATION DATA

(English Units) Pretest ☒ Post Test ☐

$\gamma_{DGM} = 0.9987$

Date 3/15/85 Barometric Pressure, Bp = 29.86

Meter Box # 6 Dry Gas Meter # ______

Orifice manometer setting, ΔH, in. H_2O	DGM Manometer Pressure Of ~~Wet Test~~ Meter ΔHW	DGM Gas volume ~~wet test~~ meter V_w, ft^3	Gas volume dry gas meter V_d, ft^3	Temperature: Wet test Meter t_w, °F	Temperature: Dry gas meter Inlet t_{di}, °F	Temperature: Dry gas meter Outlet t_{do}, °F	Temperature: Dry gas meter Average t_d, °F	Time θ, Min. .00	γ	ΔH@
0.5	0.33	61.922 6.813	71.793 76.800	72,71 72,71	85 90	78 78	83	11.67	0.9937	1.58
1	0.48	8.124 18.280	78.146 88.600	73,72 73,72	90 105	78 82	89	17.58	0.9957	1.65
2	0.82	18.752 28.925	89.085 99.588	73,72 73,72	99 111	81 84	94	12.77	0.9985	1.72
3	1.2	29.475 39.355	0.164 10.379	73,72 73,71	102 113	84 86	96	10.00	0.9992	1.66
								Avg.	0.9968	1.65

γ

$$\frac{V_w\left(Pb - \frac{\Delta Hw}{13.6}\right)(td + 460)}{Vd\left(Pb + \frac{\Delta H}{13.6}\right)(Tw + 460)}\left(\gamma_{DGM}\right)$$

ΔH@

$$\frac{0.0317\ \Delta H}{Pb\ (td + 460)}\left[\frac{(tw + 460)\theta}{Vw}\right]^2$$

$\frac{4.891}{5.007}\frac{29.86-0.33/13.6}{29.86+0.5/13.6}\frac{543}{532}(0.9987)=0.9937$	$\frac{0.0317\ (0.5)}{29.86(543)}\left[\frac{532\ (11.67)}{4.891}\right]^2 = 1.58$
$\frac{10.156}{10.454}\frac{29.86-0.48/13.6}{29.86+1/13.6}\frac{549}{533}(0.9987)=0.9957$	$\frac{0.0317(1)}{29.86\ (549)}\left[\frac{533\ (17.58)}{10.156}\right]^2 = 1.65$
$\frac{10.173}{10.503}\frac{29.86-0.82/13.6}{29.86+2/13.6}\frac{554}{533}(0.9987)=0.9985$	$\frac{0.0317\ (2)}{29.86\ (554)}\left[\frac{533\ (12.77)}{10.173}\right]^2 = 1.72$
$\frac{9.880}{10.215}\frac{29.86-1.2/13.6}{29.86+3/13.6}\frac{556}{532}(0.9987)=0.9992$	$\frac{0.0317\ (3)}{29.86(556)}\left[\frac{532\ (10.00)}{9.880}\right]^2 = 1.66$

γ = Ratio of accuracy of wet test meter to dry test meter. Tolerance = ±0.01.

ΔH@ = Orifice pressure differential that gives 0.75 cfm of air at 70°F and 29.92 inches of mercury, in. H_2O. Tolerance = ±0.15.

Post test tolerance must be within ± 0.05 and within a range of 0.10

Meter Leak Check Front ______ Back

Calibrating technician ______

Pitot Leak Check ______

Electrical Check ______

Remarks

DRY GAS METER CALIBRATION DATA

(English Units) Pretest ☐ Post Test ☒

DGM Y = .9987

Date 6/11/85 Barometric Pressure, Bp = 29.67

Meter Box # 5 Dry Gas Meter # 5

Orifice manometer setting, ΔH, in. H_2O	Manometer Pressure Of Wet Test Meter Δ Hw	Gas volume wet test meter V_w, ft^3	Gas volume dry gas meter V_d, ft^3	Temperature: Wet test Meter t_w, °F	Temperature: Dry gas meter Inlet t_{di}, °F	Temperature: Dry gas meter Outlet t_{do}, °F	Temperature: Dry gas meter Average t_d, °F	Time θ, min. .00	Y	ΔH@
.85	.42	33.329 39.495	31.050 37.261	76,75 75,75	78 84	72 76			.9925	
.85	.42	39.495 45.475	37.261 43.331	75,75 75,74	84 88	76 79			.9938	
.85	.42	45.475 53.499	43.331 51.522	75,74 75,74	88 92	79 83			.9954	

Avg. .9939

Y

$$\frac{V_w\left(P_b - \frac{\Delta H_w}{13.6}\right)\left(t_d + 460\right)}{V_d\left(P_b + \frac{\Delta H}{13.6}\right)\left(T_w + 460\right)}$$

ΔH@

$$\frac{0.0317\ \Delta H}{P_b\left(t_d + 460\right)}\left[\frac{\left(t_w + 460\right)\theta}{V_w}\right]^2$$

$\frac{6.166 \times 29.64 \times 537.5}{6.211 \times 29.73 \times 535.3} \times .9987 = .9925$	
$\frac{5.98 \times 29.64 \times 541.8}{6.07 \times 29.73 \times 534.8} \times .9987 = .9938$	
$\frac{8.024 \times 29.64 \times 545.5}{8.191 \times 29.73 \times 534.5} \times .9987 = .9954$	

Y = Ratio of accuracy of wet test meter to dry test meter. Tolerance = ±0.01.

ΔH@ = Orifice pressure differential that gives 0.75 cfm of air at 70°F and 29.92 inches of mercury, in. H_2O. Tolerance = ±0.15.

Post test tolerance must be within ± 0.05 and within a range of 0.10

Meter Leak Check Front ✓ Back ✓

Pitot Leak Check ✓

Electrical Check ✓

Calibrating technician [signature]

Remarks

TE 10/18/84 Pre Test BOX # 5

ROMETRIC PRESSURE P_b 29.88 in. Hg DRY GASMETER #

RADIAN CORPORATION

Orifice Manometer Settling H (in. H_2O)	Gas Volume Wet Test Meter V_w (ft^3)	Gas Volume Dry Gas Meter V_d (ft^3)	Temperature					Time θ (min.)	Y	ΔH@
			Wet Test Meter T_w (°F)	ΔH	Dry Gas Meter Inlet Td (°F)	Dry Gas Meter Outlet T_{do} (°F)	Dry Gas Meter Average T_d (°F)			
0.5	4.999	52.578 57.692	77	1.4	89 93	84 87		12.69	.9934	1.80
1.0	5.998	57.852 64.000	77	1.8	92 96	86 88		11.05	.9934	1.89
2.0	10	64.298 74.562	77	2.4	95 103	88 90		13.27	.9941	1.94
4.0	9.999	75.055 85.263	77	4.0	100 106	90 92		9.55	.9965	2.00
6.0	10.002	85.559 95.756	77	5.5	102 108	91 93		7.88	.9919	2.04
8.0	10.003	96.282 106.368	77	7.0	104 109	93 94		6.83	.9976	2.04
								Average	.9945	1.95

Calculations

ΔH	$\frac{\Delta H}{13.6}$	Y: $\frac{V_w P_b (T_d + 460)}{V_d (P_b + \frac{H}{13.6}) (T_w + 460)}$	ΔH@: $\frac{0.0317 \Delta H}{P_b (T_d + 460)} \left[\frac{(T_w + 460)\theta}{V_w}\right]^2$
0.5	0.0368	$\frac{4.999 \times 29.78 \times 548.3}{5.114 \times 29.92 \times 537}$ = .9934	$\frac{.5 \times .0317}{29.88 \times 548.3} \left(\frac{537 \times 12.69}{4.999}\right)^2$ = 1.80
1.0	0.0737	$\frac{5.998 \times 29.75 \times 550.5}{6.148 \times 29.95 \times 537}$ = .9934	$\frac{.0317}{29.88 \times 550.5} \left(\frac{537 \times 11.05}{5.998}\right)^2$ = 1.89
2.0	0.147	$\frac{10 \times 29.7 \times 554}{10.264 \times 30.03 \times 537}$ = .9941	$\frac{2 \times .0317}{29.88 \times 554} \left(\frac{537 \times 13.27}{1.0}\right)^2$ = 1.94
4.0	0.294	$\frac{9.999 \times 29.59 \times 557}{10.208 \times 30.17 \times 537}$ = .9965	$\frac{4 \times .0317}{29.88 \times 557} \left(\frac{537 \times 9.55}{9.999}\right)^2$ = 2.00
6.0	0.431	$\frac{10.002 \times 29.48 \times 558.5}{10.197 \times 30.32 \times 537}$ = .9919	$\frac{6 \times .0317}{29.88 \times 558.5} \left(\frac{537 \times 7.88}{10.002}\right)^2$ = 2.04
8.0	0.588	$\frac{10.003 \times 29.32 \times 560}{10.086 \times 30.45 \times 537}$ = .9976	$\frac{8 \times .0317}{29.88 \times 560} \left(\frac{537 \times 6.83}{10.003}\right)^2$ = 2.04

DRY GAS METER CALIBRATION DATA

(English Units) Pretest ☐ Post Test ☒

Date 6/11/85 Barometric Pressure, Bp = 29.67

Meter Box # 2 Dry Gas Meter # 2

Orifice manometer setting, ΔH, in. H_2O	Manometer Pressure Of Wet Test Meter ΔW	Gas volume wet test meter V_w, ft^3	Gas volume dry gas meter V_d, ft^3	Temperature: Wet test Meter t_w, °F	Temperature: Dry gas meter Inlet t_{di}, °F	Temperature: Dry gas meter Outlet t_{do}, °F	Temperature: Dry gas meter Average t_d, °F	Time θ, Min. ,80	Y	ΔH@
.85	.44	39.425 47.431	62.020 70.046	74,73 74,77	77 84	71 74			.9969	
,85	,44	47.431 55.403	70046 78.056	76,74 78,74	84 88	74 78			1.0074	
,85	,44	55.403 63.335	78,056 86.028	77,74 79,75	86 90	78 80			1.0040	

Y

$$\frac{V_w\left(Pb - \frac{\Delta W}{13.6}\right)\left(td + 460\right)}{Vd\left(Pb + \frac{\Delta H}{13.6}\right)\left(Tw + 460\right)}$$

ΔH@ Avg. 1,0007

$$\frac{0.0317\ \Delta H}{Pb\ (td + 460)}\left[\frac{tw + 460\ \theta}{Vw}\right]^2$$

$\frac{8.006 \times 29.64 \times 536.5}{8.026 \times 29.73 \times 534.5} \times .9987 =$,9969	
$\frac{7.972 \times 29.64 \times 541}{8.01 \times 29.73 \times 535.5} \times .9987 =$ 1.0074	
$\frac{7.932 \times 29.64 \times 543.5}{7.972 \times 29.73 \times 536.3} \times .9987 =$ 1,0040	

Y = Ratio of accuracy of wet test meter to dry test meter. Tolerance = ±0.01.

ΔH@ = Orifice pressure differential that gives 0.75 cfm of air at 70°F and 29.92 inches of mercury, in. H_2O. Tolerance = ±0.15.

Post test tolerance must be within ± 0.05 and within a range of 0.30

Meter Leak Check Front ✓ Back ✓

Pitot Leak Check ✓

Electrical Check ✓

Calibrating technician [signature]

Remarks

DRY GAS METER CALIBRATION DATA

(English Units) Pretest ☒ Post Test ☐

DGM Y = .9987

Date 3/19/85 Barometric Pressure, Bp = 29.74, 30.06 (3/20/85

Meter Box # 2 Dry Gas Meter # ______

Orifice manometer setting, ΔH, in. H_2O	Manometer Pressure Of Wet Test Meter ΔHW	DGM Gas volume ~~wet test~~ meter V_w, ft^3	Gas volume dry gas meter V_d, ft^3	DGM Temperature ~~Wet test~~ Meter t_w, °F	Temperature Dry gas meter Inlet t_{di}, °F	Temperature Dry gas meter Outlet t_{do}, °F	Temperature Dry gas meter Average t_d, °F	Time θ, Min. .00	Y	ΔH@
.5	.3	4.900 9.903	73.574 78.620	76,75 75,74	83 88	76 78		12.45	1.0002	1.73
1.0	.5	10.071 19.006	78.781 87.836	75,74 76,75	88 96	79 82		15.92	1.0026	1.75
* 2.0	- .9	82.984 91.813	51.466 60.374	67,66 67,66	79 89	69 71		11.71	1.0022	1.94
3.0	1.1	19.272 29.556	88.113 98.297	76,74 76,74	98 108	82 83		10.82	1.0001	1.89
								Avg.	1.0013	1.83

* 3/18/85 - 29.74

.5, 1, 3 - 3/19/85 - 30.06

Y

$$\frac{V_w\left(Pb - \frac{\Delta Hw}{13.6}\right)(td + 460)}{Vd\left(Pb + \frac{\Delta H@}{13.6}\right)(Tw + 460)}$$

ΔH@

$$\frac{0.0317\ \Delta H}{Pb\ (td + 460)}\left[\frac{tw + 460\ \theta}{Vw}\right]^2$$

$\frac{5.003 \times 30.04 \times 541.3 \times .9987}{5.046 \times 30.09 \times 535}$	= 1.0002	$\frac{.0317 \times .5}{30.06 \times 541.3}\left(\frac{535 \times 12.48}{5.003}\right)^2$ =	1.73
$\frac{8.935 \times 30.02 \times 546.3 \times .9987}{9.055 \times 30.13 \times 535}$	= 1.0026	$\frac{.0317}{30.06 \times 546.3}\left(\frac{535 \times 15.92}{8.935}\right)^2$	1.75
* $\frac{8.829 \times 29.67 \times 537 \times .9987}{8.908 \times 29.89 \times 526.5}$	= 1.0022	$\frac{.0317 \times 2}{29.74 \times 537}\left(\frac{526.5 \times 11.71}{8.829}\right)^2$	1.94
$\frac{10.067 \times 29.98 \times 552.8 \times .9987}{10.284 \times 30.28 \times 535}$	= 1.0001	$\frac{.0317 \times 3}{30.06 \times 552.8}\left(\frac{535 \times 10.82}{10.067}\right)^2$	1.89

Y = Ratio of accuracy of wet test meter to dry test meter. Tolerance = ±0.01.

ΔH@ = Orifice pressure differential that gives 0.75 cfm of air at 70°F and 29.92 inches of mercury, in. H_2O. Tolerance = ±0.15.

Post test tolerance must be within ± 0.05 and within a range of 0.10

Meter Leak Check Front ______ Back

Calibrating technician ____________

Pitot Leak Check ______

Electrical Check ______

Remarks

APPENDIX D

Meter Calibrations

RADIAN CORPORATION

PRELIMINARY VELOCITY TRAVERSE

PLANT: Site 09
DATE: 5/29/85
LOCATION: Inlet
STACK I.D.: 50"
BAROMETRIC PRESSURE, in. Hg: 29.36
STACK GAUGE PRESSURE, in. H_2O:
OPERATORS: CoG JRM

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F 2
A1	0.06	~~413~~ 862
A-2	0.26	~~632~~ 1095
-3	0.47	1429
-4	0.57	1604
-5	0.70	1671
-6	0.74	1681
-7	0.75	1711
-8	0.70	1697
-9	~~[illegible]~~ 0.70	1686
-10	0.63	1684
-11	0.65	1708
-12	0.59	1690
AVERAGE		

SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

EPA (Dur) 233
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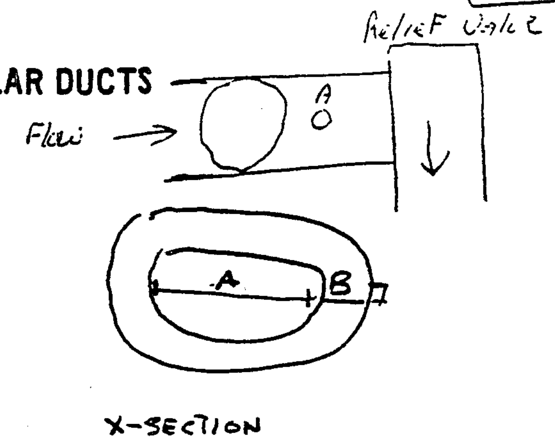
29.36 Bp

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS



SCHEMATIC OF SAMPLING LOCATION

PLANT SITE 9
DATE MAY 29, 1985
SAMPLING LOCATION INLET
INSIDE OF FAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE A) 52"
INSIDE OF NEAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE B) 9"
STACK I.D., (DISTANCE A - DISTANCE B) 43"
NEAREST UPSTREAM DISTURBANCE ≈ 30 FT
NEAREST DOWNSTREAM DISTURBANCE ≈ 6 FT
CALCULATOR JONGLEUX

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	[illegible] PB	43"	.9.03	9	10"
2	6.7	43	2.88	9	11.8"
3	11.8	43	5.1	9	14.1"
4	17.7	43	7.6	9	16.6
5	25.0	43	10 3/4	9	19 3/4
6	35.6	43	15.3	9	24.3
7	64.4	43	27.7	9	36.7
8	75.0	43	32 1/4	9	41 1/4
9	82.3	43	35.4	9	44.4
10	88.2	43	37.9	9	46.9
11	93.3	43	40.1	9	49.1
12	97.9	43.	42	9	51

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4/72

NOMOGRAPH DATA

PLANT Site 09

DATE 5/29/85

SAMPLING LOCATION INLET

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.75
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m\,avg.}$	90
PERCENT MOISTURE IN GAS STREAM BY VOLUME	B_{wo}	33
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.36
STATIC PRESSURE IN STACK, in. Hg (P_m ±0.073 x STACK GAUGE PRESSURE in in. H_2O)	P_s	-1.8
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	~~1650~~ 1700
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.60
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	0.75
C FACTOR	0.59	
CALCULATED NOZZLE DIAMETER, in.	3/8	
ACTUAL NOZZLE DIAMETER, in. 0.362 .368 0.371	0.368	
REFERENCE Δp, in. H_2O	0.61	

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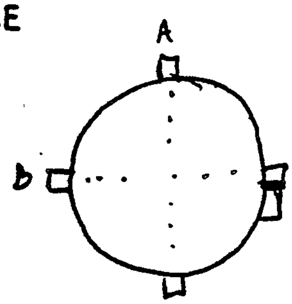
4/72

RADIAN CORPORATION

PRELIMINARY VELOCITY TRAVERSE

PLANT Site 09
DATE 3-28-85
LOCATION outlet
STACK I.D. 47½"
BAROMETRIC PRESSURE, in. Hg 29.36 @ Trailer
STACK GAUGE PRESSURE, in. H_2O -.45" H_2O
OPERATORS GARCIA HENRY



SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
A- 1	.38	335
2	.39	337
3	.38	338
4	.38	338
5	.34	338
6	.25	307
B- 1	.29	338
2	.29	338
3	.39	338
4	.44	338
5	.26	338
6	.20	338
AVERAGE	.33	336.7

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

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RADIAN CORPORATION

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Site 09
DATE 5-28-85
SAMPLING LOCATION outlet
INSIDE OF FAR WALL TO OUTSIDE OF NIPPLE. (DISTANCE A) 54½"
INSIDE OF NEAR WALL TO OUTSIDE OF NIPPLE. (DISTANCE B) 7"
STACK I.D., (DISTANCE A - DISTANCE B) 47½"
NEAREST UPSTREAM DISTURBANCE 288" (24')
NEAREST DOWNSTREAM DISTURBANCE 576" (48.7')
CALCULATOR Henry

SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
A - 1	.044	47.5"	2.09	7"	9 1/8
2	.146	47.5"	6.935	7"	13.7/8
3	.296	47.5"	14.06	7"	21.0
4	.704	47.5"	33.44	7"	40.½
5	.854	47.5"	40.565	7"	47.5/8
6	.956	47.5"	45.41	7"	52½

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4/72

NOMOGRAPH DATA

PLANT Site 09

DATE 5-30-85

SAMPLING LOCATION outlet (HCL)

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.89
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	105°F
PERCENT MOISTURE IN GAS STREAM BY VOLUME	B_{wo}	35%
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.9
STATIC PRESSURE IN STACK, in. Hg (P_m ± 0.073 x STACK GAUGE PRESSURE in in. H_2O)	P_s	-.45" H_2O
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.0
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	336
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.44
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	.48
C FACTOR		.58
CALCULATED NOZZLE DIAMETER, in.		5/16
ACTUAL NOZZLE DIAMETER, in.		.308
REFERENCE Δp, in. H_2O		.52

EPA (Dur) 234
4/72

NOMOGRAPH DATA

PLANT Site 09

DATE 5-30-85

SAMPLING LOCATION outlet (mm5)

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.702
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m\,avg.}$	105°F
PERCENT MOISTURE IN GAS STREAM BY VOLUME	B_{wo}	35%
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.9
STATIC PRESSURE IN STACK, in. Hg (P_m ± 0.073 x STACK GAUGE PRESSURE in in. H_2O)	P_s	-.45" H_2O
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.0
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	336
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.44
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	.49
C FACTOR	.52	
CALCULATED NOZZLE DIAMETER, in.	.5/16	
ACTUAL NOZZLE DIAMETER, in.	.308	
REFERENCE Δp, in. H_2O	.58	

EPA (Dur) 234
4/72

APPENDIX C.6

Preliminary Traverse Point Location Traverse and Nomograph Data Sheets

ORGANIC SAMPLING TRAIN IMPINGER RECOVERY SHEET

Sample Code Ident. Ø9-MM5-BO- FBL Date 5-30-85

Impinger No.	Solution Used	Amount of Solution (ml)	Imp. Tip Configuration	Weight (grams)	
1*	—			Final	668.4
				Initial	668.4
				Wt. gain	-0-
2	HPLC H_2O	100.2		Final	580.0
				Initial	580.0
				Wt. gain	-0-
3	HPLC H_2O	101.4		Final	561.7
				Initial	561.7
				Wt. gain	-0-
4	—			Final	461.2
				Initial	461.2
				Wt. gain	-0-
5	Silica gel	201.8		Final	677.2
				Initial	677.2
				Wt. gain	0
6				Final	
				Initial	
				Wt. gain	
7				Final	
				Initial	
				Wt. gain	

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 0

*QA SAMPLE FOR ORGANIC COLLECTION EFFICIENCY - SAVE IN CONTAINER #4.

Samples for Further Analysis:

Sample No.	Description	Species	Results (Total mg.)

ORGANIC SAMPLING TRAIN RECOVERY SHEET

PLANT SITE 09

DATE 5-30-85

SAMPLING LOCATION BAGHOUSE OUTLET

SAMPLE TYPE MM5

RUN NUMBER 09-MM5-BO FBL

SAMPLE BOX NUMBER ______

CLEAN-UP PERSON D Benson

SOLVENT RINSES Acetone/MeCl₂

COMMENTS:

FRONT HALF - PARTICULATE PHASE

SOLVENT WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER

CONTAINER # ______

GRAVIMETRIC RESULTS		LABORATORY RESULTS
FINAL: ______ mg		
TARE: ______ mg		
NET: ______ mg		______ µg

FILTER NUMBER ______ ______

CONTAINER # ______

GRAVIMETRIC RESULTS	LABORATORY RESULTS
FINAL: ______ mg	
TARE: ______ mg	
NET: ______ mg	______ µg

FRONT HALF SUBTOTAL ______ mg ______ µg

ORGANIC-VAPOR PHASE

TRANSFER LINE AND CONDENSER (SOLVENT RINSE) — CONTAINER # ______ ______ µg

RESIN TRAP (XAD-2) (NOTE): CAP & LABEL IMMEDIATELY — TRAP # 28 (361.7) - (361.9) = -(0.2) ______ µg

IMPINGER NO.1 (QA) — CONTAINER #4 ______ NET GAIN ______ (See Impinger Results Reverse Side) ______ µg

TOTAL ______ µg

NOTES/OBSERVATIONS:

ORGANIC SAMPLING TRAIN IMPINGER RECOVERY SHEET

Sample Code Ident. Ø9-HCl-FBL Date 5-30-85

Impinger No.	Solution Used	Amount of Solution (ml)	Imp. Tip Configuration		Weight (grams)
1*	NaOH (.1N)	101.1		Final	622.4
				Initial	622.4
				Wt. gain	0
2	NaOH (.1N)	101.8		Final	615.0
				Initial	614.9
				Wt. gain	.1
3	—			Final	432.2
				Initial	432.5
				Wt. gain	-(0.3)
4	Silica gel	202.7		Final	702.9
				Initial	702.9
				Wt. gain	0
5				Final	
				Initial	
				Wt. gain	
6				Final	
				Initial	
				Wt. gain	
7				Final	
				Initial	
				Wt. gain	

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 0

*QA SAMPLE FOR ORGANIC COLLECTION EFFICIENCY - SAVE IN CONTAINER #4.

Samples for Further Analysis:

Sample No.	Description	Species	Results (Total mg.)

ORGANIC SAMPLING TRAIN RECOVERY SHEET

PLANT SITE Ø9

DATE 5-30-85

SAMPLING LOCATION BAGHOUSE OUTLET

SAMPLE TYPE HCl

RUN NUMBER FIELD BLANK (FBL)

SAMPLE BOX NUMBER ____

CLEAN-UP PERSON D. Benson

SOLVENT RINSES NaOH

COMMENTS:

		GRAVIMETRIC RESULTS	LABORATORY RESULTS
FRONT HALF - PARTICULATE PHASE			
SOLVENT WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER	CONTAINER # ____	FINAL: ____ mg	
		TARE: ____ mg	
		NET: ____ mg	____ µg
FILTER NUMBER ____ ____ / ____ ____ / ____ ____	CONTAINER # ____	FINAL: ____ mg	
		TARE: ____ mg	
		NET: ____ mg	____ µg
		FRONT HALF SUBTOTAL ____ mg	____ µg
ORGANIC-VAPOR PHASE			
TRANSFER LINE AND CONDENSER (SOLVENT RINSE)	CONTAINER # —		____ µg
RESIN TRAP (XAD-2) (NOTE): CAP & LABEL IMMEDIATELY	TRAP # ____		____ µg
IMPINGER NO.1 (QA)	CONTAINER #4 ____	NET GAIN ____ (See Impinger Results Reverse Side)	____ µg
			TOTAL ____ µg

NOTES/OBSERVATIONS:

ORGANIC SAMPLING TRAIN IMPINGER RECOVERY SHEET

Sample Code Ident. Ø9-MM5-BI-FBL Date 5-30-85

Impinger No.	Solution Used	Amount of Solution (ml)	Imp. Tip Configuration		Weight (grams)
1*	—			Final	651.8
				Initial	651.7
				Wt. gain	.1
2	HPLC H_2O	100.2		Final	578.0
				Initial	577.6
				Wt. gain	.4
3	HPLC H_2O	101.0		Final	638.7
				Initial	638.6
				Wt. gain	.1
4	—			Final	482.3
				Initial	482.4
				Wt. gain	-(.1)
5	Silica gel	200.4		Final	697.4
				Initial	697.6
				Wt. gain	-(0.2)
6				Final	
				Initial	
				Wt. gain	
7				Final	
				Initial	
				Wt. gain	

~~TOTAL~~ WEIGHT GAIN OF ~~IMPINGERS~~ (grams) 0.3

~~AAA~~ SAMPLE FOR ORGANIC COLLECTION EFFICIENCY - SAVE IN CONTAINER #4.

832H3.M1

Samples for Further Analysis:

Sample No.	Description	Species	Results (Total mg.)

ORGANIC SAMPLING TRAIN RECOVERY SHEET

PLANT SITE 09

DATE 5-30-85

SAMPLING LOCATION BAGHOUSE INLET

SAMPLE TYPE MM5

RUN NUMBER 09-MM5-BI-FBL

SAMPLE BOX NUMBER ____

CLEAN-UP PERSON D Benson

SOLVENT RINSES Acetone/MeCl2

COMMENTS:

		GRAVIMETRIC RESULTS	LABORATORY RESULTS
FRONT HALF - PARTICULATE PHASE			
SOLVENT WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER	CONTAINER # ____	FINAL: ____ mg	
		TARE: ____ mg	
		NET: ____ mg	____ µg
FILTER ~~NUMBER~~ ____ ____ / ____ ____ / ____ ____	CONTAINER # ____	FINAL: ____ mg	
		TARE: ____ mg	
		NET: ____ mg	____ µg
		FRONT HALF SUBTOTAL ____ mg	____ µg
ORGANIC-VAPOR PHASE			
TRANSFER LINE AND CONDENSER (SOLVENT RINSE)	CONTAINER # ____		____ µg
RESIN TRAP (XAD-2) (NOTE): CAP & LABEL IMMEDIATELY	TRAP # 29 (387.6) - (387.6) =	0	____ µg
IMPINGER NO.1 (QA)	CONTAINER #4 ____	NET GAIN ____ (See Impinger Results Reverse Side)	____ µg
			TOTAL ____ µg

NOTES/OBSERVATIONS:

ORGANIC SAMPLING TRAIN IMPINGER RECOVERY SHEET

Sample Code Ident. Ø9- AMBIENT - B Date 5-29-85

Impinger No.	Solution Used	Amount of Solution (ml)	Imp. Tip Configuration	Weight (grams)	
1*	2nd Silica gel	201.8		Final	700.7
				Initial	655.4
				Wt. gain	45.3
2	Silica gel	203.5		Final	730.7
				Initial	692.1
				Wt. gain	38.6
3				Final	
				Initial	
				Wt. gain	
4				Final	
				Initial	
				Wt. gain	
5				Final	
				Initial	
				Wt. gain	
6				Final	
				Initial	
				Wt. gain	
7				Final	
				Initial	
				Wt. gain	

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 83.9 ✓

*QA SAMPLE FOR ORGANIC COLLECTION EFFICIENCY - SAVE IN CONTAINER #4.

Samples for Further Analysis:

Sample No.	Description	Species	Results (Total mg.)

ORGANIC SAMPLING TRAIN RECOVERY SHEET

PLANT ϕ9

DATE 5-29-85

SAMPLING LOCATION

SAMPLE TYPE AMBIENT - B

RUN NUMBER C9 - AMBIENT - 1B

SAMPLE BOX NUMBER

CLEAN-UP PERSON ABenson

SOLVENT RINSES

COMMENTS:

		GRAVIMETRIC RESULTS	LABORATORY RESULTS
FRONT HALF - PARTICULATE PHASE			
SOLVENT WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER	CONTAINER #	FINAL: ____ mg	
		TARE: ____ mg	
		NET: ____ mg	____ µg
FILTER NUMBER	CONTAINER #	FINAL: ____ mg	
		TARE: ____ mg	
		NET: ____ mg	____ µg
		FRONT HALF SUBTOTAL ____ mg	____ µg
ORGANIC-VAPOR PHASE			
TRANSFER LINE AND CONDENSER (SOLVENT RINSE)	CONTAINER #		____ µg
RESIN TRAP (XAD-2) (NOTE): CAP & LABEL IMMEDIATELY	TRAP # 20 ( )-(350.7) =		____ µg
IMPINGER NO.1 (QA)	CONTAINER #4	NET GAIN (See Impinger Results Reverse Side)	____ µg
			TOTAL ____ µg

NOTES/OBSERVATIONS:

Check % moisture with Ambient B

ORGANIC SAMPLING TRAIN IMPINGER RECOVERY SHEET

Sample Code Ident. Ø9-AMB-A Date 5-29-85

Impinger No.	Solution Used	Amount of Solution (ml)	Imp. Tip Configuration	Weight (grams)	
1*	Silica gel	200.2	Popped ~~cotton~~	Final	?
				Initial	~~721.4~~
				Wt. gain	
2 (2nd)	silica gel	202.1		Final	780.6
				Initial	736.6
				Wt. gain	44.0
3				Final	
				Initial	
				Wt. gain	
4				Final	
				Initial	
				Wt. gain	
5				Final	
				Initial	
				Wt. gain	
6				Final	
				Initial	
				Wt. gain	
7				Final	
				Initial	
				Wt. gain	

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 44.0 + (1st) = ✓

*QA SAMPLE FOR ORGANIC COLLECTION EFFICIENCY - SAVE IN CONTAINER #4.

Samples for Further Analysis:

Sample No.	Description	Species	Results (Total mg.)

PLANT Site Ø9

DATE 5-29-85

SAMPLING LOCATION ____

SAMPLE TYPE Ambient - A

RUN NUMBER Ø9 - AMB - 1A

SAMPLE BOX NUMBER ____

CLEAN-UP PERSON D Benson

SOLVENT RINSES Acetone / MeCl2

COMMENTS:

		GRAVIMETRIC RESULTS	LABORATORY RESULTS
FRONT HALF - PARTICULATE PHASE			
SOLVENT WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER	CONTAINER # ____	FINAL: ____ mg	
		TARE: ____ mg	
		NET: ____ mg	____ µg
FILTER NUMBER ____ ____ / ____ ____ / ____ ____	CONTAINER # ____	FINAL: ____ mg	
		TARE: ____ mg	
		NET: ____ mg	____ µg
		FRONT HALF SUBTOTAL ____ mg	____ µg
ORGANIC-VAPOR PHASE			
TRANSFER LINE AND CONDENSER (SOLVENT RINSE)	CONTAINER # ____		____ µg
RESIN TRAP (XAD-2) (NOTE): CAP & LABEL IMMEDIATELY	TRAP # 22 ( ) - (360.7) =	____	____ µg
IMPINGER NO.1 (QA)	CONTAINER #4 ____	NET GAIN ____ (See Impinger Results Reverse Side)	____ µg
			TOTAL ____ µg

NOTES/OBSERVATIONS:

ORGANIC SAMPLING TRAIN IMPINGER RECOVERY SHEET

Sample Code Ident. ∅9-MM5-BI-∅3 Date 5-31-85

Impinger No.	Solution Used	Amount of Solution (ml)	Imp. Tip Configuration		Weight (grams)
1*	—			Final	1868.1
				Initial	651.7
				Wt. gain	1216.4
2	HPLC H_2O	100.3		Final	573.9
				Initial	578.2
				Wt. gain	-(4.3)
3	HPLC H_2O	100.4		Final	641.4
				Initial	638.2
				Wt. gain	3.2
4	—			Final	485.9
				Initial	482.3
				Wt. gain	3.6
5	Silica gel	200.4		Final	743.9
				Initial	697.4
				Wt. gain	46.5
6				Final	
				Initial	
				Wt. gain	
7				Final	
				Initial	
				Wt. gain	

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 1265.4 ✓

*QA SAMPLE FOR ORGANIC COLLECTION EFFICIENCY - SAVE IN CONTAINER #4.

Samples for Further Analysis:

Sample No.	Description	Species	Results (Total mg.)

ORGANIC SAMPLING TRAIN RECOVERY SHEET

PLANT Site 09

DATE 5-31-85

SAMPLING LOCATION Baghouse Inlet

SAMPLE TYPE MM5

RUN NUMBER 03 09-MM5-BI-3

SAMPLE BOX NUMBER ______

CLEAN-UP PERSON D. Benson

SOLVENT RINSES Acetone/MeCl2

COMMENTS:

		GRAVIMETRIC RESULTS	LABORATORY RESULTS
FRONT HALF - PARTICULATE PHASE			
SOLVENT WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER	CONTAINER # ______	FINAL: ______ mg	
		TARE: ______ mg	
		NET: ______ mg	______ µg
FILTER NUMBER ______ ______ / ______ ______ / ______ ______	CONTAINER # ______	FINAL: ______ mg	
		TARE: ______ mg	
		NET: ______ mg	______ µg
		FRONT HALF SUBTOTAL ______ mg	______ µg
ORGANIC-VAPOR PHASE			
TRANSFER LINE AND CONDENSER (SOLVENT RINSE)	CONTAINER # ______		______ µg
RESIN TRAP (XAD-2) (NOTE): CAP & LABEL IMMEDIATELY	TRAP # 30 (378.6) − (376.4) =	2.2	______ µg
IMPINGER NO.1 (QA)	CONTAINER #4 ______	NET GAIN ______ (See Impinger Results Reverse Side)	______ µg
			TOTAL ______ µg

NOTES/OBSERVATIONS:

ORGANIC SAMPLING TRAIN IMPINGER RECOVERY SHEET

Sample Code Ident. Ø9-MMS-BI-Ø2 Date 5-30-85

Impinger No.	Solution Used	Amount of Solution (ml)	Imp. Tip Configuration		Weight (grams)
1*	—	—		Final	1755.8
				Initial	684.8
				Wt. gain	1071.0
2	HPLC H_2O	100.7		Final	615.1
				Initial	623.2
				Wt. gain	-(8.1)
3	HPLC H_2O	101.9		Final	615.6
				Initial	614.1
				Wt. gain	1.5
4	—			Final	442.5
				Initial	435.5
				Wt. gain	7.0
5	Silica gel	200.6		Final	783.3
				Initial	734.7
				Wt. gain	48.6
6				Final	
				Initial	
				Wt. gain	
7				Final	
				Initial	
				Wt. gain	

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 1120.0

*QA SAMPLE FOR ORGANIC COLLECTION EFFICIENCY - SAVE IN CONTAINER #4.

Samples for Further Analysis:

Sample No.	Description	Species	Results (Total mg.)

ORGANIC SAMPLING TRAIN RECOVERY SHEET

PLANT SITE Ø9

DATE 5-30-85

SAMPLING LOCATION BAGHOUSE INLET

SAMPLE TYPE MMS

RUN NUMBER Ø2 09-MMS-BI-2

SAMPLE BOX NUMBER ____

CLEAN-UP PERSON D Benson

SOLVENT RINSES Acetone / MeCl2

COMMENTS:

		GRAVIMETRIC RESULTS	LABORATORY RESULTS
FRONT HALF - PARTICULATE PHASE			
SOLVENT WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER	CONTAINER # ____	FINAL: ____ mg	
		TARE: ____ mg	
		NET: ____ mg	____ µg
FILTER NUMBER ____ ____	CONTAINER # ____	FINAL: ____ mg	
____ ____		TARE: ____ mg	
____ ____		NET: ____ mg	____ µg
		FRONT HALF SUBTOTAL ____ mg	____ µg
ORGANIC-VAPOR PHASE			
TRANSFER LINE AND CONDENSER (SOLVENT RINSE)	CONTAINER # ____		____ µg
RESIN TRAP (XAD-2) (NOTE): CAP & LABEL IMMEDIATELY	TRAP # 20 (348.7) - (347.6) =	1.1	____ µg
IMPINGER NO.1 (QA)	CONTAINER #4 ____	NET GAIN ____ (See Impinger Results Reverse Side)	____ µg
			TOTAL ____ µg

NOTES/OBSERVATIONS:

ORGANIC SAMPLING TRAIN IMPINGER RECOVERY SHEET

Sample Code Ident. Ø9-MMS-BI-Ø1 Date 5-29-85

Impinger No.	Solution Used	Amount of Solution (ml)	Imp. Tip Configuration		Weight (grams)
1*	—	—		Final	1708.8
				Initial	653.8
				Wt. gain	1055.0
2	HPLC H_2O	103.5		Final	638.1
				Initial	641.5
				Wt. gain	−(3.4)
3	HPLC H_2O	102.5		Final	579.6
				Initial	580.2
				Wt. gain	−(0.6)
4	—	—		Final	489.3
				Initial	482.2
				Wt. gain	7.1
5	Silica gel	200.4		Final	738.1
				Initial	698.1
				Wt. gain	40.0
6				Final	
				Initial	
				Wt. gain	
7				Final	
				Initial	
				Wt. gain	

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 1098.1 ✓

*QA SAMPLE FOR ORGANIC COLLECTION EFFICIENCY - SAVE IN CONTAINER #4.

Samples for Further Analysis:

Sample No.	Description	Species	Results (Total mg.)

ORGANIC SAMPLING TRAIN RECOVERY SHEET

PLANT Site Ø9

DATE 5-29-85

SAMPLING LOCATION Baghouse Inlet

SAMPLE TYPE MM5

RUN NUMBER Ø1 09-MM5-BI-1

SAMPLE BOX NUMBER ______

CLEAN-UP PERSON D Benson

SOLVENT RINSES Acetone/MeCl2

COMMENTS:

FRONT HALF - PARTICULATE PHASE

		GRAVIMETRIC RESULTS	LABORATORY RESULTS
SOLVENT WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER	CONTAINER # ______	FINAL: ______ mg	
		TARE: ______ mg	
		NET: ______ mg	______ µg
FILTER NUMBER ______ ______ / ______ ______ / ______ ______	CONTAINER # ______	FINAL: ______ mg	
		TARE: ______ mg	
		NET: ______ mg	______ µg
		FRONT HALF SUBTOTAL ______ mg	______ µg

ORGANIC-VAPOR PHASE

			LABORATORY RESULTS
TRANSFER LINE AND CONDENSER (SOLVENT RINSE)	CONTAINER # ______		______ µg
RESIN TRAP (XAD-2) (NOTE): CAP & LABEL IMMEDIATELY	TRAP # 15 1ST (354.1) - (353.3) =	0.8	______ µg
	2ND #27 (379.2) - (385.7) =	-6.5	
IMPINGER NO.1 (QA)	CONTAINER #4 ______	NET GAIN ______ (See Impinger Results Reverse Side)	______ µg
		TOTAL	______ µg

NOTES/OBSERVATIONS:

2ND filter taken up w/2ND XAD

First XAD (module #15) in run for 20 min only.

ORGANIC SAMPLING TRAIN IMPINGER RECOVERY SHEET

Sample Code Ident. Ø9-HCl-Ø3 Date 5-31-85

Impinger No.	Solution Used	Amount of Solution (ml)	Imp. Tip Configuration		Weight (grams)
1*	NaOH (.1N)	101.0		Final	883.6
				Initial	622.1
				Wt. gain	261.5
2	NaOH (.1N)	101.3		Final	771.4
				Initial	614.4
				Wt. gain	157.0
3	–			Final	446.0
				Initial	432.5
				Wt. gain	13.5
4	Silica gel	202.7		Final	725.0
				Initial	702.9
				Wt. gain	22.1
5				Final	
				Initial	
				Wt. gain	
6				Final	
				Initial	
				Wt. gain	
7				Final	
				Initial	
				Wt. gain	

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 454.1 ✓

*QA SAMPLE FOR ORGANIC COLLECTION EFFICIENCY - SAVE IN CONTAINER #4.

Samples for Further Analysis:

Sample No.	Description	Species	Results (Total mg.)

ORGANIC SAMPLING TRAIN RECOVERY SHEET

PLANT Site Ø9

DATE 5-31-85

SAMPLING LOCATION Baghouse Outlet

SAMPLE TYPE HCl

RUN NUMBER Ø3 09-HCL-BO-3

SAMPLE BOX NUMBER ______

CLEAN-UP PERSON D Benson

SOLVENT RINSES NaOH

COMMENTS:

FRONT HALF - PARTICULATE PHASE		GRAVIMETRIC RESULTS	LABORATORY RESULTS
SOLVENT WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER	CONTAINER # ______	FINAL: ______ mg TARE: ______ mg NET: ______ mg	______ μg
FILTER NUMBER ______ ______ / ______ ______ / ______ ______	CONTAINER # ______	FINAL: ______ mg TARE: ______ mg NET: ______ mg	______ μg
		FRONT HALF SUBTOTAL ______ mg	______ μg

ORGANIC-VAPOR PHASE			
TRANSFER LINE AND CONDENSER (SOLVENT RINSE)	CONTAINER # ______		______ μg
RESIN TRAP (XAD-2) (NOTE): CAP & LABEL IMMEDIATELY	TRAP # ______		______ μg
IMPINGER NO.1 (QA)	CONTAINER #4 ______	NET GAIN ______ (See Impinger Results Reverse Side)	______ μg
			TOTAL ______ μg

NOTES/OBSERVATIONS:

ORGANIC SAMPLING TRAIN IMPINGER RECOVERY SHEET

Sample Code Ident. ∅9-HCl-∅2 Date 5-30-85

Impinger No.	Solution Used	Amount of Solution (ml)	Imp. Tip Configuration		Weight (grams)
1*	NaOH (.1N)	102.1		Final	758.3
				Initial	571.9
				Wt. gain	186.4 ✓
2	NaOH (.1N)	101.6		Final	831.0
				Initial	588.7
				Wt. gain	242.3 ✓
3	—			Final	823.5
				Initial	453.8
				Wt. gain	369.7 ✓
4	Silica gel	201.0		Final	737.0
				Initial	689.1
				Wt. gain	47.9 ✓
5				Final	
				Initial	
				Wt. gain	
6				Final	
				Initial	
				Wt. gain	
7				Final	
				Initial	
				Wt. gain	

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 846.3 ✓

*QA SAMPLE FOR ORGANIC COLLECTION EFFICIENCY - SAVE IN CONTAINER #4.

Samples for Further Analysis:

Sample No.	Description	Species	Results (Total mg.)

ORGANIC SAMPLING TRAIN RECOVERY SHEET

PLANT SITE Ø9

DATE 5-30-85

SAMPLING LOCATION BAGHOUSE OUTLET

SAMPLE TYPE HCl

RUN NUMBER Ø2 09-HCL-BO-2

SAMPLE BOX NUMBER ____

CLEAN-UP PERSON D. Benson

SOLVENT RINSES NaOH

COMMENTS:

		GRAVIMETRIC RESULTS	LABORATORY RESULTS
FRONT HALF - PARTICULATE PHASE			
SOLVENT WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER	CONTAINER # ____	FINAL: ____ mg	
		TARE: ____ mg	
		NET: ____ mg	____ μg
FILTER NUMBER ____ ____	CONTAINER # ____	FINAL: ____ mg	
____ ____		TARE: ____ mg	
____ ____		NET: ____ mg	____ μg
		FRONT HALF SUBTOTAL ____ mg	____ μg
ORGANIC-VAPOR PHASE			
TRANSFER LINE AND CONDENSER (SOLVENT RINSE)	CONTAINER # ____		____ μg
RESIN TRAP (XAD-2) (NOTE): CAP & LABEL IMMEDIATELY	TRAP # —		____ μg
IMPINGER NO.1 (QA)	CONTAINER #4 ____	NET GAIN ____ (See Impinger Results Reverse Side)	____ μg
			TOTAL ____ μg

NOTES/OBSERVATIONS:

ORGANIC SAMPLING TRAIN IMPINGER RECOVERY SHEET

Sample Code Ident. Ø9-HCl-Ø1 Date 5-29-85

Impinger No.	Solution Used	Amount of Solution (ml)	Imp. Tip Configuration		Weight (grams)
1*	NaOH (.1N)	100.9		Final	822.8
				Initial	622.2
				Wt. gain	200.6
2	NaOH (.1N)	101.3		Final	829.0
				Initial	614.0
				Wt. gain	215.0
3	-	-		Final	779.8
				Initial	432.1
				Wt. gain	347.7
4	Silica gel	200.2		Final	726.3
				Initial	700.5
				Wt. gain	25.8
5				Final	
				Initial	
				Wt. gain	
6				Final	
				Initial	
				Wt. gain	
7				Final	
				Initial	
				Wt. gain	

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 789.1 ✓

*QA SAMPLE FOR ORGANIC COLLECTION EFFICIENCY - SAVE IN CONTAINER #4.

Samples for Further Analysis:

Sample No.	Description	Species	Results (Total mg.)

PLANT SITE Ø9

DATE 5-29-85

SAMPLING LOCATION BAGHOUSE OUTLET

SAMPLE TYPE HCl

RUN NUMBER Ø1 09-HCL-BO-1

SAMPLE BOX NUMBER ____

CLEAN-UP PERSON D Benson

SOLVENT RINSES ~~Acetone/MeCl2~~ NaOH

COMMENTS:

		GRAVIMETRIC RESULTS	LABORATORY RESULTS
FRONT HALF - PARTICULATE PHASE			
SOLVENT WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER	CONTAINER # ____	FINAL: ____ mg	
		TARE: ____ mg	
		NET: ____ mg	____ μg
FILTER NUMBER ____ ____ / ____ ____ / ____ ____	CONTAINER # ____	FINAL: ____ mg	
		TARE: ____ mg	
		NET: ____ mg	____ μg
		FRONT HALF SUBTOTAL ____ mg	____ μg
ORGANIC-VAPOR PHASE			
TRANSFER LINE AND CONDENSER (SOLVENT RINSE)	CONTAINER # ____		____ μg
RESIN TRAP (XAD-2) (NOTE): CAP & LABEL IMMEDIATELY	TRAP # ____		____ μg
IMPINGER NO.1 (QA)	CONTAINER #4 ____	NET GAIN ____ (See Impinger Results Reverse Side)	____ μg
			TOTAL ____ μg

NOTES/OBSERVATIONS:

ORGANIC SAMPLING TRAIN IMPINGER RECOVERY SHEET

Sample Code Ident. 69-MHS-B0-03 Date 5-31-85

Impinger No.	Solution Used	Amount of Solution (ml)	Imp. Tip Configuration	Weight (grams)	
1*	—			Final	2008.0
				Initial	668.5
				Wt. gain	1339.5
2	HPLC H_2O	100.5		Final	889.3
				Initial	580.5
				Wt. gain	308.8
3	HPLC H_2O	100.7		Final	631.2
				Initial	576.4
				Wt. gain	54.8
4	—			Final	473.5
				Initial	461.3
				Wt. gain	12.2
5	Silica gel	201.8		Final	720.7
				Initial	677.2
				Wt. gain	43.5
6				Final	
				Initial	
				Wt. gain	
7				Final	
				Initial	
				Wt. gain	

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 1758.8 ✓

*QA SAMPLE FOR ORGANIC COLLECTION EFFICIENCY - SAVE IN CONTAINER #4.

Samples for Further Analysis:

Sample No.	Description	Species	Results (Total mg.)

ORGANIC SAMPLING TRAIN RECOVERY SHEET

PLANT SITE Ø9

DATE 5-31-85

SAMPLING LOCATION BAGHOUSE OUTLET

SAMPLE TYPE MMS

RUN NUMBER Ø3 09-MMS-BO-3

SAMPLE BOX NUMBER ______

CLEAN-UP PERSON D Benson

SOLVENT RINSES Acetone/MeCl2

COMMENTS:

		GRAVIMETRIC RESULTS	LABORATORY RESULTS
FRONT HALF - PARTICULATE PHASE			
SOLVENT WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER	CONTAINER # ______	FINAL: ______ mg	
		TARE: ______ mg	
		NET: ______ mg	______ µg
FILTER NUMBER ______ ______	CONTAINER # ______	FINAL: ______ mg	
______ ______		TARE: ______ mg	
______ ______		NET: ______ mg	______ µg
		FRONT HALF SUBTOTAL ______ mg	______ µg
ORGANIC-VAPOR PHASE			
TRANSFER LINE AND CONDENSER (SOLVENT RINSE)	CONTAINER # ______		______ µg
RESIN TRAP (XAD-2) (NOTE): CAP & LABEL IMMEDIATELY	TRAP # 11 (358.6) − (357.8) =	0.8	______ µg
IMPINGER NO.1 (QA)	CONTAINER #4 ______	NET GAIN ______ (See Impinger Results Reverse Side)	______ µg
			TOTAL ______ µg

NOTES/OBSERVATIONS:

ORGANIC SAMPLING TRAIN IMPINGER RECOVERY SHEET

Sample Code Ident. 169-MH5-BO-02 Date 5-30-85

Impinger No.	Solution Used	Amount of Solution (ml)	Imp. Tip Configuration	Weight (grams)	
1*	—			Final	2032.3
				Initial	667.7
				Wt. gain	1364.6
2	HPLC H_2O	101.6		Final	773.3
				Initial	590.0
				Wt. gain	183.3
3	HPLC H_2O	100.8		Final	626.4
				Initial	626.8
				Wt. gain	-(0.4)
4	—			Final	448.0
				Initial	441.1
				Wt. gain	6.9
5	Silica gel	200.6		Final	680.9
				Initial	649.3
				Wt. gain	31.6
6				Final	
				Initial	
				Wt. gain	
7				Final	
				Initial	
				Wt. gain	

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 1586.0 ✓

*QA SAMPLE FOR ORGANIC COLLECTION EFFICIENCY - SAVE IN CONTAINER #4.

Samples for Further Analysis:

Sample No.	Description	Species	Results (Total mg.)

ORGANIC SAMPLING TRAIN RECOVERY SHEET

PLANT SITE Ø9

DATE 5-30-85

SAMPLING LOCATION BAGHOUSE OUTLET

SAMPLE TYPE MM5

RUN NUMBER Ø2 09-MM5-B0-2

SAMPLE BOX NUMBER ____

CLEAN-UP PERSON D Benson

SOLVENT RINSES Acetone / MeCl2

COMMENTS:

		GRAVIMETRIC RESULTS	LABORATORY RESULTS
FRONT HALF - PARTICULATE PHASE			
SOLVENT WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER	CONTAINER # ____	FINAL: ____ mg	
		TARE: ____ mg	
		NET: ____ mg	____ µg
FILTER NUMBER ____ ____ / ____ ____ / ____ ____	CONTAINER # ____	FINAL: ____ mg	
		TARE: ____ mg	
		NET: ____ mg	____ µg
		FRONT HALF SUBTOTAL ____ mg	____ µg
ORGANIC-VAPOR PHASE			
TRANSFER LINE AND CONDENSER (SOLVENT RINSE)	CONTAINER # ____		____ µg
RESIN TRAP (XAD-2) (NOTE): CAP & LABEL IMMEDIATELY	TRAP # 13 (362.1) - (362.3) =	-(0.2)	____ µg
IMPINGER NO.1 (QA)	CONTAINER #4 ____	NET GAIN ____ (See Impinger Results Reverse Side)	____ µg
			TOTAL ____ µg

NOTES/OBSERVATIONS:

ORGANIC SAMPLING TRAIN IMPINGER RECOVERY SHEET

Sample Code Ident. Ø9-MM5-BO-Ø1 Date 5-29-85

Impinger No.	Solution Used	Amount of Solution (ml)	Imp. Tip Configuration		Weight (grams)
1*	—			Final	2007.8
				Initial	668.3
				Wt. gain	1339.5
2	HPLC H_2O	100.7		Final	899.6
				Initial	580.5
				Wt. gain	319.1
3	HPLC H_2O	101.2		Final	490.2
				Initial	560.9
				Wt. gain	-(70.7)
4	—	—		Final	467.8
				Initial	461.0
				Wt. gain	6.8
5	Silica gel	201.1		Final	714.0
				Initial	676.3
				Wt. gain	37.7
6				Final	
				Initial	
				Wt. gain	
7				Final	
				Initial	
				Wt. gain	

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 1632.4

*QA SAMPLE FOR ORGANIC COLLECTION EFFICIENCY - SAVE IN CONTAINER #4.

Samples for Further Analysis:

Sample No.	Description	Species	Results (Total mg.)

PLANT SITE Ø9

DATE 5-29-86

SAMPLING LOCATION BAGHOUSE OUTLET

SAMPLE TYPE MM5

RUN NUMBER Ø1 09-MM5 BO-1

SAMPLE BOX NUMBER ______

CLEAN-UP PERSON D Benson

SOLVENT RINSES Acetone / $MeCl_2$

COMMENTS:

		GRAVIMETRIC RESULTS	LABORATORY RESULTS
FRONT HALF - PARTICULATE PHASE			
SOLVENT WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER	CONTAINER # ______	FINAL: ______ mg	
		TARE: ______ mg	
		NET: ______ mg	______ µg
FILTER NUMBER ______ ______ / ______ ______ / ______ ______	CONTAINER # ______	FINAL: ______ mg	
		TARE: ______ mg	
		NET: ______ mg	______ µg
		FRONT HALF SUBTOTAL ______ mg	______ µg
ORGANIC-VAPOR PHASE			
TRANSFER LINE AND CONDENSER (SOLVENT RINSE)	CONTAINER # ______		______ µg
RESIN TRAP (XAD-2) (NOTE): CAP & LABEL IMMEDIATELY	TRAP # 23 (372.1) - (368.9) =	3.2	______ µg
IMPINGER NO.1 (QA)	CONTAINER #4 ______	NET GAIN ______ (See Impinger Results Reverse Side)	______ µg
			TOTAL ______ µg

NOTES/OBSERVATIONS:

APPENDIX C.5

Sampling Train Recovery Sheets

RADIAN CORPORATION

FIELD DATA

PLANT Site 09
DATE 5-31-85
SAMPLING LOCATION outlet
SAMPLE TYPE HCl
RUN NUMBER 3 09-HCL-BC-3
OPERATOR Henry / Garcia
AMBIENT TEMPERATURE 70
BAROMETRIC PRESSURE 28.97
STATIC PRESSURE, (P_s) -.45" H_2O
FILTER NUMBER (s) —

PROBE LENGTH AND TYPE 5' Glass
NOZZLE I.D. .308
ASSUMED MOISTURE, % 35
SAMPLE BOX NUMBER —
METER BOX NUMBER M
METER $\Delta H_@$ 1.83
C FACTOR .58
PROBE HEATER SETTING 60%
HEATER BOX SETTING 250°F
REFERENCE Δp .50
METER γ 1.0007

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 10 MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
			796.098									
Single pt.	0	1105	~~938.326~~									
				.50	1.9	1.9	329	78	75	1	271	60
	10	15	803.2	.50	1.9	1.9	330	94	86	1	279	54
	20	25	810.4	.50	1.9	1.9	331	103	86	1	273	68
	30	35	817.8	.50	1.9	1.9	332	106	90	1	281	74
	40	45	824.8	.46	1.7	1.7	333	109	94	1	276	64
	50	55	832.2	.50	1.9	1.9	333	111	97	1	266	63
	60	1205	839.471	.50	1.9	1.9	333					
						1.87	331.33	94.08				
	60		43.373									

COMMENTS: 19.756

C-33

RADIAN CORPORATION

FIELD DATA

PLANT Site 09
DATE 5-30-85
SAMPLING LOCATION outlet
SAMPLE TYPE HCL
RUN NUMBER 2 09-HCL-BO-2
OPERATOR HENRY / GARCIA
AMBIENT TEMPERATURE 70°F
BAROMETRIC PRESSURE 29.06
STATIC PRESSURE, (P_s) -.45" H_2O
FILTER NUMBER (s) —

Int. LK CK. .015
Final LK CK .013

PROBE LENGTH AND TYPE 5' Glass
NOZZLE I.D. .304
ASSUMED MOISTURE, % 35%
SAMPLE BOX NUMBER —
METER BOX NUMBER 9
METER $\Delta H_@$ 1.96
C FACTOR ~~1.0025~~ .80
PROBE HEATER SETTING —
HEATER BOX SETTING 250°F
REFERENCE Δp .48
METER γ 1.0029

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 10 MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
Single Pt	0	1443	837.149									
	10	53	842.85	.35	1.35	1.35	346	85	84	0	284	66
	20	1503	849.52	.39	1.5	1.5	347	93	85	0	267	66
	30	13	855.84	.34	1.35	1.35	346	100	88	0	245	65
	40	23	862.19	.35	1.35	1.35	347	100	90	0	240	63
	50	33	868.80	.37	1.45	1.45	347	102	93	0	247	58
	60	43	875.36	.37	1.45	1.45	347	101	95	0	246	58
	70	53	882.97	.35	1.35	1.35	348	103	96	0	252	63
	80	1603	888.67	.39	1.5	1.5	345	106	96	0	245	64
	90	13	895.44	.38	1.5	1.5	346	109	98	0	240	67
	100	23	902.28	.38	1.5	1.5	346	107	97	0	256	70
	110	33	908.92	.38	1.5	1.5	346	111	99	0	242	75
	120	43	915.851	.38	1.5	1.5	346	112	101	0	270	69
			END OF TEST									
	120		78.702			1.44	346.42	97.96				

COMMENTS: 17.24966

RADIAN CORPORATION

FIELD DATA

PLANT Site 09
DATE 5-29-85
SAMPLING LOCATION outlet
SAMPLE TYPE HCL
RUN NUMBER (1) 09-HCL-BO-1
OPERATOR Henry / Garcia
AMBIENT TEMPERATURE 69°F
BAROMETRIC PRESSURE 29.31
STATIC PRESSURE, (P_s) = .45" H_2O
FILTER NUMBER (s) —

LEAK CHECK .014
FINAL LEAK CHECK .014

PROBE LENGTH AND TYPE 5' GLASS
NOZZLE I.D. .308
ASSUMED MOISTURE, % 30%
SAMPLE BOX NUMBER
METER BOX NUMBER ~~7B~~ 9
METER $\Delta H_@$ 1.702
C FACTOR .66
PROBE HEATER SETTING 60%
HEATER BOX SETTING 250°F
REFERENCE Δp .42
METER γ ~~.9978~~ 1.0029

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 10 MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
Single Pt	0	1453	759.284									
	10	1503	765.42	.33	1.35	1.35	340	94	87	0	253	90
	20	13	771.91	.33	1.35	1.35	341	107	90	0	255	80
	30	23	778.350	.33	1.35	1.35	342 -	106	94	0	252	88
	40	33	784.84	.34	1.4	1.4	342	113	95	0	260	73
	50	43	791.32	.33	1.35	1.35	340	113	98	0	259	60
	60	53	797.77	.33	1.35	1.35	340	114	101	0	256	57
	70	1603	803.82	.30	1.2	1.2	342	118	102	0	259	60
	80	13	809.95	.30	1.2	1.2	342	117	105	0	256	59
	90	23	815.78	.30	1.2	1.2	341	115	105	0	260	58
	100	33	821.94	.30	1.2	1.2	339	117	105	0	257	63
	110	43	828.46	.33	1.35	1.35	341	122	108	0	259	64
	120	53	835.058	.33	1.35	1.35	340	119	110	0	251	65
	120		75.774			1.30	340.8	106.4				

COMMENTS:

16.02423

EPA (Dur) 235

APPENDIX C.4

HCl Outlet Run Sheets

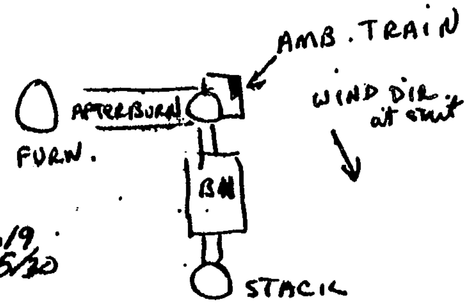
ADIAN
ORATION

FIELD DATA

↑ WIND DIR at 1915 5/29

This Run is between 40 and 100 cubic feet higher than it should be due to broke S.G. Impinges on day #2

PLANT Site 09
DATE ~~10~~ 5/29/85
SAMPLING LOCATION AMBIENT
SAMPLE TYPE AMBIENT A
RUN NUMBER
OPERATOR MWJ/TMCA
AMBIENT TEMPERATURE 80° SUNNY
BAROMETRIC PRESSURE 29.20 — 29.19 on 5/30
STATIC PRESSURE (P_s) —
FILTER NUMBER (s) —



PROBE LENGTH AND TYPE 1' PYREX
NOZZLE I.D. 1/2"
ASSUMED MOISTURE, % 80% RH
SAMPLE BOX NUMBER A
METER BOX NUMBER 5
METER ΔH@ 1.95
C FACTOR —
PROBE HEATER SETTING —
HEATER BOX SETTING —
REFERENCE Δp —
METER γ .9945

A

START Leak Rate .005 at 15 "Hg SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5/30 MINUTES

	TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft³	VELOCITY HEAD (Δp_s), in. H2O Water Bath	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H2O DESIRED	ACTUAL	~~STACK~~ TEMPERATURE (T_s), °F AMB	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	~~SAMPLE BOX~~ TEMPERATURE, °F XAD-2	IMPINGER TEMPERATURE, °F
		0	1330	243.985									
5-29	AMB-A	5	13:35	246.55	39°	.87	.87	74°	84°	80°	3.0	68°	60°
		10	13:40	249.25	42°	.87	.87	74°	90	82	3.0	68°	60°
		15	13:45	251.87	41°	.85	.85	74°	94	84	3.0	68°	60°
		135	16:05	326.20	37°	.85	.85	73°	105	100	3.0	70°	60°
			1700	355.4	36	.85	.85	75	108	99	3.0	58	"
			1806	390.7	32	.85	.85	79	107	99	3.0	56	"
	STOP		1915	427.887	58°	.85	.85	71	106	98	3.0	54°	"
	~~START~~												
5-30	START		1135	428.03	39	.85	.85	74	77	76	3.0	69	
3 minute imp 68°	STOP		1140	431.609				~~80~~			~~3~~	~~59~~	
	START		1430	431.609	40	.89	.85	80	81	80	3	59	
			1610	470.9	36	.85	.85	80	95	90	3	54	
			16:45	~~564~~ to 484.1	37	0.36	.36	80	97	92	3	54	
			1658	487.4	37	.85	.85	78	96	92	4	56	
			1755	520.2	41	.85	.85	79	99	92	4	52	
	STOP		1925	617.579	40	—	—	77	95	90	4	61	
	change Silica Gel — Bottom Broken out — initial leak check .005												
	START		1005	618.653	39°	.85	.85	64°	69	66	3	52	
Down to .45			1140	656.4	46	.85	.185	71	101	93	4	57	
			1236	687.4	47	.85	.85	78	~~112~~	~~100~~	6	66	
			1345	725.869	56	.45	.85	79	98	89	6	58	
		1035 min		481.884			.85	75.6	92.1				

COMMENTS:

ORPORATION

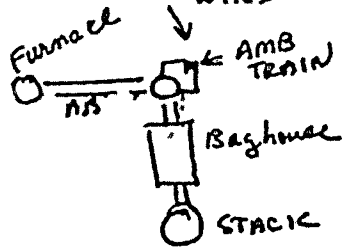
FIELD DATA

B

B.P.
29.19 – 5/30

PLANT Site Ø 9
DATE 5/29/85
SAMPLING LOCATION AMBIENT - B
SAMPLE TYPE " XAD-2
RUN NUMBER
OPERATOR MWH / JMcR.
AMBIENT TEMPERATURE 80°
BAROMETRIC PRESSURE 29.20
STATIC PRESSURE, (P_s) —
FILTER NUMBER (s) —

WIND 0-10MPH



PROBE LENGTH AND TYPE 1' Pyrex.
NOZZLE I.D. 1/2"
ASSUMED MOISTURE, % 80% RH.
SAMPLE BOX NUMBER B
METER BOX NUMBER 2
METER $\Delta H_@$
C FACTOR
PROBE HEATER SETTING N/A
HEATER BOX SETTING N/A
REFERENCE Δp 1.83
METER γ 1.0013

START Leak Rate .008 at 10" Hg

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 5/30 MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft³	VELOCITY HEAD (Δp_s), in. H_2O Water Bath	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F AMB.	DRY GAS METER TEMPERATURE INLET ($T_{m_{in}}$), °F	OUTLET ($T_{m_{out}}$), °F	PUMP VACUUM, in. Hg	SORBENT TEMPERATURE, °F XAD-2	IMPINGER TEMPERATURE, °F
	0	13:30	327.052									
AMBB	5	13:35	329.60	39°	.85	.85	74°	83°	79°	3.5	69°	60°
	10	13:40	332.20	42°	.83	.83	74°	87	80	3.5	71°	60°
	15	13:45	334.85	41°	.83	.83	74°	89	82	3.5	72°	60°
	135	15:05	408.20	37°	.83	.85	73°	99	96	3.5	74°	60°
		1700	437.5	36	.83	.83	75	97	96	4	65°	"
		1807	472.9	32	.83	.83	79	97	92	4	55°	"
STOP		1915	509.642	58	.83	.83	71	97	94	4	54°	"
START		1134	509.74	39	.83	.83	74	77	76	4	66	
STOP		1140	513.697				~~80~~			4	62	
START		1430	513.697	40	.83	.83	80	81	80	4	63	
		1610	552.1	36	.83	.83	80	93	91	4	55	
		16:42	564.10	37	.35	.35	80	95	92	4	54	
		16:58	568.3	37	.85	.85	78	98	93	6	55	
		18:55	601.2	41	.83	.86	79	101	95	6	58	
STOP		19:25	651.540	40	—	—	77	94	94	6	61	
	Changed Silica Gel out – initial leak check .01											
		10:05	652.442	39°	.85	.85	64°	68	65	4	59°	
		11:40	686.4	46	.85	.85	71	96	88	6	57	
		12:35	717.3	47	.85	.85	~~78~~	102	46	6	66	
		13:45	756.268	56	.85	.85	79	95	89		60	
						.83 ✓	75.4°	99.7 ✓				
	1036		429.216									

5-29

5-30 up 70°

Down 56.35

COMMENTS:

EPA (Dur) 235

APPENDIX C.3

Ambient Run Sheets

FIELD DATA

PLANT Site 09
DATE 5-31-85
SAMPLING LOCATION Outlet
SAMPLE TYPE MMS
RUN NUMBER 3 09-MMS-BO 3
OPERATOR Henry / Garcia
AMBIENT TEMPERATURE 70°F
BAROMETRIC PRESSURE 28.97
STATIC PRESSURE (P_s) -.45" H_2O
FILTER NUMBER (s) —
MINIMUM SAMPLE VOLUME 120 ft³
Final LK CK .005

page 3 of 3

PROBE LENGTH AND TYPE 5' Glass
NOZZLE I.D. .308
ASSUMED MOISTURE, % 35
SAMPLE BOX NUMBER —
METER BOX NUMBER 10
METER Δ H@ 1.702
C FACTOR .52
PROBE HEATER SETTING 50%
HEATER BOX SETTING 250°F
REFERENCE Δp .58
DRY/GAS METER FACTOR (Y) .9978

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5 MINUTES

A-3 Traverse Point Number	185 Sampling Time Min.	1318 Clock Time (24-hr Clock)	1050.28 Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, °F	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Actual	Temperature °F/°C (Circle One) Probe	Filter Skin	Filter Out	Recirc. Water	Absorbent Trap	Dry Gas Meter Inlet (T_m in)	Dry Gas Meter Outlet (T_m out)	Impinger Exit	Pump Vacuum in. Hg
3	190	23	1053.80	.42	339	1.4	1.4	—	242	—	—	69	102	93	65	12
3	195	28	1057.35	.45	339	1.5	1.5	—	258	—	—	68	100	93	65	12
3	200	33	1060.72	.45	339	1.5	1.5	—	297	—	—	66	102	93	64	13
2	205	38	1064.46	.42	339	1.4	1.4	—	268	—	—	68	103	94	64	13
2	210	43	1067.92	.42	339	1.4	1.4	—	261	—	—	70	105	94	64	13
2	215	48	1072.55	.39	339	1.3	1.3	—	263	—	—	65	109	95	64	12
2	220	53	1074.67	.42	338	1.4	1.4	—	245	—	—	66	111	97	65	12
1	225	58	1078.01	.33	333	1.1	1.1	—	285	—	—	66	111	98	64	12
1	230	1403	1081.05	.32	331	1.05	1.05	—	254	—	—	64	112	99	65	11
1	235	08	1084.84	.33	330	1.1	1.1	—	249	—	—	65	105	99	65	11
1	240	13	1087.182	.35	330	1.15	1.15	—	216	—	—	66	106	98	65	11
	240		166.962		333.21		1.45						97.79			

COMMENTS

18.48465

09-MM5-BC-3

Page 2 of 3

	Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s in °F	Oriface Pressure Differential (ΔH, in. H_2O) Desired	Actual	Temperature °F/°C (Circle One) Probe	Filter Skin	Filter Out	Recirc. Water	Absorbent Trap	Dry Gas Meter Inlet (T_m in)	Dry Gas Meter Outlet (T_m out)	Impinger Exit	Pump Vacuum in. Hg
	3	80	1122	974.1	.47	330	1.6	1.6		270			63	113	95	60	12
	2	85	27	977.8	.50	331	1.7	1.7		254			66	114	97	61	13
	2	90	32	981.5	.50	330	1.7	1.7		239			71	115	98	61	13
	2	95	37	985.1	.47	331	1.6	1.6		227			68	114	99	60	12
	2	100	42	988.9	.50	329	1.7	1.7		223			65	117	99	60	13
	1	105	47	992.4	.45	329	1.5	1.5		220			66	118	100	60	12
	1	110	52	996.0	.50	331	1.7	1.7		273			68	118	102	60	13
	1	115	57	999.7	.50	331	1.7	1.7		271			74	119	102	60	13
STOP	1	120	1202	1003.442	.45	331	1.8	1.5		249			66	119	103	61	12
					CHANGED		PORT										
START		120	1213	1003.643													
	A-6	125	18	1006.95	.43	335	1.4	1.4		271			67	101	99	63	12
	6	130	23	1010.41	.40	336	1.3	1.3		259			71	109	100	59	12
	6	135	28	1013.94	.44	338	1.45	1.45		261			78	108	100	63	12
	6	140	33	1017.33	.42	338	1.4	1.4		288			67	109	100	64	12
	5	145	38	1021.02	.47	342	1.6	1.6		268			69	109	101	66	12
	5	150	43	1024.46	.48	341	1.6	1.6		297			69	105	96	65	13
	5	155	48	1028.11	.50	342	1.7	1.7		280			69	109	99	67	13
	5	160	53	1031.85	.50	340	1.7	1.7		257			69	108	97	66	13
	4	165	58	1036.64	.50	340	1.7	1.7		243			70	103	97	66	13
	4	170	1303	1039.34	.50	340	1.7	1.7		288			72	102	95	67	14
	4	175	08	1043.42	.52	339	1.8	1.8		258			70	101	93	66	14
	4	180	13	1046.71	.48	338	1.6	1.6		239			72	104	93	68	13
	3	185	18	1050.28	.42	339	1.4	1.4		231			69	105	93	66	12
	TOTAL		●		●	●	●	●	●	●	●	●	●	●	●	●	●
	AVERAGE	●	●	●	●		●		●	●	●	●	●			●	●

FIELD DATA

PLANT S. Te #09	PROBE LENGTH AND TYPE 5' glass
DATE 5/31/85	NOZZLE I.D. .308
SAMPLING LOCATION baghouse outlet	ASSUMED MOISTURE, % 35
SAMPLE TYPE MM5	SAMPLE BOX NUMBER —
RUN NUMBER 09-MM5-BO 3	METER BOX NUMBER 10
OPERATOR Alg	METER ΔH@ 1.70
AMBIENT TEMPERATURE 70	C FACTOR .52
BAROMETRIC PRESSURE 28.97	PROBE HEATER SETTING 300°
STATIC PRESSURE (P_s) -.45	HEATER BOX SETTING 250°
FILTER NUMBER (s) N.A.	REFERENCE Δp .58
MINIMUM SAMPLE VOLUME 120 ft³	DRY/GAS METER FACTOR (Y) .9928

Page 1 of 3

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5 MINUTES

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, in °F	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Actual	Temperature °F/°C (Circle One) Probe	Filter Skin	Filter Out	Recirc. Water	Absorbent Trap	Dry Gas Meter Inlet (T_m in)	Dry Gas Meter Outlet (T_m out)	Impinger Exit	Pump Vacuum in. Hg
	0	1002	920.019													
B-6	5	07	923.5	.47	326	1.6	1.6		280			61	70	68	53	12
6	10	12	926.9	.45	326	1.5	1.5		280			62	73	68	54	12
6	15	17	930.4	.45	327	1.5	1.5		260			66	81	71	65	12
6	20	22	933.9	.45	328	1.5	1.5		280			68	84	72	69	12
5	25	27	937.1	.36	327	1.2	1.2		270			70	88	74	70	11
5	30	32	940.3	.36	328	1.2	1.2		270			66	90	76	71	11
5	35	37	943.73	.36	330	1.2	1.2		272			61	91	78	70	11
5	40	42	946.8	.34	328	1.15	1.15		265			61	94	80	69	11
4	45	47	950.0	.36	328	1.2	1.2		290			62	95	81	69	11
4	50	52	953.2	.34	328	1.15	1.15		270			66	98	83	68	11
4	55	57	956.5	.36	328	1.2	1.2		252			61	101	85	68	11
4	60	1102	959.7	.34	328	1.15	1.15		280			57	104	88	68	11
3	65	07	963.2	.47	329	1.6	1.6		261			60	105	90	66	12
3	70	12	966.9	.50	328	1.7	1.7		248			62	109	92	61	12
3	75	17	970.5	.47	328	1.4	1.6		242			62	108	92	59	12

COMMENTS

FIELD DATA

PLANT Site 09
DATE 5-30-85
SAMPLING LOCATION outlet
SAMPLE TYPE MM5
RUN NUMBER 2 09-MM5-BO-2
OPERATOR HENRY/Garcia
AMBIENT TEMPERATURE 70°F
BAROMETRIC PRESSURE
STATIC PRESSURE (P_s) -.45" H_2O
FILTER NUMBER (s) —
MINIMUM SAMPLE VOLUME 120 f^3

Page 3 of 3

PROBE LENGTH AND TYPE 5' Glass
NOZZLE I.D. .308
ASSUMED MOISTURE, % 35
SAMPLE BOX NUMBER —
METER BOX NUMBER 10
METER Δ H@ 1.702
C FACTOR .52
PROBE HEATER SETTING 60%
HEATER BOX SETTING 250°F
REFERENCE Δp .56
DRY/GAS METER FACTOR (Y) .9978

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5 MINUTES

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, in °F	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Orifice Pressure Differential (ΔH, in. H_2O) Actual	Temperature °F/°C (Circle One) Probe	Filter Skin	Filter Out	Recirc. Water	Absorbent Trap	Dry Gas Meter Inlet (T_m in)	Dry Gas Meter Outlet (T_m out)	Impinger Exit	Pump Vacuum in. Hg
A-3	190	1800	~~886.9~~ 890.1	.34	346	1.2	1.2		281			69	92	91	66	10
3	195	05	893.3	.36	346	1.2	1.2		275			68	91	91	66	10
3	200	10	896.4	.36	347	1.2	1.2		250			73	90	90	67	10
2	205	15	899.5	.36	346	1.2	1.2		234			78	89	89	67	10
2	210	20	902.3	.34	346	1.15	1.15		223			71	88	88	67	10
2	215	25	905.7	.31	346	1.0	1.0		290			66	88	88	67	10
2	220	30	908.9	.36	346	1.2	1.2		261			65	88	88	67	10
1	225	35	911.5	.24	340	.28	.28		238			66	87	87	68	8
1	230	40	914.1	.24	341	.78	.78		221			68	87	87	68	8
1	235	45	916.7	.24	340	.78	.78		280			70	86	86	69	8
1	240	1850	919.229	.22	340	.73	.73		253			64	86	86	69	8
			✓		✓								✓			
	240		145.078		344.38		1.10 ✓						98.	22 ✓		

COMMENTS

16.21706

09-MMS-BU-2

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, in °F	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Actual	Temperature °F/°C (Circle One) Probe	Filter Skin	Filter Out	Recirc. Water	Absorbent Trap	Dry Gas Meter Inlet (T_m in)	Dry Gas Meter Outlet (T_m out)	Impinger Exit	Pump Vacuum in. Hg
	75	1555	816.560													
B-3	80	1600	819.94	.42	344	1.4	1.4	—	244	—	—	67	119	99	59	10
2	85	05	823.28	.38	345	1.25	1.25	—	261	—	—	69	121	100	60	10
2	90	10	826.30	.38	345	1.25	1.25	—	253	—	—	70	122	100	61	10
2	95	15	829.90	.35	345	1.15	1.15	—	235	—	—	66	117	100	62	10
2	100	20	833.13	.34	344	1.15	1.15	—	290	—	—	65	121	99	61	9.5
1	105	25	835.98	.37	343	1.30	1.30	—	261	—	—	64	123	100	61	10
1	110	30	839.12	.36	344	1.2	1.2	—	245	—	—	65	124	101	60	10
1	115	35	842.26	.37	344	1.2	1.2	—	236	—	—	67	125	102	60	10
STOP 1	120	40	845.535	.39	344	1.3	1.3	—	240	—	—	72	126	103	62	10
					CHANGED			PORT								
START	120	1650	845.712													
A-8	125	55	849.00	.33	339	1.1	1.1	—	210	—	—	67	102	103	63	10
6	130	1700	852.07	.33	340	1.1	1.1	—	274	—	—	65	102	101	61	10
6	135	05	854.8	.31	340	1.0	1.0	—	278	—	—	69	100	99	64	10
6	140	10	857.5	.33	342	1.1	1.1	—	262	—	—	65	99	98	64	10
5	145	15	860.7	.40	340	1.3	1.3	—	257	—	—	67	99	98	64	10
5	150	20	864.1	.40	343	1.3	1.3	—	291	—	—	66	98	98	64	10
5	155	25	867.3	.36	343	1.2	1.2	—	275	—	—	65	97	97	64	10
5	160	30	870.4	.36	344	1.2	1.2	—	258	—	—	62	97	97	65	10
4	165	35	873.7	.41	346	1.35	1.35	—	245	—	—	71	96	96	68	11
4	170	40	877.0	.39	346	1.3	1.3	—	244	—	—	69	94	93	65	11
4	175	45	880.4	.39	346	1.3	1.3	—	238	—	—	65	93	92	65	11
4	180	50	883.6	.39	345	1.3	1.3	—	234	—	—	67	92	92	65	11
3	185	1755	886.8	.36	346	1.2	1.2	—	229	—	—	71	91	91	66	10
TOTAL																
AVERAGE																

FIELD DATA

	PRE	POST
A	.010	
B	.014	.004
		.018

PLANT Site 09
DATE 5-~~29~~30-85
SAMPLING LOCATION outlet
SAMPLE TYPE MMS
RUN NUMBER 02 09-MM5-BO-2
OPERATOR Henry/Garcia
AMBIENT TEMPERATURE 70°F
BAROMETRIC PRESSURE 29.06
STATIC PRESSURE (P_s) −.45" H_2O
FILTER NUMBER (s) —
MINIMUM SAMPLE VOLUME 120 ft³

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PROBE LENGTH AND TYPE 5' Glass
NOZZLE I.D. .308
ASSUMED MOISTURE, % 35
SAMPLE BOX NUMBER —
METER BOX NUMBER 10
METER Δ H@ 1.702
C FACTOR .52
PROBE HEATER SETTING 60%
HEATER BOX SETTING 250°F
REFERENCE Δp .56
DRY/GAS METER FACTOR (Y) .9978

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5 MINUTES

Temperature °F/°C (Circle One): °F circled

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, °F	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Actual	Probe	Filter Skin	Filter Out	Recirc. Water	Absorbent Trap	Dry Gas Meter Inlet (T_m in)	Dry Gas Meter Outlet (T_m out)	Impinger Exit	Pump Vacuum in. Hg
B	0	1440	773.974													
B-6	5	45	776.47	.35	345	1.15	1.15	—	272	—	—	71	83	83	65	8
6	10	50	779.50	.36	345	1.2	1.2	—	256	—	—	73	84	83	63	9
6	15	55	782.71	.35	345	1.15	1.15	—	272	—	—	75	91	83	64	9
6	20	1500	786.10	.39	347	1.3	1.3	—	303	—	—	68	98	85	64	10
5	25	05	789.30	.37	345	1.05	1.05	—	282	—	—	68	103	86	65	9
5	30	10	792.18	.32	347	1.05	1.05	—	259	—	—	69	106	88	66	9
5	35	15	795.31	.35	345	1.15	1.15	—	248	—	—	69	107	88	66	9.5
5	40	20	798.51	.34	346	1.15	1.15	—	282	—	—	73	111	90	66	9.5
*4	45	25	800.78	.12	346	.44	.44	—	272	—	—	69	114	92	66	6
*4	50	30	802.74	.12	346	.44	.44	—	271	—	—	66	117	93	67	6
*4	55	35	804.79	.14	346	.48	.48	—	287	—	—	67	120	95	69	6
*4	60	40	806.85	.14	347	.48	.48	—	256	—	—	68	120	97	68	6
3	65	45	809.89	.39	346	1.3	1.3	—	241	—	—	67	120	98	60	10
3	70	50	813.66	.38	347	1.25	1.25	—	287	—	—	71	119	99	58	10
3	75	55	Missed MCR	.40	345	1.35	1.35	—	255	—	—	66	118	98	58	10

COMMENTS * Low Flows Due to Dead Spot in stack

FIELD DATA

PLANT Site 09
DATE 5-24-85
SAMPLING LOCATION Outlet
SAMPLE TYPE MMS
RUN NUMBER 09-MMS-BC-1
OPERATOR HENRY/GARCIA
AMBIENT TEMPERATURE MAX-88°
BAROMETRIC PRESSURE
STATIC PRESSURE (P_s) -.45" H_2O
FILTER NUMBER (s) —
MINIMUM SAMPLE VOLUME 120 ft³

page 3 of 3

PROBE LENGTH AND TYPE 5' GLASS.
NOZZLE I.D. .308
ASSUMED MOISTURE, % 30%
SAMPLE BOX NUMBER
METER BOX NUMBER 10
METER Δ H@ 1.70
C FACTOR .64
PROBE HEATER SETTING 60%
HEATER BOX SETTING 250
REFERENCE Δp .42
DRY/GAS METER FACTOR (Y) .9978

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY ______ MINUTES

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s °F	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Actual	Temperature °F/°C (Circle One) Probe	Filter Skin	Filter Out	Recirc. Water	Absorbent Trap	Dry Gas Meter Inlet (T_m in)	Dry Gas Meter Outlet (T_m out)	Impinger Exit	Pump Vacuum in. Hg
3	190	1814	733.1	.37	342	1.5	1.5		238			68	88	88	62	8
3	195	19	736.6	.37	341	1.5	1.5		224			66	89	88	63	8
3	200	24	740.0	.35	341	1.35	1.35		267			70	89	89	63	8
2	205	29	743.3	.35	342	1.35	1.35		245			68	91	90	62	8
2	210	34	746.8	.35	342	1.35	1.35		227			68	90	88	62	8
2	215	39	749.9	.34	342	1.30	1.30		284			70	90	89	62	8
2	220	44	753.3	.33	342	1.30	1.30		254			67	89	89	64	8
1	225	49	756.4	.28 ~~.04~~	337	1.15	1.15		244			68	90	89	64	2
1	230	54	759.5	.28	342	1.15	1.15		267			66	91	91	65	2
1	235	~~1905~~ 59	762.8	.33	341	1.30	1.30		244			66	90	90	65	2
1	240	1904	766.092	.33	344	1.30	1.30		289			69	91	91	66	8
													106.4	97.5		
	240		150343		339.81	1.242	1.242									

101.96

COMMENTS

15.43609

04-MMS-BO-1

	A-J Traverse Point Number	75 Sampling Time Min.	1605 Clock Time (24-hr Clock)	666.90 Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, in °F	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Orifice Pressure Differential (ΔH, in. H_2O) Actual	Temperature °F/°C (Circle One) Probe	Filter Skin	Filter Out	Recirc. Water	Absorbent Trap	Dry Gas Meter Inlet (T_m in)	Dry Gas Meter Outlet (T_m out)	Impinger Exit	Pump Vacuum in. Hg
	A-3	80	10	670.17	.33	341	1.35	1.35	—	282	—	—	63	124	105	55	7
	2	85	15	673.48	.33	345	1.35	1.35	—	266	—	—	65	125	106	57	7
	2	90	20	676.86	.32	341	1.3	1.3	—	281	—	—	66	124	105	55	7
	2	95	25	680.08	.30	341	1.2	1.2	—	257	—	—	71	124	106	57	7
	2	100	30	683.27	.28	323	1.2	1.2	—	282	—	—	73	126	107	56	7
	1	105	35	686.55	.30	340	1.2	1.2	—	261	—	—	64	129	109	58	7
	1	110	40	689.34	.22	330	.88	.88	—	283	—	—	64	130	111	59	6
	1	115	45	692.04	.22	330	.88	.88	—	267	—	—	63	130	110	58	5.5
STOP	1	120	50	694.737	.22	332	.88	.88	—	263	—	—	61	132	118	58	6
					CHANGED				PORT								
START		120	1704	694.977													
	B-6	125	09	697.59	.27	338	1.1	1.1	—	249	—	—	69	102	103	63	6
	6	130	14	700.50	.27	339	1.1	1.1	—	287	—	—	68	101	100	57	6
	6	135	19	703.70	.28	339	1.15	1.15	—	274	—	—	71	99	98	58	7
	6	140	24	706.67	.26	338	1.05	1.05	—	277	—	—	75	98	98	59	7
	5	145	29	709.8	.30	338	1.2	1.2	—	291	—	—	70	99	98	60	7
	5	150	34	711.7	.10	339	.4	.4	—	266	—	—	68	99	98	63	4
	5	155	39	713.56	.10	339	.4	.4	—	296	—	—	66	99	98	64	4
	5	160	44	715.25	.05	345	.2	.2	—	260	—	—	59	97	96	67	4
	4	165	49	716.2	.05	342	.2	.2	—	282	—	—	59	93	92	69	4
	4	170	54	719.3	.37	342	1.5	1.5	—	258	—	—	62	93	92	63	7
	4	175	59	723.0	.34	342	1.4	1.4		245			67	91	90	60	7
	4	180	1804	726.1	.34	342	1.4	1.4		290			76	90	89	63	7
	3	185	09	729.6	.37	342	1.5	1.5		263			80	89	88	62	9
	TOTAL		●		●	●	●	●	●	●	●	●	●	●	●	●	●
	AVERAGE	●	●	●	●	See next page ●	→	●	●	●	●	●	See next sheet			●	●

FIELD DATA

	PRE	POST
A	.021	.019
b	.017	.018

PLANT Site 09
DATE 5-29-85
SAMPLING LOCATION outlet
SAMPLE TYPE MM5
RUN NUMBER 1 09-MM5-BC-1
OPERATOR Henry / Garcia
AMBIENT TEMPERATURE 65°F
BAROMETRIC PRESSURE 29.31
STATIC PRESSURE (P_s) -.45" H_2O
FILTER NUMBER (s) –
MINIMUM SAMPLE VOLUME 120 f^3

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PROBE LENGTH AND TYPE 5' GLASS
NOZZLE I.D. .308
ASSUMED MOISTURE, % 30
SAMPLE BOX NUMBER
METER BOX NUMBER ~~9~~ 10
METER Δ H@ ~~1.85~~ 1.28
C FACTOR .64
PROBE HEATER SETTING 60%
HEATER BOX SETTING 250°F
REFERENCE Δp .42
DRY/GAS METER FACTOR (Y) .9928

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5 MINUTES

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s in °F	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Actual	Temperature (°F)/°C (Circle One) Probe	Filter Skin	Filter Out	Recirc. Water	Absorbent Trap	Dry Gas Meter Inlet (T_m in)	Dry Gas Meter Outlet (T_m out)	Impinger Exit	Pump Vacuum in. Hg
	0	1450	615.509													
A-b	5	55	618.465	.33	339	1.35	1.35	—	250	—	—	69	95	95	68	5
b	10	1500	621.81	.32	338	1.3	1.3	—	280	—	—	68	98	94	59	7
b	15	05	625.61	.37	339	1.5	1.5	—	258	—	—	65	105	88	61	7
b	20	10	628.48	.38	341	1.55	1.55	—	286	—	—	65	113	97	64	7.5
b	25	15	632.20	.37	340	1.5	1.5	—	266	—	—	66	115	98	66	8
5	30	20	635.22	.37	341	1.5	1.5	—	254	—	—	79	111	98	67	8
5	35	25	638.83	.37	341	1.5	1.5	—	277	—	—	66	115	97	68	12
5	40	30	642.32	.37	340	1.5	1.5	—	249	—	—	66	119	98	65	8
5	45	35	645.88	.38	340	1.55	1.55	—	282	—	—	65	122	99	57	7
4	50	40	649.37	.38	339	1.55	1.55	—	260	—	—	65	123	101	55	8
4	55	45	653.23	.41	339	1.8	1.8	—	291	—	—	67	120	102	54	8
4	60	50	656.73	.41	342	1.8	1.8	—	266	—	—	69	120	104	56	8.5
3	65	55	660.20	.33	343	1.35	1.35	—	292	—	—	71	122	103	65	8.5
3	70	1600	663.62	.33	342	1.35	1.35	—	277	—	—	62	123	103	57	8.5
3	75	05	666.90	.28	343	1.15	1.15	—	275	—	—	65	125	105	58	7

COMMENTS

C-15

APPENDIX C.2

MM5-Outlet Run Sheets

FIELD DATA

PLANT Site 09
DATE 5/31/85
SAMPLING LOCATION INLET
SAMPLE TYPE MM5
RUN NUMBER 03 09-MM5-BI-3
OPERATOR CLJ/JRM
AMBIENT TEMPERATURE 70
BAROMETRIC PRESSURE 28.97
STATIC PRESSURE (P_s) -1.8
FILTER NUMBER (s) –
MINIMUM SAMPLE VOLUME –

Page 3 of 3

PROBE LENGTH AND TYPE 6 ft glass
NOZZLE I.D. 0.368
ASSUMED MOISTURE, % 33
SAMPLE BOX NUMBER 9E
METER BOX NUMBER 6
METER Δ H@ 1.75
C FACTOR 0.59
PROBE HEATER SETTING 250
HEATER BOX SETTING 250
REFERENCE Δp 0.60
DRY/GAS METER FACTOR (Y) 1.0053

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5 MINUTES

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, °F 2	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Actual	Temperature °F/°C (Circle One) Probe 3	Filter Skin 4	Filter Out	Probe Cooling Water 9	Absorbent Trap 5	Dry Gas Meter Inlet (T_m in) 7	Dry Gas Meter Outlet (T_m out) 8	Impinger Exit 6	Pump Vacuum in. Hg
3	195	13:25	1062.17	0.50	1527	1.5	1.5	203	297	–	62	67	112	98	78	8
3	200	13:30	1065.48	0.45	1538	1.3	1.3	201	286	–	62	64	111	98	76	7
2	205	13:35	1068.43	0.25	1330	0.93	0.93	188	253	–	60	70	110	98	77	5
2	210	13:40	1071.34	0.27	1353	1.0	1.0	175	231	–	61	66	110	98	77	5
2	215	13:45	1074.35	0.30	1377	1.1	1.1	169	263	–	61	67	110	98	77	6
2	220	13:50	1077.65	0.37	1384	1.4	1.4	171	267	–	61	63	113	98	78	7
1	225	13:55	1080.30	0.20	1161	0.77	0.77	174	278	–	59	63	114	100	79	5
1	230	14:00	~~108~~ 1083.19	0.25	1269	0.93	0.93	161	263	–	61	60	113	100	71	5
1	235	14:05	1085.90	0.25	1279	0.93	0.93	159	262	–	61	62	114	100	68	5
1 STOP	240	14:10	1088.224	0.25	1294	0.93	0.93	158	262	–	61	63	111	100	67	5
final leakrate			0.05 ft³/min @ 8 in Hg													
through nozzle																
final leakrate			0.013 ft³/min @ 18 in Hg													
from cyclone																
	240		173.972		1600.14		1.72						103.29			

COMMENTS w/ ΔH adjusted for temp (1500°F) Ref ΔH = 0.50

33.80447

C9-MM5-BI-3 Page 2 of 3

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s in °F 2	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Actual	Temperature (°F) °C (Circle One) Probe 3	Filter Skin 4	Filter Out	Probe Cooling Water 1	Cooling Absorbent Trap 5	Dry Gas Meter Inlet (T_m in) 7	Dry Gas Meter Outlet (T_m out) 8	Impinger Exit 6	Pump Vacuum in. Hg
9	~~11:25~~ 75	11:25	970.29	0.62	1682	1.8	1.8	243	269	—	91	60	118	94	66	6
9	80	11:30	974.80	0.63	1683	1.8	1.8	242	264	—	92	62	119	95	64	6
8	85	11:35	977.20	0.60	1689	1.8	1.8	242	259	—	89	64	117	96	65	6
8	90	11:40	981.50	0.65	1689	2.0	2.0	241	257	—	90	61	119	96	64	7
8	95	11:45	985.41	0.70	1686	2.0	2.0	244	260	—	88	73	120	97	66	7
8	100	11:50	989.47	0.75	1686	2.2	2.2	248	265	—	89	61	121	98	65	7
7	105	11:55	993.50	0.75	1687	2.2	2.2	253	269	—	85	64	124	99	65	7
7	110	12:00	997.47	0.70	1687	2.0	2.0	251	269	—	83	61	125	100	66	7
7	115	12:05	1001.50	0.76	1687	2.0	2.0	248	269	—	86	60	123	102	67	7
7	120	12:10	1005.46	0.75	1685	2.2	2.2	247	252	—	82	60	121	101	68	8
6	125	12:15	1009.50	0.70	1677	2.0	2.0	249	268	—	71	59	121	102	68	8
6	130	12:20	1013.35	0.63	1683	1.8	1.8	241	267	—	70	60	122	102	68	7
6	135	12:25	1017.38	0.68	1678	2.0	2.0	234	260	—	71	60	123	103	68	8
6	140	12:30	1022.60	0.73	1675	2.2	2.2	236	261	—	71	64	122	103	69	8
5	145	12:35	1025.40	0.68	1655	2.0	2.0	239	266	—	65	60	121	103	70	8
5	150	12:40	1029.18	0.60	1659	1.8	1.8	234	264	—	66	61	120	103	71	8
5	155	12:45	1033.10	0.67	1660	2.0	2.0	226	256	—	68	60	118	102	71	8
5	160	12:50	1036.90	0.63	1661	1.8	1.8	230	260	—	68	62	119	102	72	8
4	165	12:55	1040.65	0.55	1631	1.6	1.6	225	257	—	65	62	118	102	73	8
4	170	13:00	1044.25	0.50	1623	1.5	1.5	216	247	—	64	63	115	101	73	7
4	175	13:05	1047.74	0.55	1627	1.6	1.6	212	239	—	64	63	114	100	74	7
4	180	13:10	1051.43	0.60	1629	1.8	1.8	210	235	—	65	64	112	99	75	8
3	185	13:15	1055.00	0.55	1520	1.6	1.6	210	283	—	63	65	113	99	78	8
3	190	13:20	1058.65	0.60	1503	1.8	1.9	205	293	—	61	65	113	98	79	8
TOTAL		●		●	●	●	●	●	●	●	●	●	●	●	●	●
AVERAGE	●	●	●	●		●		●	●	●	●	●			●	●

FIELD DATA

PLANT Site 09
DATE 5|31|85
SAMPLING LOCATION INLET
SAMPLE TYPE MM5
RUN NUMBER 03 09-MM5-BI-3
OPERATOR CLJ / JRM
AMBIENT TEMPERATURE 70
BAROMETRIC PRESSURE 28.97
STATIC PRESSURE (P_s) -1.8
FILTER NUMBER (s) —
MINIMUM SAMPLE VOLUME —

1 of 3

PROBE LENGTH AND TYPE 6 ft glass
NOZZLE I.D. 0.368
ASSUMED MOISTURE, % 33
SAMPLE BOX NUMBER ~~9E~~ 9E
METER BOX NUMBER 6
METER Δ H@ 1.75
C FACTOR 0.59
PROBE HEATER SETTING 250 F
HEATER BOX SETTING 250 F
REFERENCE Δp 0.60
DRY/GAS METER FACTOR (Y) 1.0053

initial leakcheck before = 0.012 ft³/min @ 15 in Hg
probe
initial leakrate from nozzle 0.04 ft³/min @ 15 in Hg

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5 MINUTES

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, °F (2)	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Actual	Temperature °F (Circle One): Probe (2)	Filter Skin (4)	Filter Out	Probe Cooling Recirc Water (9)	Absorbent Trap (5)	Dry Gas Meter Inlet (T_{in}) (7)	Dry Gas Meter Outlet (T_{out}) (8)	Impinger Exit (6)	Pump Vacuum in. Hg
START	0	10:10	914.752													
12	5	10:15	918.5	0.60	1687	1.9	1.9	257	261	—	98	56	82	74	52	5
12	10	10:20	922.1	0.60	1688	1.9	1.9	299	304	—	105	57	88	75	53	5
12	15	1025	925.6	0.60	1683	1.8	1.8	269	303	—	99	56	89	75	56	5
12	20	1030	929.30	0.60	1684	1.8	1.8	235	279 ~~304~~	—	99	57	92	77	59	5
11	25	1035	932.90	0.60	1677	1.8	1.8	261	238	—	101	57	94	78	68	5
11	30	1040	936.60	0.60	1686	1.8	1.8	238	256	—	102	57	95	79	60	5
11	35	1045	940.26	0.63	1680	1.9	1.9	236	251	—	98	56	98	80	60	5
11	40	1050	943.90	0.58	1681	1.8	1.8	236	249	—	98	56	101	81	60	6
10	45	10:55	947.65	0.61	1680	1.8	1.8	236	233	—	95	57	105	83	60	6
10	50	11:00	951.20	0.60	1686	1.8	1.8	~~249~~ 236	~~304~~ 268	—	95	63	110	87	60	6
10	55	11:05	955.97	0.67	1677	2.0	2.0	233	293	—	98	59	110	87	60	6
10	60	11:10	958.83	0.67	1680	2.0	2.0	242	302	—	95	60 ~~79~~	113	89	62	6
9	65	11:15	962.76	0.60	1685	1.8	1.8	243	279	—	95	62	114	91	63	6
9	70	11:20	966.57	0.65	1684	2.0	2.0	242	274	—	92	60	116	92	65	6

COMMENTS

FIELD DATA

PLANT Site 09
DATE 5/30/85
SAMPLING LOCATION INLET
SAMPLE TYPE MM5
RUN NUMBER 02 09-MM5-BI-2
OPERATOR CLJ/JRM
AMBIENT TEMPERATURE 70°F
BAROMETRIC PRESSURE 29.11 corrected for height
STATIC PRESSURE (P_s) -1.8
FILTER NUMBER (s) –
MINIMUM SAMPLE VOLUME 120

Page 3 of 3

PROBE LENGTH AND TYPE 6 ft glass
NOZZLE I.D. 0.368
ASSUMED MOISTURE, % 33
SAMPLE BOX NUMBER 2E
METER BOX NUMBER 6
METER Δ H@ 1.75
C FACTOR 0.59
PROBE HEATER SETTING 250
HEATER BOX SETTING 250
REFERENCE Δp 0.60
DRY/GAS METER FACTOR (Y) 1.0053

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5 MINUTES

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s in °F (2)	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Actual	Temperature °F (Circle One) Probe (3)	Filter Skin (4)	Filter Out	Probe Cooling Water (9)	Absorbent Trap (5)	Dry Gas Meter Inlet (T_m in) (7)	Dry Gas Meter Outlet (T_m out) (8)	Impinger Exit (6)	Pump Vacuum in. Hg
3	195	17:55	896.21	0.30	1475	0.91	0.91	191	274	—	64	62	126	109	69	12
3	200	18:00	899.14	0.35	1463	~~0.91~~ 1.1	~~0.94~~ 1.1	185	280	—	64	65	125	109	70	13
2	205	18:05	901.20	0.13	1194	0.40	0.40	~~765~~	280	—	61	68	123	109	72	7
2	210	18:10	903.21	0.15	1147	0.47	0.47	158	233	—	61	66	117	108	72	8
2	215	18:15	905.25	0.15	1160	0.47	047	163	254	-	61	66	115	107	73	8
2	220	18:20	907.30	0.15	1170	0.47	0.47	167	260	-	61	67	114	106	73	8
1	225	18:25	908.57	0.03	835	0.15	0.15	168	258	-	59	69	111	105	75	4
1	230	18:30	909.76	0.03	810	0.15	0.15	157	260	-	59	69	109	103	76	5
1	235	18:35	911.85	0.03	868	0.15	0.15	150	252	—	58	68	107	103	75	5
1	240	18:40	912.12	0.03	833	0.15	0.16	148	252	-	59	68	107	102	76	5
	240		157.100		1544.89		1.46						111.02			

COMMENTS 6 with revision for lower stack temp

29.81478

09-MM5-BI-2 Page 2 of 3

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, °F (2)	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Actual	Temperature °F/°C (Circle One) Probe (3)	Filter Skin (4)	Filter Out	Cooling Recirc. Water (9)	Absorbent Trap (5)	Dry Gas Meter Inlet (T_m in) (7)	Dry Gas Meter Outlet (T_m out) (8)	Impinger Exit (6)	Pump Vacuum in. Hg
9	75	15:55	808.80	0.54	1689	1.6	1.6	240	268	—	101	66	104	122	69	12
9	80	16:00	812.40	0.60	1679	1.8	1.8	238	268	—	100	64	103	122	69	13
8	85	16:05	816.60	0.65	1688	2.0	2.0	242	267	—	96	65	104	125	70	14
8	90	16:10	820.02	0.65	1683	2.0	2.0	244	276	—	96	65	105	126	71	15
8	95	16:15	823.80	0.60	1676	1.8	1.8	244	277	—	96	67	105	124	72	15
8	100	16:20	827.67	0.60	1684	1.8	1.8	248	275	—	99	66	105	124	69	15
7	105	16:25	831.29	0.65	1673	2.0	2.0	250	274	—	90	66	105	126	66	15
7	110	16:30	835.5	0.60	1673	1.8	1.8	249	276	—	94	67	127	106	65	16
7	115	1635	839.05	0.60	1680	1.8	1.8	250	279	—	90	66	129	107	65	16
7	120	1640	843.1	0.60	1682	1.8	1.8	243	279	—	89	66	131	108	65	17
6	125	1645	847.0	0.55	1671	1.7	1.7	224	270	—	74	69	130	109	66	17
6	130	16:50	850.35	0.60	1672	1.8	1.8	227	269	—	74	67	129	108	66	17
6	135	16:55	854.21	0.67	1677	2.0	2.0	227	270	—	74	65	128	108	67	17
6	140	17:00	858.08	0.67	1674	2.0	2.0	231	273	—	74	63	127	107	67	18
5	145	17:05	862.97	0.66	1680	2.0	2.0	232	272	—	76	65	127	107	67	18
5	150	17:10	865.83	0.63	1672	1.9	1.9	232	259	—	75	65	127	107	68	18
5	155	17:15	870.8	0.55	1663	1.7	1.7	232	274	—	69	66	128	107	68	17
5	160	17:20	873.16	0.55	1654	1.7	1.7	225	260	—	71	66	127	107	66	17
4	165	17:25	876.75	0.50	1618	1.5	1.5	223	262	—	67	63	128	107	68	17
4	170	17:30	880.29	0.55	1619	1.7	1.7	217	253	—	66	65	130	108	[illegible]	17
4	175	17:35	883.77	0.50	1607	1.5	1.5	213	250	—	66	65	129	109	69	17
4	180	17:40	887.00	0.45	1614	1.4	1.4	210	246	—	66	64	128	109	69	16
3	185	17:45	890.35	0.35	1473	1.1	1.1	211	240	—	64	64	128	109	69	14
3	190	17:50	893.38	0.33	1472	1.0	1.0	200	226	—	64	63	127	109	69	13
TOTAL		●		●	●	●	●	●	●	●	●	●	●	●	●	●
AVERAGE	●	●	●	●		●		●	●	●	●	●			●	●

FIELD DATA

PLANT: Site 09
DATE: 5/30/85
SAMPLING LOCATION: INLET
SAMPLE TYPE: MM5
RUN NUMBER: 02 09-MM5-BI-2
OPERATOR: CLJ/JKM
AMBIENT TEMPERATURE: 70 °F
BARometric PRESSURE: ~~29.28~~ 29.16 \ CORRECTED FOR HEIGHT (50 ft) 29.11
STATIC PRESSURE (P_s): -1.8
FILTER NUMBER (s): –
MINIMUM SAMPLE VOLUME: 120 scfm

Page 1 of 3

PROBE LENGTH AND TYPE: 6ft glass
NOZZLE I.D.: 0.368
ASSUMED MOISTURE, %: 33
SAMPLE BOX NUMBER: 2E
METER BOX NUMBER: 6
METER Δ H@: 1.75
C FACTOR: 0.59
PROBE HEATER SETTING: 250
HEATER BOX SETTING: 250
REFERENCE Δp: 0.60
DRY/GAS METER FACTOR (Y): 1.0053

— initial leakrate = 0.02 ft³/min @12 in Hg through nozzle
— final leakrate = 0.017 ft³/min @19 in Hg through nozzle

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5 MINUTES

	Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, °F (2)	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Orifice Pressure Differential Actual	Temperature °F (Circle One): Probe (3)	Filter Skin (4)	Filter Out	Probe Cooling Water (9)	Absorbent Trap (5)	Dry Gas Meter Inlet ($T_{m\,in}$) (7)	Dry Gas Meter Outlet ($T_{m\,out}$) (8)	Impinger Exit (6)	Pump Vacuum in. Hg
START		0	14:40	755.020						~~299~~							
	12	5	14:45	758.45	0.55	1684	1.7	1.7	a	277	–	57	76	85	84	83	9
	12	10	14:50	761.92	0.55	1687	1.7	1.7	a	317	–	108	64	85	91	58	9
	12	15	14:55	765.32	0.50	1685	1.5	1.5	282	318	–	109	64	87	99	61	9
	12	20	15:00	768.79	0.55	1691	1.7	1.7	282	305	–	109	61	88	104	62	10
	11	25	15:05	772.27	0.57	1689	1.7	1.7	285	299	–	107	63	90	108	62	10
	11	30	15:10	776.02	0.65	1689	2.0	2.0	283	298	–	108	63	92	111	64	11
	11	35	15:15	779.60	0.57	1688	1.7	1.7	289	303	–	113	64	93	112	65	11
	11	40	15:20	783.35	0.65	1685	2.0	2.0	284	296	–	108	63	94	115	65	11
	10	45	15:25	787.08	0.58	1687	1.8	1.8	276	295	–	108	63	96	96	65	12
	10	50	15:30	790.75	0.60	1692	1.8	1.8	273	291	–	106	64	98	105	66	12
	10	55	15:35	794.42	0.56	1683	1.7	1.7	264	289	–	105	67	100	122	67	12
	10	60	15:40	798.00	0.55	1685	1.7	1.7	249	281	–	106	66	101	122	68	12
	9	65	15:45	801.63	0.55	1692	1.7	1.7	244	274	–	123	66	102	123	68	12
	9	70	15:50	805.22	0.57	1690	1.7	1.7	242	275	–	101	64	104	124	69	12

COMMENTS a – thermocouple not functioning

FIELD DATA

PLANT Site 09
DATE 5/29/85
SAMPLING LOCATION Inlet
SAMPLE TYPE MMS
RUN NUMBER 01 09-MMS-BI-1
OPERATOR CLT/JRM
AMBIENT TEMPERATURE 65
BAROMETRIC PRESSURE 29.36 in Hg
STATIC PRESSURE (P_s) -1.8
FILTER NUMBER (s) —
MINIMUM SAMPLE VOLUME 120 dscfm

page 3 of 3

PROBE LENGTH AND TYPE 6 ft glass
NOZZLE I.D. 0.368
ASSUMED MOISTURE, % 33
SAMPLE BOX NUMBER 2E
METER BOX NUMBER 6
METER Δ H@ 1.75
C FACTOR 0.59
PROBE HEATER SETTING 250
HEATER BOX SETTING 250
REFERENCE Δp 0.61
DRY/GAS METER FACTOR (Y) 1.0053

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5 MINUTES

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, in °F (2)	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Actual	Temperature °F (Circle One) Probe (3)	Filter Skin (4)	Filter Out	Recirc. Water (9)	Absorbent Trap (5)	Dry Gas Meter Inlet (T_m in) (7)	Outlet (T_m out) (8)	Impinger Exit (6)	Pump Vacuum in. Hg
3	185	18:05	724.61	0.32	1382	0.97	0.97	222	254	—	63	72	100	111	68	10
3	190	18:10	727.64	0.35	1377	1.1	1.1	223	241	—	62	73	99	103	67	11
3	195	18:15	730.65	0.37	~~1447~~ 1443	1.1	1.1	225	236	—	62	73	100	115	67	10
3	200	18:20	733.65	0.37	1454.	1.1	1.1	222	265	—	63	71	100	113	67	10
2	205	18:25	736.16	0.21	1200	0.62	0.62	221	253	—	61	71	99	110	67	8
2	210	18:30	738.60	0.22	1209	0.63	0.63	205	228	—	61	71	99	110	67	8
2	215	18:35	741.07	0.23	1190	0.69	0.69	200	269	—	66	79	106	118	73	8
2	220	18:40	743.60	0.23	1226	0.69	0.69	194	262	—	61	72	101	112	67	8
1	225	18:45	745.62	0.13	961	0.40	0.40	193	271	—	61	73	101	~~113~~ 113	68	6
1	230	18:50	747.70	0.14	976	0.41	0.41	182	244	—	61	73	102	114	69	6
1	235	18:55	749.78	0.13	997	0.40	0.40	179	222	—	60	69	104	117	68	6
1	240	19:00	751.743	0.13	1009	0.40	0.40	174	251		60	68	106	118	68	6
final leakcheck			0.012	ft³/min		@ 11 in Hg										
													112.2			
	240		151.490		1566.3		1.27									

STOP

C-5

COMMENTS

28.7482

09-MMS-BI-1

Page 2 of 3

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_{st} in °F (2)	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Actual	Temperature (°F) (Circle One) Probe (3)	Filter Skin (4)	Filter Out	Recirc. Water (9)	Absorbent Trap (5)	Dry Gas Meter Inlet ($T_{m\ in}$) (7)	Dry Gas Meter Outlet ($T_{m\ out}$) (8)	Impinger Exit (6)	Pump Vacuum in. Hg
9	65	16:05	641.75	0.50	1712	1.5	1.5	~~152~~ 290	330	–	121	71	110	127	63	8
9	70	16:10	645.15	0.48	1712	1.4	1.4	291	317	–	122	69	110	125	61	8
9	75	16:15	648.68	0.54	1699	1.6	1.6	291	301	–	126	68	110	126	62	8
9	80	16:20	652.20	0.55	1697	1.7	1.7	284	291	–	121	66	110	127	59	8
8	85	16:25	655.71	0.51	1716	1.5	1.5	268	281	–	115	73	110	125	59	8
8	90	16:30	659.20	0.50	1712	1.5	1.5	257	272	–	120	76	111	129	60	8
8	95	16:35	662.78	0.56	1703	1.7	1.7	255	265	–	111	69	111	130	60	9
8	100	16:40	666.42	0.55	[illegible]	1.7	1.7	199	210	–	92	50	91	112	41	9
7	105	16:45	669.98	0.50	1697	1.5	1.5	256	305	–	103	64	112	133	62	9
7	110	16:50	673.60	0.56	1704	1.7	1.7	260	297	–	102	65	112	133	63	10
7	115	16:55	677.94	0.53	1710	1.6	1.6	262	289	–	105	69	113	131	65	10
7	120	17:00	680.99	0.57	1696	1.7	1.7	261	284	–	100	67	113	128	67	11
6	125	17:05	684.25	0.47	1692	1.4	1.4	259	318	–	82	74	111	124	69	9
6	130	17:10	687.88	0.55	1682	1.7	1.7	239	300	–	81	75	111	121	70	11
6	135	17:15	691.51	0.53	1680	1.6	1.6	243	294	–	81	75	107	122	71	11
6	140	17:20	695.78	0.53	1681	1.6	1.6	243	287	–	82	76	106	121	72	11
5	145	17:25	698.64	0.47	1670	1.4	1.4	240	278	–	74	76	105	122	74	11
5	150	17:30	702.05	0.45	1668	1.4	1.4	234	270	–	73	75	106	129	74	11
5	155	17:35	705.45	0.45	1667	1.4	1.4	229	263	–	74	75	105	122	70	11
5	160	17:40	708.82	0.45	1679	1.4	1.4	228	258	–	73	73	106	115	67	11
4	165	17:45	712.10	0.40	1613	1.2	1.2	227	252	–	66	74	105	119	67	10
4	170	17:50	715.25	0.40	1610	1.2	1.2	218	241	–	65	75	104	117	67	10
4	175	17:55	718.43	0.42	1614	1.3	1.3	212	288	–	66	74	103	116	68	10
4	180	18:00	721.65	0.40	1617	1.2	1.2	218	271	–	66	72	101	112	68	11
TOTAL		●		●	●	●	●	●	●	●	●	●	●	●	●	●
AVERAGE	●	●	●	●		●		●	●	●	●	●			●	●

FIELD DATA

PLANT Site 09
DATE 5/29/85
SAMPLING LOCATION INLET
SAMPLE TYPE MM5
RUN NUMBER 01 C9-MM5-BI-1
OPERATOR CLJ/JRM
AMBIENT TEMPERATURE 65
BAROMETRIC PRESSURE ~~29.36 in Hg~~ -29.30 Corrected
STATIC PRESSURE (P_s) -1.8
FILTER NUMBER (s) —
MINIMUM SAMPLE VOLUME 120 dscfm

Page 1 of 3

PROBE LENGTH AND TYPE 6 ft glass
NOZZLE I.D. ~~0.234~~ 0.368
ASSUMED MOISTURE, % 33
SAMPLE BOX NUMBER 2E
METER BOX NUMBER 6
METER Δ H@ 1.75
C FACTOR 0.59
PROBE HEATER SETTING 250
HEATER BOX SETTING 250
REFERENCE Δp 0.61
DRY/GAS METER FACTOR (Y) 1.0053

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5 MINUTES

INITIAL LEAKRATE THROUGH NOZZLE = 0.008 cuft/min @ 5 in Hg

Initial leakrate, from cyclone = 0.008 ft³/min @ 15 in Hg

Temperature (°F) (Circle One)

	Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s in °F (2)	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Actual	Probe (3)	Filter Skin (4)	Filter Out	Probe Cooling Recirc. Water (1)	Absorbent Trap (5)	Dry Gas Meter Inlet ($T_{m\,in}$) (7)	Dry Gas Meter Outlet ($T_{m\,out}$) (8)	Impinger Exit (6)	Pump Vacuum in. Hg
START		0	14:45	598.530										~~100~~			
	A-12	5	14:50	601.10	0.40	1692	1.2	1.2	165	274	—	114	85	100	98	76	17
	-12	10	14:56	603.49	0.39	1693	1.2	1.2	222	284	—	140	73	100	102	71	18
	-12	15	15:00	606.60	0.45	1697	1.4	1.4	249	299	—	102	70	90	104	68	21
STOP	-12	20	15:05	609.814	0.40	1716	1.2	1.2	275	314	—	158	74	101	113	65	22
	plugged XAD, change to #27				start	leakcheck			0.01	ft³/min @			5 in Hg				
START	START	20	15:20	611.537													
	-11	25	15:25	614.90	0.48	1712	1.5	1.5	269	295	—	139	78	102	117	62	5
	-11	30	15:30	618.10	0.44	1699	1.3	1.3	286	311	—	137	81	105	123	63	6
	-11	35	15:35	621.35	0.45	1699	1.4	1.4	294	372	—	137	81	108	125	63	6
	-11	40	15:40	624.66	0.45	1699	1.4	1.4	294	372	—	137	81	108	125	63	6
	-10	45	15:45	628.05	0.50	1717	1.5	1.5	295	321	—	135	78	109	124	63	7
	-10	50	15:50	631.4	0.47	1700	1.4	1.4	296	327	—	134	70	109	123	62	7
	-10	55	15:55	634.80	0.50	1706	1.5	1.5	296	328	—	129	73	110	125	62	7
	-16	60	16:00	638.3	0.53	1699	1.6	1.6	293	327		123	76	109	125	62	7

COMMENTS

APPENDIX C.1

MM5-Inlet Run Sheets

APPENDIX C

Field Data Sheets

Overall, the data appears to be fairly typical of routine operations at the plant. If you require any additional information to complete your final report, please call me at the direct dial number listed above.

Very truly yours,

February 21, 1986

Mr. Andrew J. Miles
Senior Scientist
RADIAN CORPORATION
P.O. Box 13000
Research Triangle Park, N.C. 27709

Re: React Plant Operating Information

Dear Andrew:

We have reviewed the draft test report forwarded to .p.. and have no corrections or comments to offer. The operating data we promised for the test period is presented below:

1. Spent Carbon Volatiles

Date	Total Volatiles % W/W	Moisture - % w/w	Organics - %w/w (By Difference)
5/29/85	52.5	36.4	16.1
5/30/85	48.8	37.2	11.6
5/31/85	48.4	36.0	12.4

2. Production Rate

Date	React Product - Lbs
5/29	47,894
5/30	62,605
5/31	60,987

3. Baghouse Dust

Date	Lbs. Collected
5/29	4,980
5/30	5,186
5/31	4,666

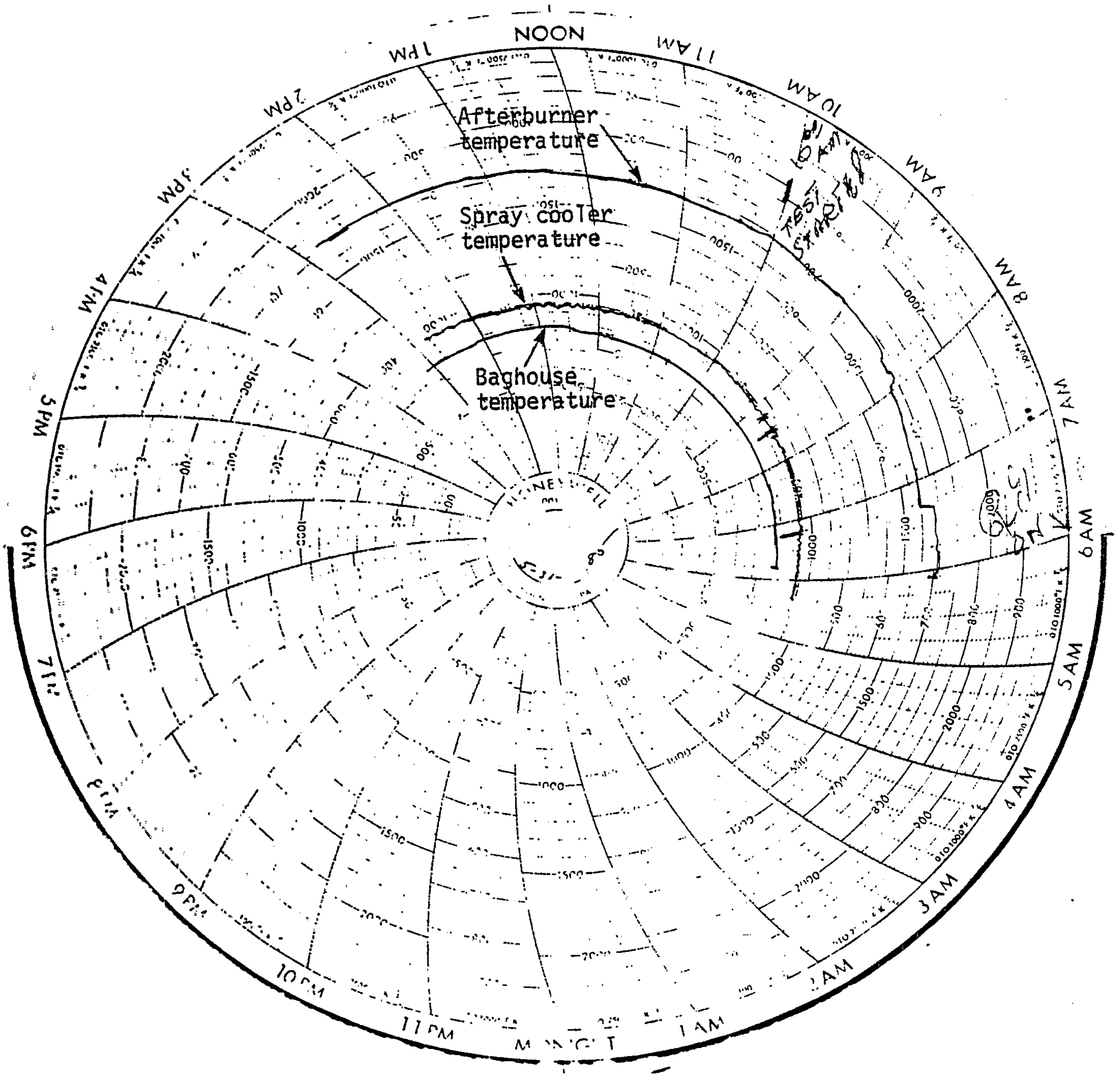


Figure B-12. Stripchart of afterburner temperature, spray cooler outlet temperature, and baghouse outlet temperature, Run 3.

1383 10/80

SERVICE BUILDING LOG SHEET

DATE. May 30 1985 OPERATOR 7-3 Gray 1715 OPERATOR 3-11 ____ OPERATOR 11-7 ____

	AIR PRESSURE AT RECEIVER	AIR PRESSURE TO NOZZLES	H_2O PRESSURE TO NOZZLES	WHICH COMP. IS RUNNING	CLOCK TIME ON COMP.	WHICH PUMP IS RUNNING	ALKALI SOLUTION RATE	ALKALI BATCH MADE	COMMENTS
DESIRED CONDITION									
7 AM	120	100	132	2	21463	1	3.8	745	
8 AM	120	100	132	2	21464	1	3.3		
9 AM	120	100	132	2	21465	1	3.5		
10 AM	120	100	132	2	21466	1	3.2		
11 AM	120	100	132	2	21467	1	3.5		
12 NOON	120	100	132	3	21468	1	3.5	1215	
1 PM	120	100	132	3	21469	1	3.5		
2 PM	120	100	132	3	21470	1	3.5		
3 PM									
4 PM									
5 PM									
6 PM									
7 PM									
8 PM									
9 PM									
10 PM									
11 PM									
12 MID.									
1 AM									
2 AM									
3 AM									
4 AM									
5 AM									
6 AM									

REMARKS: Record any unusual occurrences on your shift, etc. Turn into Foreperson at end of 11-7 shift.

COMMENTS:

OPERATOR 7-3

OPERATOR 3-11

OPERATOR 11-7

Figure B-11. Spray cooler operating log, Run 3.

1382 10/80

PARTICULATE ABATEMENT LOG SHEET

DATE: May 30 1985 OPERATOR 7-3 Gray 1715 OPERATOR 3-11 ________ OPERATOR 11-7 ________

	E.C. INLET TEMPERATURE	E.C. OUTLET TEMPERATURE	BAGHOUSE OUTLET TEMPERATURE	DEVIATION	BAGHOUSE ΔP	H_2O VALVE #1 % OPEN	H_2O VALVE #2 % OPEN	H_2O FLOW GPM	AFTERBURNER DRAFT	I.D. FAN DRAFT
DESIRED CONDITION										
7 AM	1600	400	350	-10	6.5	0	38	25	25	80
8 AM	1600	400	350	+8	6.0	0	38	25	25	85
9 AM	1670	400	350	+10	6.0	0	36	24	25	80
10 AM	1670	400	350	+1	6.0	0	36	24	25	80
11 AM	1650	400	350	+5	5.5	0	36	24	25	75
12 NOON	1670	400	350	-7	5.5	0	38	25	25	75
1 PM	1700	400	350	-2	6.0	0	36	24	25	75
2 PM	1700	400	350	+11	5.0	0	38	25	25	80
3 PM										
4 PM										
5 PM										
6 PM										
7 PM										
8 PM										
9 PM										
10 PM										
11 PM										
12 MID.										
1 AM										
2 AM										
3 AM										
4 AM										
5 AM										
6 AM										

REMARKS: Record any unusual occurrences on your shift, etc. Turn into Foreperson at end of 11-7 shift.

COMMENTS:

OPERATOR 7-3 800 AM Gray OK

OPERATOR 3-11

OPERATOR 11-7

Figure B-10. Baghouse operating log, Run 3.

FURNACE AFTERBURNER LOG SHEET

DATE: 5-31-85 OPERATOR 7-3 Wellman OPERATOR 3-11 ______ OPERATOR 11-7 ______

	TEMPERATURE	AFTERBURNER HEATING CONTROLLER	AFTERBURNER COOLING CONTROLLER	"A" FURNACE DRAFT	"A" FURNACE DRAFT CONTROLLER	AFTERBURNER DRAFT	AFTERBURNER DRAFT CONTROLLER	OXYGEN CONTENT	OXYGEN CONTROLLER	I.D. FAN AMPS	BURNER A GAS/OIL OR OFF	BURNER B GAS/OIL OR OFF
DESIRED CONDITION												
7 AM	1740	70	0	35	35	1.0	55-60			31	gas	gas
8 AM	1755	65	0	25	35	1.0	60			32	"	"
9 AM	1740	65	0	40	25	.70	60			33	"	"
10 AM	1745	65	0	50	25	1.5	55			33	"	"
11 AM	1735	65	0	50	25	1.6	55			33	"	"
12 NOON											"	"
1 PM	1735	65	0	55	25	1.2	55			33	"	
2 PM	1741	65	0	50	25	1.2	50			33	"	
3 PM												
4 PM												
5 PM												
6 PM												
7 PM												
8 PM												
9 PM												
10 PM												
11 PM												
12 MID.												
1 AM												
2 AM												
3 AM												
4 AM												
5 AM												
6 AM												

REMARKS: Record any unusual occurrences on your shift, etc. Turn into Foreperson at end of 11-7 shift.

COMMENTS: ALL AFTERBURNER OUTAGES AND THEIR CAUSE MUST BE RECORDED.

OPERATOR 7-3

OPERATOR 3-11

OPERATOR 11-7

Figure B-9. Afterburner operating log, Run 3.

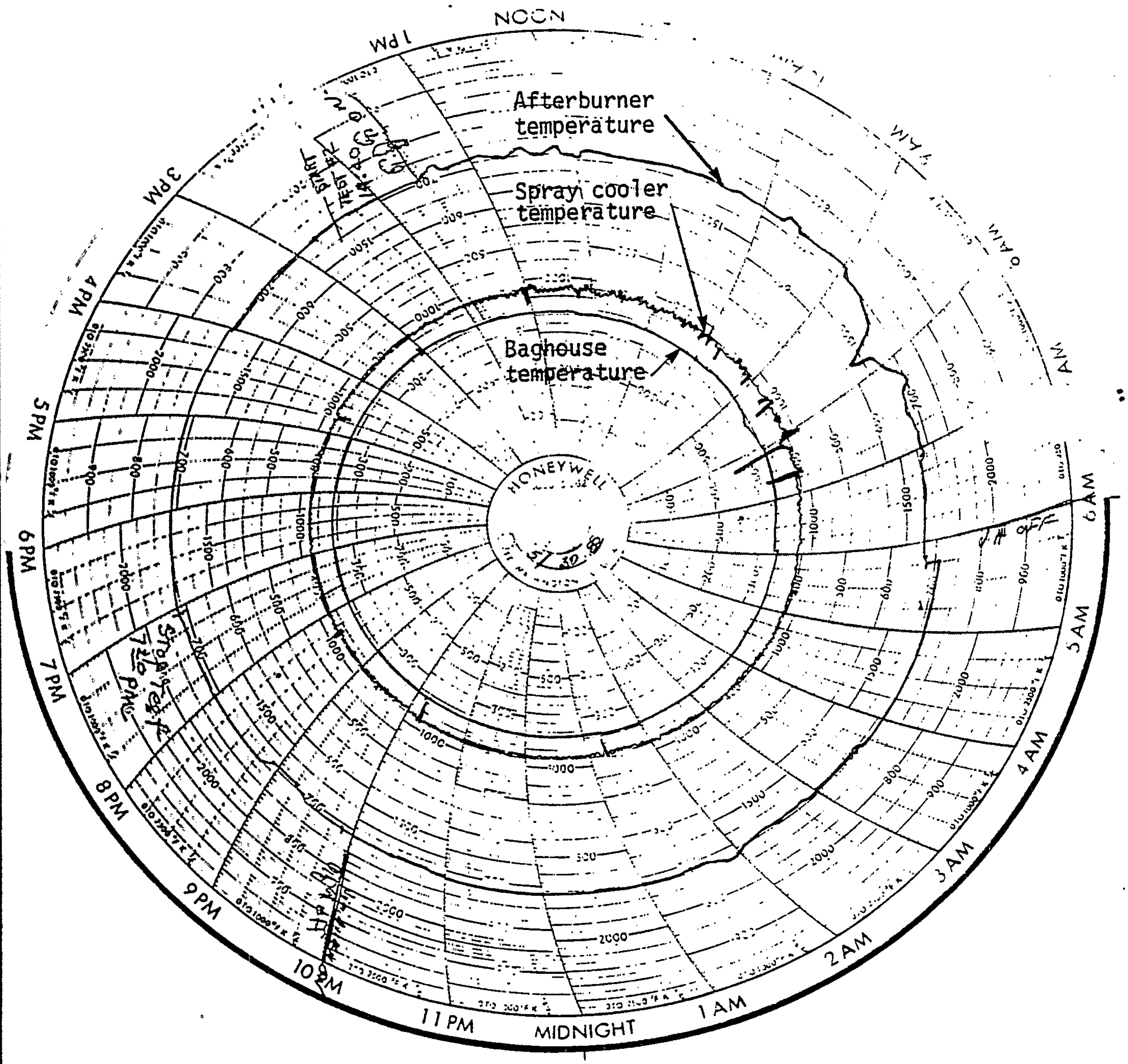
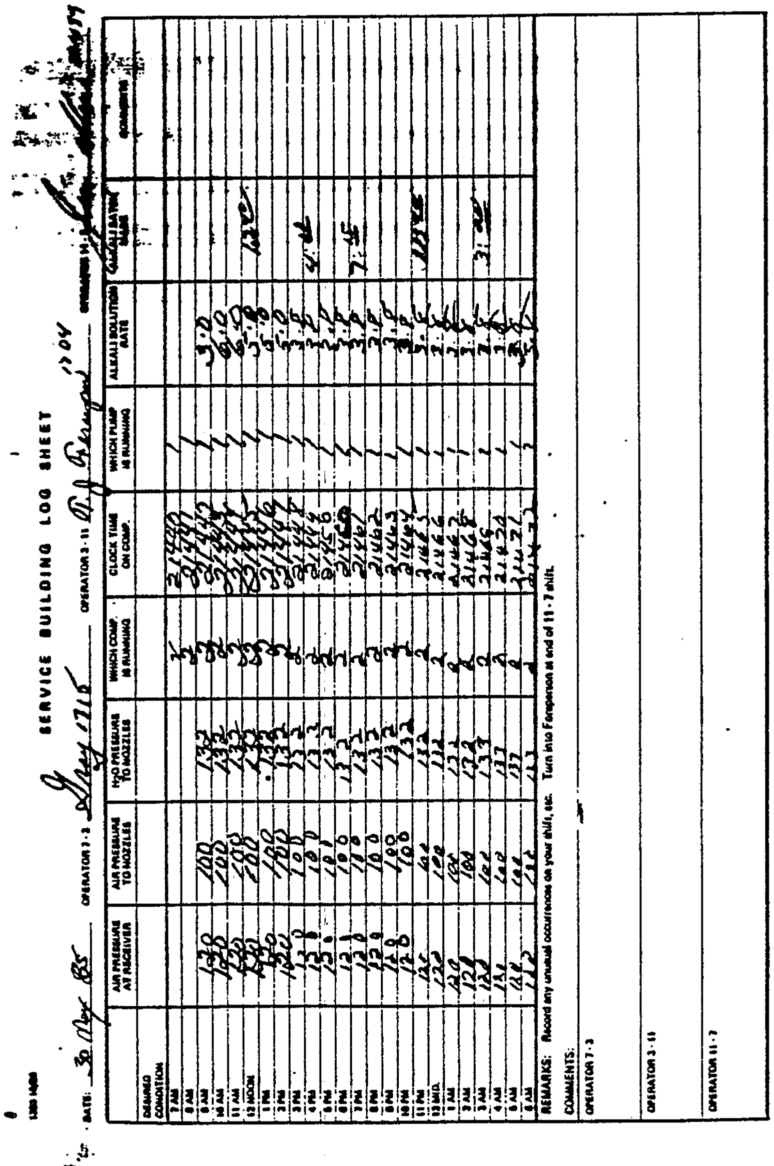


Figure B-8. Stripchart of afterburner temperature, spray cooler outlet temperature, and baghouse outlet temperature, Run 2.



SERVICE BUILDING LOG SHEET

DATE: 30 Nov 85 OPERATOR 7-3 Gray 1716 OPERATOR 3-11 R. J. Ferguson 1704 OPERATOR 11-7 [illegible]

	AIR PRESSURE AT RECEIVER	AIR PRESSURE TO NOZZLES	H₂O PRESSURE TO NOZZLES	WHICH COMP. IS RUNNING	CLOCK TIME ON COMP.	WHICH PUMP IS RUNNING	ALKALI SOLUTION RATE	ALKALI BATCH MADE	COMMENTS
DESIRED CONDITION									
7 AM				3	21440	1			
8 AM				2	21441	1			
9 AM	120	100	132	2	21442	1	3.0		
10 AM	120	100	132	2	21443	1	6.0		
11 AM	120	100	132	2	21444	1	6.0	12:00	
12 NOON	120	100	132	2	21445	1	5.8		
1 PM	120	100	132	2	21446	1	5.0		
2 PM	120	100	132	2	21447	1	5.0		
3 PM	120	100	132	2	21448	1	3.8	4:00	
4 PM	128	100	133	2	21449	1	3.8		
5 PM	125	101	132	2	21456	1	3.8		
6 PM	121	100	132	2	21460	1	3.8	7:45	
7 PM	120	110	132	2	21461	1	3.8		
8 PM	120	100	132	2	21462	1	3.8		
9 PM	128	100	132	2	21463	1	3.8		
10 PM	120	100	132	2	21464	1	3.8	11:[illegible]	
11 PM	125	100	132	2	21465	1	3.8		
12 MID.	120	100	132	2	21466	1	3.8		
1 AM	120	100	132	2	21467	1	3.8		
2 AM	120	100	132	2	21468	1	3.8	3:[illegible]	
3 AM	120	100	133	2	21469	1	3.8		
4 AM	121	100	137	2	21470	1	3.8		
5 AM	120	100	137	2	21471	1	3.8		
6 AM	122	100	133	2	21472	2	3.8		

REMARKS: Record any unusual occurrences on your shift, etc. Turn into Foreperson at end of 11-7 shift.

COMMENTS:

OPERATOR 7-3

OPERATOR 3-11

OPERATOR 11-7

Figure B-7. Spray cooler operating log, Run 2.

1312 10/80

PARTICULATE ABATEMENT LOG SHEET

DATE 30 May 85 OPERATOR 7-3 Grey 1715 OPERATOR 3-11 T.J. Ferenpa 1704 OPERATOR 11-7 Jim E. Allen #1699

	E C INLET TEMPERATURE	E.C. OUTLET TEMPERATURE	BAGHOUSE OUTLET TEMPERATURE	DEVIATION	BAGHOUSE ΔP	H_2O VALVE #1 % OPEN	H_2O VALVE #2 % OPEN	H_2O FLOW GPM	AFTERBURNER DRAFT	I.D. FAN DRAFT
DESIRED CONDITION										1 Amp
7 AM	Helping	at	A	FCE	6:00 AM	— 8:30	AM		~~25~~	~~65~~
8 AM										
9 AM	1680	400	350	+4	4.5	0	26	22	25	65
10 AM	1720	400	350	-5	5.5	0	36	24	25	75
11 AM	1620	400	350	+7	5.5	0	30	23	25	70
12 NOON	1700	400	350	-1	4.5	0	48	27	25	100
1 PM			Helping	at	A FCE					
2 PM	1700	400	35	+3	5.0	0	34	23	25	70
3 PM	1690	400	350	+0	7.5	0	35	23	20	75
4 PM	1640	400	350	-4	6.0	0	35	24	20	75
5 PM	1700	400	350	-6	6.5	0	33	24	20	75
6 PM	1700	400	350	-5	6.0	0	32	24	20	75
7 PM	1710	400	350	+0	6.0	0	36	24	20	75
8 PM	1710	400	350	+2	6.0	0	34	24	20	75
9 PM	1710	400	250	-5	5.5	0	32	24	20	75
10 PM	1710	400	350	+6	5.0	0	32	25	20	75
11 PM	1700	400	350	+3	5.5	0	40	25	20	25
12 MID.	1700	400	250	+0	5.0	0	22	24	23	28
1 AM	1700	400	350	-1	4.0	0	37	25	25	75
2 AM	1720	400	350	+6	4.5	0	36	25	22	74
3 AM	1700	400	350	+13	5.0	0	40	25	22	74
4 AM	1700	400	350	+8	5.0	0	40	25	22	75
5 AM	1700	400	350	-2	6.0	0	37	25	22	74
6 AM	1700	400	350	-1	6.0	0	37	25	22	74

100

REMARKS: Record any unusual occurrences on your shift, etc. Turn into Foreperson at end of 11 - 7 shift.

COMMENTS:

1:00 #2-996 lb
1:30 #3-6010 lb
2:01 #1 936 lb

OPERATOR 7-3 8:20 AM
Sprays OK

OPERATOR 3-11
8:23 all sprays ok!

OPERATOR 11-7 SPRAYS. OK 11:00

11-7 1:05 AM #4. 3110

Figure B-6. Baghouse operating log, Run 2.

1381 10/80

FURNACE AFTERBURNER LOG SHEET

DATE: 5-30-85 OPERATOR 7-3 L. DUFF OPERATOR 3-11 Giammarria OPERATOR 11-7 Wilson

	TEMPERATURE	AFTERBURNER HEATING CONTROLLER	AFTERBURNER COOLING CONTROLLER	"A" FURNACE DRAFT	"A" FURNACE DRAFT CONTROLLER	AFTERBURNER DRAFT	AFTERBURNER DRAFT CONTROLLER	OXYGEN CONTENT	OXYGEN CONTROLLER	I.D. FAN AMPS	BURNER A GAS/OIL OR OFF	BURNER B GAS/OIL OR OFF
DESIRED CONDITION												
7 AM	✓											
8 AM	1460	50	—	.75	.15	1.5	.45	—	2.0	31	GAS	GAS
9 AM	1260	65	—	.50	30	1.0	40	—	2.0	31	"	"
10 AM	1750	60	—	50	40	1.0	50	—	2.0	31	"	"
11 AM	1250	60	—	50	45	1.0	45	—	2.0	30	"	"
12 NOON	1250	55	—	50	45	1.0	45	—	2.0	32	"	"
1 PM	1240	50	—	50	40	1.0	40	—	2.0	33	"	"
2 PM	1740	60	—	25	.55	1.0	50	—	2.0	30	"	"
3 PM	1240	60	0	.40	30	1.1	50			30	—	—
4 PM	1740	60	0	.50	.25	1.4	50			31	—	—
5 PM	1740	65	0	.45	25	.2	50			30	—	—
6 PM	1740	65	0	.40	35	.2	50			30	—	—
7 PM	1730	65	0	.50	15	1.0	50			30	—	—
8 PM	1740	65	0	.50	10	1.5	50			31	—	—
9 PM	1740	65	0	.25	25	1.0	50			32	—	—
10 PM	1740	65	0	.50	20	1.0	55			33	—	—
11 PM	1725	65	0	35	30	1.0	55			31	gas	gas
12 MID.	1755	65	0	50	25	1.5	50			32	"	"
1 AM	1750	65	0	35	30	1.0	55			30	"	"
2 AM	1745	70	0	50	11	1.4	50			30	"	"
3 AM	1745	65	0	50	25	1.1	55			31	"	"
4 AM	1750	65	0	50	15	1.5	55			32	"	"
5 AM	1750	70	0	35	30	1.0	55-60			32	"	"
6 AM	1745	65	0	55	25	1.5	55			33	"	"

REMARKS: Record any unusual occurrences on your shift, etc. Turn into Foreperson at end of 11 - 7 shift.

COMMENTS: ALL AFTERBURNER OUTAGES AND THEIR CAUSE MUST BE RECORDED.

OPERATOR 7 - 3

OPERATOR 3 - 11

OPERATOR 11 - 7

Figure B-5. Afterburner operating log, Run 2.

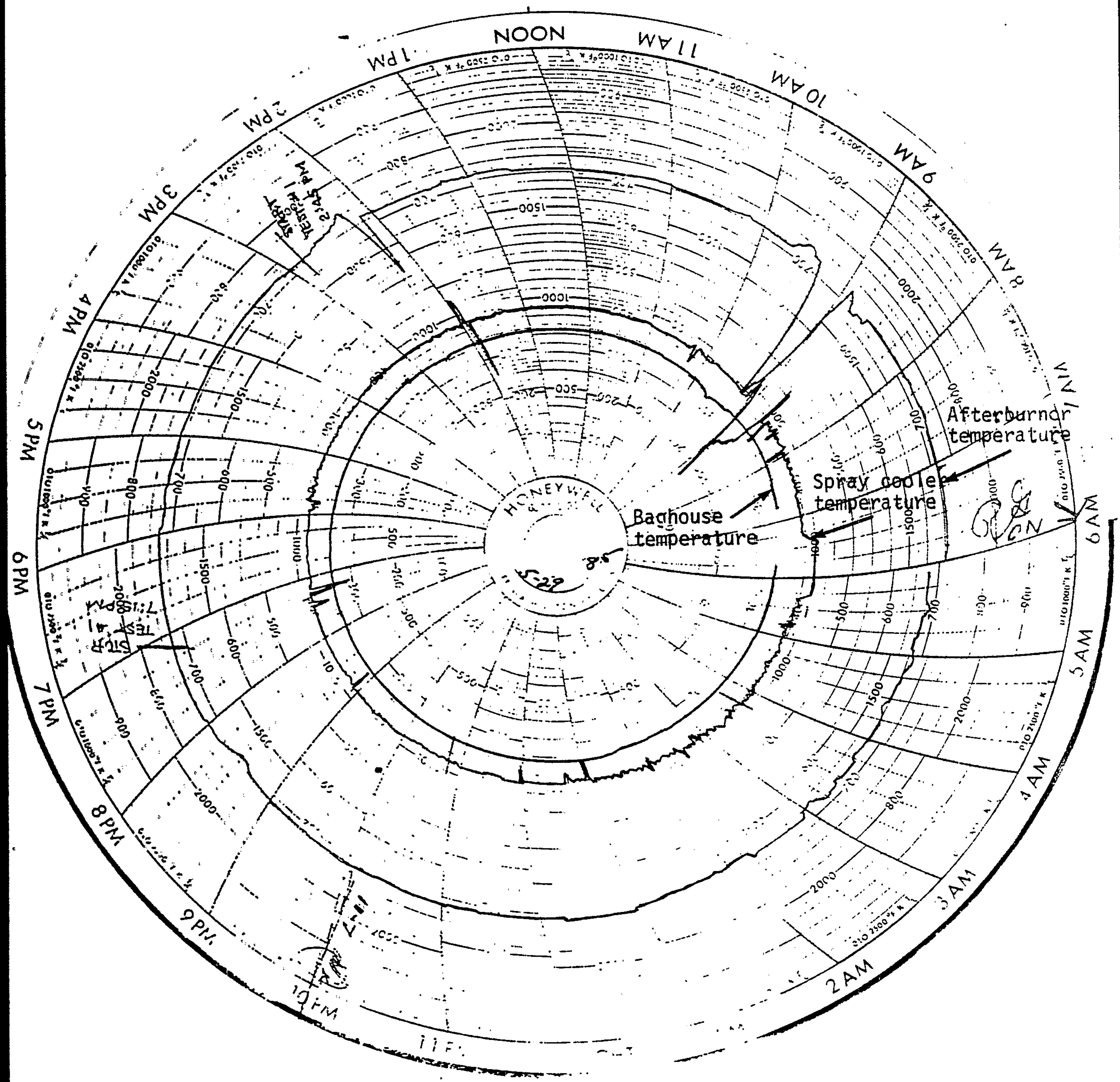


Figure B-4. Stripchart of afterburner temperature, spray cooler outlet temperature, and baghouse outlet temperature, Run 1.

1363 10/80

SERVICE BUILDING LOG SHEET

DATE 29 MAY 85 OPERATOR 7 - 3 Gray 1715 OPERATOR 3 - 11 D.J. Fereyan 1704 OPERATOR 11 - 7 COTMAN

	AIR PRESSURE AT RECEIVER	AIR PRESSURE TO NOZZLES	H_2O PRESSURE TO NOZZLES	WHICH COMP. IS RUNNING	CLOCK TIME ON COMP.	WHICH PUMP IS RUNNING	ALKALI SOLUTION RATE	ALKALI BATCH MADE	COMMENTS
DESIRED CONDITION									
7 AM	120	100	132	2	21416	1	4.0	700	
8 AM	120	100	132	2	21417	1	3.5		
9 AM	120	100	132	2	21418	1	—		
10 AM	120	100	132	2	21419	1	3.5		
11 AM	120	100	132	2	21420	1	3.5	11:00	
12 NOON	120	100	132	2	21421	1	3.5		
1 PM	120	100	132	2	21422	1	3.5		
2 PM	120	100	132	2	21423	1	3.5		
3 PM	120	100	132	2	21424	1	3.5		
4 PM	120	100	132	2	21425	1	3.5		
5 PM	120	100	132	2	21426	1	3.5		
6 PM	120	100	132	2	21427	1	3.5		
7 PM	120	100	132	2	21428	1	3.5	5:00	
8 PM	120	100	132	2	21429	1	3.5		
9 PM	120	110	132	2	21430	1	3.5	8:00	
10 PM	120	100	132	2	21431	1	3.5		
11 PM	120	100	132	2	21432	1	3.0		
12 MID.	120	102	133	2	21433	1	3.0	12:00	
1 AM	120	102	133	2	21434	1	3.0		
2 AM	120	100	132	2	21435	1	~~3.0~~		
3 AM	120	100	132	2	21436	1	[illegible]		
4 AM	120	95	130	2	21437	1	[illegible]		
5 AM	125	95	132	2	21438	1			
6 AM	120	96	133	2	21439	1			

REMARKS: Record any unusual occurrences on your shift, etc. Turn into Foreperson at end of 11 - 7 shift.

COMMENTS:

OPERATOR 7 - 3

OPERATOR 3 - 11

OPERATOR 11 - 7

Figure B-3. Spray cooler operating log, Run 1.

1392 10/80

PARTICULATE ABATEMENT LOG SHEET

DATE: 29 MAY 85 OPERATOR 7-3 Gray 715 OPERATOR 3-11 T.J. Ferguson 1704 OPERATOR 11-7 COTMAN

	E.C. INLET TEMPERATURE	E.C. OUTLET TEMPERATURE	BAGHOUSE OUTLET TEMPERATURE	DEVIATION	BAGHOUSE ΔP	H_2O VALVE #1 % OPEN	H_2O VALVE #2 % OPEN	H_2O FLOW GPM	AFTERBURNER DRAFT	I.D. FAN DRAFT
DESIRED CONDITION										
7 AM	1710	400	350	+2	5.0	0	36	24	25	75
8 AM	1700	400	350	-3	5.0	0	36	24	25	70
9 AM	Down – Checking for Clinkers – lost afterburner									
10 AM	1700	400	350	-5	6.5	0	36	24	25	75
11 AM	1700	400	350	+1	6.0	0	40	25	25	75
12 NOON	1710	400	350	-2	5.5	0	34	23	25	75
1 PM	1740	400	350	-7	5.5	0	30	22	25	70
2 PM	1740	400	350	+4	4.3	0	30	22	25	70
3 PM	1710	400	350	-3	4.0	0	37	22	20	75
4 PM	1710	400	350	-5	4.5	0	29	21	20	65
5 PM	1710	400	350	+1	6.0	0	31	22	20	70
6 PM	1720	400	350	+2	5.0	0	37	24	20	70
7 PM	1740	400	350	+9	5.5	0	35	24	20	70
8 PM	1740	400	350	+4	5.5	0	33	24	20	70
9 PM	1710	400	350	+2	5.5	0	35	24	20	75
10 PM	1700	400	345	-5	5.0	0	38	24	20	80
11 PM	1700	400	345	-2	5.0	0	36	26	20	75
12 MID.	1700	400	345	+5	5.0	0	37	25	20	75
1 AM	1680	400	345	-1	5.0	0	40	24	20	70
2 AM	1600	400	340	+9	4.5	0	24	24	20	60
3 AM	1600	400	340	+1	4.5	0	24	24	20	60
4 AM	1580	400	330	-13	4.0	0	26	22	20	65
5 AM	1580	400	330	+0	3.5	0	22	20	20	60
6 AM	1600	400	330	+7	5.0	0	23	20	20	60

REMARKS: Record any unusual occurrences on your shift, etc. Turn into Foreperson at end of 11-7 shift.

COMMENTS:

OPERATOR 7-3 6:30 AM Sprays OK

FILTER CAKE 1542 1 – 1030 – 7:30 AM 2 – 1084 – 7:30 AM 3 – 1046 – 11:30 AM

OPERATOR 3-11 6:00 all sprays OK!

OPERATOR 11-7 1:00 all sprays OK – 1:15 AM FURNACE DOWN due to KLINKERS #4 Bulk Box 1208

Figure B-2. Baghouse operating log, Run 1.

1381 10/80

FURNACE AFTERBURNER LOG SHEET

DATE: 5-29-85 OPERATOR 7-3 L. Duff OPERATOR 3-11 R Cox OPERATOR 11-7 Wilson

	TEMPERATURE	AFTERBURNER HEATING CONTROLLER	AFTERBURNER COOLING CONTROLLER	"A" FURNACE DRAFT	"A" FURNACE DRAFT CONTROLLER	AFTERBURNER DRAFT	AFTERBURNER DRAFT CONTROLLER	OXYGEN CONTENT	OXYGEN CONTROLLER	I.D. FAN AMPS	BURNER A GAS/OIL OR OFF	BURNER B GAS/OIL OR OFF
DESIRED CONDITION												
7 AM	1740	55	0	50	10	1.5	50	—	2.0	31	GAS	GAS
8 AM	1740	60	0	50	10	1.0	55	—	2.0	30	"	"
9 AM												
10 AM	1740	65	0	50	25	1.5	55	—	2.0	34	"	"
11 AM	1750	65	0	50	25	1.0	60	—	2.0	32	"	"
12 NOON	1740	60	0	25	30	1.5	45	—	2.0	32	"	"
1 PM	1750	50	0	50	25	1.0	50	—	2.0	31	"	"
2 PM	1750	50	0	50	25	1.0	50	—	2.0	31	"	"
3 PM	1760	50	0	25	30	1.0	45	—	2.0	30	"	"
4 PM	1750	50	0	50	25	1.0	40	—	2.0	31	"	"
5 PM	1720	60	0	25	25	1.0	45	—	2.0	31	"	"
6 PM	1720	50	0	50	20	1.5	50	—	2.0	31	"	"
7 PM	1720	40	0	50	20	1.0	50	—	2.0	31	"	"
8 PM	1770	40	0	25	25	1.7	50	—	2.0	31	"	"
9 PM	1760	45	0	50	10	1.0	50	—	2.0	31	"	"
10 PM	1760	60	0	50	20	1.5	50	—	2.0	31	"	"
11 PM	1745	65	0	25	10	90	55	—		31	gas	gas
12 MID.	1745	60	0	25	0	1.0	50	—		30	"	"
1 AM	1735	55/60	0	50	15	1.2	50			31	"	"
2 AM												
3 AM												
4 AM												
5 AM												
6 AM												

REMARKS: Record any unusual occurrences on your shift, etc. Turn into Foreperson at end of 11-7 shift.

COMMENTS: ALL AFTERBURNER OUTAGES AND THEIR CAUSE MUST BE RECORDED.

OPERATOR 7-3

OPERATOR 3-11

OPERATOR 11-7

Figure B-1. Afterburner operating log, Run 1.

Table B.1. Hearth Temperature History During Test Period[1]

Run No.	Time	Deviation From Run and Hearth Specific Mean (%)							
		Hearth Nos.							Flue Gas
		1	2	3	4	5	6	7	
1 5/29/85	1400	6.1	-0.4	0.8	9.9	1.1	6.0	0	2.7
	1500	3.8	-1.6	0	6.3	0.5	6.0	-1.2	0.2
	1600	2.6	-2.8	-0.6	4.5	0	4.9	-6.1	0.2
	1700	2.6	-1.6	0	5.4	0	4.9	-6.6	0.2
	1800	1.4	-2.8	-0.6	6.3	-0.5	3.7	-4.4	-1.0
	1900	16.8	5.6	0.8	16.2	0.5	6.0	1.6	10.0
	2000	17.9	8.0	2.2	17.1	0.5	6.0	1.6	10.0
	Average	7.3	0.7	0.4	9.4	0.3	5.4	-2.2	3.2
2 5/30/85	1400	5.0	6.8	2.2	0	-2.7	-2.5	0	16.1
	1500	4.4	7.4	2.5	3.6	-1.4	-1.9	1.6	5.1
	1600	3.8	6.2	0	5.4	-0.5	-0.2	1.3	3.9
	1700	2.6	5.6	0	4.5	-0.5	-0.2	1.0	3.9
	1800	1.4	4.4	-0.6	3.6	-0.5	0	1.0	2.7
	1900	0	4.4	-0.3	3.6	0.3	0.3	0	-2.2
	2000	-3.3	0.8	-1.0	-0.9	0	-0.2	0.8	-2.2
	Average	2.1	5.1	0.7	2.8	-0.8	-0.7	0.8	4.4
3 5/31/85	900	-8.0	-4.6	-0.6	-8.1	1.9	-3.9	3.5	-6.5
	1000	-8.6	-5.2	-1.0	-11.3	1.4	-4.5	3.0	-6.5
	1100	-12.1	-8.2	-2.7	-15.8	0.5	-4.8	0.2	-10.2
	1200	-12.7	-8.2	-1.0	-17.1	0	-6.8	1.0	-10.2
	1300	-12.7	-8.2	-1.0	-17.1	0	-6.8	1.0	-10.2
	1400	-11.6	-7.0	-0.6	-16.2	-0.3	-6.8	0.8	-8.9
	Average	-11.0	-7.0	-1.2	-14.2	0.5	-5.6	1.6	-8.7

[1]The host plant considers the hearth temperature data confidential.

APPENDIX B

Process Monitoring Data

TABLE A-6. FIXED GAS ANALYSIS

Run Number	CO_2 (vol %)	O_2 (vol %)	N_2 (vol %)
Furnace Outlet			
Run 1	10.52	7.58	81.89
Run 2	9.23	6.45	84.31
Run 3	7.83	9.94	82.35
Baghouse Outlet			
Run 1	4.85	14.03	81.41
Run 2	4.91	13.71	80.74
Run 3	4.23	14.61	81.12
Spray Cooler Inlet			
Run 1	9.29	7.51	83.18
Run 2	7.62	8.40	83.97
Run 3	7.89	8.85	83.24

APPENDIX A.6

EPA Method 3 Data

SAMPLE CALCULATION
PAGE THREE

9) Isokinetic sampling rate (%) :

Dimensional Constant C = K4 x 60 x 144 x [1 / (Pi /4)]
K4 = .0945 FOR ENGLISH UNITS

$$I\% = \frac{C \times Vm(std) \times (Ts + 460)}{Vs \times Tt \times Ps \times Md \times (Dn)^2}$$

$$I\% = \frac{1039.574 \times 138.5027 \times 799.81}{2444.376 \times 240 \times 29.27691 \times .6427925 \times (.308)^2}$$

I% = 109.9573

10) Excess air (%) :

$$EA = \frac{100 \times \%O2}{(.264 \times \%N2) - \%O2} = \frac{100 \times 14.03}{(.264 \times 81.12) - 14.03}$$

EA = 189.96

11) Particulate Concentration :

Cs = (grams part.) / Vm(std) = 0 / 138.5027

Cs = 0.0000000 Grams/DSCF

$$Ca = \frac{T(std) \times Md \times Ps \times Cs}{P(std) \times Ts}$$

$$Ca = \frac{528 \times .6427925 \times 29.27691 \times 0.0000000}{29.92 \times 799.81}$$

Ca = 0.0000000 Grams/ACF

LBS/HR = Cs x 0.002205 x Qsd x 60

LBS/HR = 0.0000000x 0.002205 x 12490.1 x 60

LBS/HR = 0

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5)Average Molecular Weight of DRY stack gas :

$$MWd = (.44 \times \%CO2) + (.32 \times \%O2) + (.28 \times \%N2)$$

$$MWd = (.44 \times 4.85) + (.32 \times 14.03) + (.28 \times 81.12) = 29.3372$$

6)Average Molecular Weight of wet stack gas :

$$MW = MWd \times Md + 18(1 - Md)$$

$$MW = 29.3372 \times .6427925 + 18(1 - .6427925) = 25.28747$$

7) Stack gas velocity in feet-per-minute (fpm) at stack conditions :

$$Vs = KpxCp \times [SQRT (dP)]\{ave\} \times SQRT [Ts \{avg\}] \times SQRT [1/(PsxMW)] \times 60sec/min$$

$$Vs = 85.49 \times .84 \times 60 \times 15.43609 \times SQRT[1/(29.27691 \times 25.28747)]$$

$$Vs = 2444.376 \text{ FPM}$$

8) Average stack gas dry volumetric flow rate (DSCFM) :

$$Qsd = \frac{Vs \times As \times Md \times T(std) \times Ps}{144 \text{ cu.in./cu.ft.} \times (Ts + 460) \times P(std)}$$

$$Qsd = \frac{2444.376 \times 1772.059 \times .6427925 \times 528 \times 29.27691}{144 \times 799.81 \times 29.92}$$

$$Qsd = 12490.08 \text{ dscfm}$$

RADIAN SOURCE TEST
EPA METHOD 2 - 5
SAMPLE CALCULATION

PLANT : SITE #09
PLANT SITE :
SAMPLING LOCATION : BAGHOUSE EXHAUST
TEST # : 09-MM5-BO-1
DATE : 5/29/85
TEST PERIOD : 1450-1650 1704-1904

1) Volume of dry gas sampled at standard conditions (68 deg-F ,29.92 in. Hg).

$$Vm(std) = \frac{Y \times Vm \times [T(std) + 460] \times [Pb + (Pm/13.6)]}{P(std) \times (Tm + 460)}$$

$$Vm(std) = \frac{.9978 \times 150.343 \times 528 \times [29.31 + (1.24/13.6)]}{29.92 \times (101.96 + 460)}$$

Vm(std) = 138.503dscf

2) Volume of water vapor at standard conditions:

Vw(gas) = 0.04715 cf/gm x W(1) gm

Vw(gas) = 0.04715 x 1632.4 = 76.968 scf

3) Percent Moisture in stack gas :

$$\%M = \frac{100 \times Vw(gas)}{Vm(std) + Vw(gas)}$$

$$\%M = \frac{100 \times 76.968}{138.503 + 76.968} = 35.72\ \%$$

4) Mole fraction of dry stack gas :

$$Md = \frac{100 - \%M}{100} = \frac{100 - 35.72}{100} = .6427925$$

RADIAN SOURCE TEST
EPA METHODS 2-5
DEFINITION OF TERMS

PARAMETER	DEFINITION
Tt(min.)	TOTAL SAMPLING TIME
Dn(in.)	SAMPLING NOZZLE DIAMETER
Ps(in.H2O)	ABSOLUTE STACK STATIC GAS PRESSURE
Vm(cu.ft.)	ABSOLUTE VOLUME OF GAS SAMPLE MEASURED BY DGM
Vw(gm.)	TOTAL STACK MOISTURE COLLECTED
Pm(in.H2O)	AVERAGE STATIC PRESSURE OF DGM
Tm(F)	AVERAGE TEMPERATURE OF DGM
Pb(in.Hg.)	BAROMETRIC PRESSURE
% CO2	CARBON DIOXIDE CONTENT OF STACK GAS
% O2	OXYGEN CONTENT OF STACK GAS
% N2	NITROGEN CONTENT OF STACK GAS
SQR(DELPS)	AVE. SQ. ROOT OF S-PITOT DIFF. PRESSURE-TEMP. PRODUCTS
As(sq.in.)	CROSS-SECTIONAL AREA OF STACK(DUCT)
Ts(F)	TEMPERATURE OF STACK
Vm(dscf)	STANDARD VOLUME OF GAS SAMPLED ,Vm(std),AS DRY STD. CF
Vm(dscm)	STANDARD VOLUME OF GAS SAMPLED,Vm(std),AS DRY STD. CM
Vw gas(scf)	VOLUME OF WATER VAPOR IN GAS SAMPLE,STD
% moisture	WATER VAPOR COMPOSITION OF STACK GAS
Md	PROPORTION, BY VOLUME,OF DRY GAS IN GAS SAMPLE
MWd	MOLECULAR WEIGHT OF STACK GAS,DRY BASIS LB/LB-MOLE
MW	MOLECULAR WEIGHT OF STACK GAS,WET BASIC LB/LB-MOLE
Vs(fpm)	AVERAGE STACK GAS VELOCITY
Flow(acfm)	AVERAGE STACK GAS FLOW RATE(ACTUAL STACK COND.)
Flow(acmm)	AVERAGE STACK GAS FLOW RATE(ACTUAL STACK COND.)
Flow(dscfm)	AVERAGE STACK GAS VOLUMETRIC FLOW RATE(DRY BASIS)
Flow(dscmm)	AVERAGE STACK GAS VOLUMETRIC FLOW RATE(DRY BASIS)
% I	PERCENT ISOKINETIC
% EA	PERCENT EXCESS AIR IN STACK GAS
DGM	DRY GAS METER
Y	DRY GAS METER CORRECTION FACTOR
Pg	STACK STATIC GAS PRESSURE
Cp	PITOT COEFFICIENT
dH	ORIFICE PLATE DIFF. PRESS. VALUE
dP	PITOT DIFF. PRESS. VALUE

*** EPA STANDARD CONDITIONS: Temperature = 68 deg-F (528 deg-R)
Pressure = 29.92 in. Hg.

APPENDIX A.5

Modified Method 5 and EPA Methods 1-4 Sample Calculations

RADIAN SOURCE TEST
EPA METHOD 5
PARTICULATE LOADING

PLANT : SITE #09
PLANT SITE :
SAMPLING LOCATION : BAGHOUSE EXHAUST
TEST # : 09-HCL-BO-3
DATE : 5/31/85
TEST PERIOD : 1105-1205

PARAMETER	FRONT-HALF	TRAIN TOTAL
Total Grams	0.0010000	0.0013000
Grams/dscf	0.0000249	0.0000323
Grams/acf	0.0000105	0.0000136
Grains/dscf	0.0003835	0.0004985
Grains/acf	0.0001615	0.0002100
Grams/dscm	0.0008775	0.0011408
Grams/acm	0.0003696	0.0004805
Pounds/dscf	0.0000001	0.0000001
Pounds/acf	0.0000000	0.0000000
Pounds/Hr	0.0535614	0.0696298
Kilograms/Hr	0.0242953	0.0315839

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RADIAN SOURCE TEST
EPA METHODS 2-5
FINAL RESULTS

PLANT : SITE #09
PLANT SITE :
SAMPLING LOCATION : BAGHOUSE EXHAUST
TEST # : 09-HCL-BO-3
DATE : 5/31/85
TEST PERIOD : 1105-1205

PARAMETER	RESULT
Vm(dscf)	40.23723
Vm(dscm)	1.139518
Vw gas(scf)	21.41082
Vw gas (scm)	.6063543
% moisture	34.73073
Md	.6526928
MWd	29.26121
MW	25.35011
Vs(fpm)	3142.888
Vs (mpm)	958.1976
Flow(acfm)	38676.27
Flow(acmm)	1095.312
Flow(dscfm)	16289.97
Flow(dscmm)	461.3319
% I	97.9713
% EA	214.341

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R A D I A N   S O U R C E   T E S T
E P A   M E T H O D   2 - 5
(R A W   D A T A)

PLANT : SITE #09
PLANT SITE :
SAMPLING LOCATION : BAGHOUSE EXHAUST
TEST # : 09-HCL-BO-3
DATE : 5/31/85
TEST PERIOD : 1105-1205

PARAMETER	VALUE
Sampling time (min.)	60
Barometric Pressure (in.Hg)	28.97
Sampling nozzle diameter (in.)	.308
Meter Volume (cu.ft.)	43.373
Meter Pressure (in.H2O)	1.87
Meter Temperature (F)	94.08
Stack dimension (sq.in.)	1772.059
Stack Static Pressure (in.H2O)	-.45
Stack Moisture Collected (gm)	454.1
Absolute stack pressure(in Hg)	28.93691
Average stack temperature (F)	331.33
Percent CO2	4.23
Percent O2	14.61
Percent N2	81.16001
Delps Subroutine result	19.756
DGM Factor	1.0007
Pitot Constant	.84

RADIAN SOURCE TEST
EPA METHOD 5
PARTICULATE LOADING

PLANT	:	SITE #09
PLANT SITE	:	
SAMPLING LOCATION	:	BAGHOUSE EXHAUST
TEST #	:	09-HCL-BO-2
DATE	:	5/30/85
TEST PERIOD	:	1443-1643

PARAMETER	FRONT-HALF	TRAIN TOTAL
Total Grams	0.0021500	0.0013700
Grams/dscf	0.0000295	0.0000188
Grams/acf	0.0000121	0.0000077
Grains/dscf	0.0004556	0.0002903
Grains/acf	0.0001870	0.0001191
Grams/dscm	0.0010427	0.0006644
Grams/acm	0.0004278	0.0002726
Pounds/dscf	0.0000001	0.0000000
Pounds/acf	0.0000000	0.0000000
Pounds/Hr	0.0540798	0.0344602
Kilograms/Hr	0.0245304	0.0156310

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R A D I A N   S O U R C E   T E S T
E P A   M E T H O D S   2 - 5
F I N A L   R E S U L T S

PLANT : SITE #09
PLANT SITE :
SAMPLING LOCATION : BAGHOUSE EXHAUST
TEST # : 09-HCL-BO-2
DATE : 5/30/85
TEST PERIOD : 1443-1643

PARAMETER	RESULT
Vm(dscf)	72.80946
Vm(dscm)	2.061964
Vw gas(scf)	39.90305
Vw gas (scm)	1.130054
% moisture	35.40251
Md	.645975
MWd	29.334
MW	25.32148
Vs(fpm)	2741.458
Vs (mpm)	835.8103
Flow(acfm)	33736.28
Flow(acmm)	955.4115
Flow(dscfm)	13842.82
Flow(dscmm)	392.0288
% I	104.3096
% EA	176.3498

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R A D I A N   S O U R C E   T E S T
E P A   M E T H O D   2 - 5
(R A W   D A T A)

PLANT	:	SITE #09
PLANT SITE	:	
SAMPLING LOCATION	:	BAGHOUSE EXHAUST
TEST #	:	09-HCL-BO-2
DATE	:	5/30/85
TEST PERIOD	:	1443-1643

PARAMETER	VALUE
Sampling time (min.)	120
Barometric Pressure (in.Hg)	29.06
Sampling nozzle diameter (in.)	.308
Meter Volume (cu.ft.)	78.70201
Meter Pressure (in.H2O)	1.44
Meter Temperature (F)	97.96
Stack dimension (sq.in.)	1772.059
Stack Static Pressure (in.H2O)	-.45
Stack Moisture Collected (gm)	846.3
Absolute stack pressure(in Hg)	29.02691
Average stack temperature (F)	346.42
Percent CO2	4.91
Percent O2	13.71
Percent N2	81.38
Delps Subroutine result	17.24966
DGM Factor	1.0029
Pitot Constant	.84

RADIAN SOURCE TEST
EPA METHOD 5
PARTICULATE LOADING

PLANT : SITE #09
PLANT SITE :
SAMPLING LOCATION : BAGHOUSE EXHAUST
TEST # : 09-HCL-BO-1
DATE : 5/29/85
TEST PERIOD : 1453-1653

PARAMETER	FRONT-HALF	TRAIN TOTAL
Total Grams	0.0011600	0.0009100
Grams/dscf	0.0000167	0.0000131
Grams/acf	0.0000070	0.0000055
Grains/dscf	0.0002571	0.0002017
Grains/acf	0.0001081	0.0000848
Grams/dscm	0.0005883	0.0004615
Grams/acm	0.0002474	0.0001941
Pounds/dscf	0.0000000	0.0000000
Pounds/acf	0.0000000	0.0000000
Pounds/Hr	0.0288847	0.0226596
Kilograms/Hr	0.0131020	0.0102783

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R A D I A N   S O U R C E   T E S T
E P A   M E T H O D S   2 - 5
F I N A L   R E S U L T S

PLANT : SITE #09
PLANT SITE :
SAMPLING LOCATION : BAGHOUSE EXHAUST
TEST # : 09-HCL-BO-1
DATE : 5/29/85
TEST PERIOD : 1453-1653

PARAMETER	RESULT
Vm(dscf)	69.62365
Vm(dscm)	1.971742
Vw gas(scf)	37.20606
Vw gas (scm)	1.053676
% moisture	34.82745
Md	.6517255
MWd	29.3372
MW	25.38874
Vs(fpm)	2532.523
Vs (mpm)	772.1106
Flow(acfm)	31165.14
Flow(acmm)	882.5966
Flow(dscfm)	13104.1
Flow(dscmm)	371.1082
% I	105.3684
% EA	189.9622

Program Revision:1/16/84

R A D I A N   S O U R C E   T E S T
E P A   M E T H O D   2 - 5
(R A W   D A T A)

PLANT	:	SITE #09
PLANT SITE	:	
SAMPLING LOCATION	:	BAGHOUSE EXHAUST
TEST #	:	09-HCL-BO-1
DATE	:	5/29/85
TEST PERIOD	:	1453-1653

PARAMETER	VALUE
Sampling time (min.)	120
Barometric Pressure (in.Hg)	29.31
Sampling nozzle diameter (in.)	.308
Meter Volume (cu.ft.)	75.774
Meter Pressure (in.H2O)	1.3
Meter Temperature (F)	106.4
Stack dimension (sq.in.)	1772.059
Stack Static Pressure (in.H2O)	-.45
Stack Moisture Collected (gm)	789.1
Absolute stack pressure(in Hg)	29.27691
Average stack temperature (F)	340.8
Percent CO2	4.85
Percent O2	14.03
Percent N2	81.12
Delps Subroutine result	16.02473
DGM Factor	1.0029
Pitot Constant	.84

APPENDIX A.4

HCl Train Results

TABLE A-3. RADIAN CEM DATA, RUN 3

FACTOR FOR 3% O_2 NORMALIZATION OF OTHER PROCESS GASES	NORMALIZED / CORRECTED DATA - WITH ACTUAL O_2 *				
	TIME	O_2 (%V)	CO (PPMV) @ 3% O_2	CO_2 (%V) @ 3% O_2	THC (PPMV) @ 3% O_2
2.8445	955	14.6	177.3	13.4	3.9
2.8705	1000	14.7	198.0	13.4	2.3
2.9167	1005	14.9	176.0	12.7	3.0
2.8796	1010	14.7	200.3	13.1	2.8
2.8921	1015	14.7	125.0	13.2	2.7
2.9670	1020	14.9	157.3	13.5	2.5
2.8960	1025	14.7	185.9	13.1	2.2
2.8904	1030	14.7	186.2	13.2	2.4
2.8852	1035	14.7	196.5	12.5	2.5
2.8991	1040	14.7	175.2	13.1	2.8
2.8975	1045	14.7	182.2	13.0	2.2
3.0626	1050	15.1	201.2	13.6	2.2
2.8965	1055	14.7	170.6	13.1	2.1
2.8963	1100	14.7	171.0	13.0	2.0
3.0623	1105	15.1	153.7	13.3	1.7
2.8966	1110	14.7	129.3	13.1	1.6
2.8933	1115	14.7	138.6	13.2	1.5
2.9726	1120	14.9	144.9	12.3	1.4
2.8913	1125	14.7	116.2	13.3	1.4
2.8892	1130	14.7	106.2	13.3	1.3
3.4359	1135	15.7	105.0	11.6	1.4
2.8309	1140	14.6	105.6	13.3	1.1
2.8743	1145	14.7	93.8	13.3	1.0
2.8941	1150	14.7	76.9	12.7	1.0
2.8957	1155	14.7	99.7	13.5	1.1
2.8799	1200	14.7	79.7	13.4	1.1
2.9165	1205	14.8	61.2	12.7	1.2
2.7626	1210	14.4	93.2	13.6	1.6
2.6033	1215	14.0	95.5	13.5	1.6
2.5771	1220	14.0	68.3	13.8	1.5
[illegible]	1225	14.0	92.1	13.5	2.3
2.7571	1230	14.0	84.3	13.4	1.3
2.7263	1235	14.3	96.3	11.9	1.8
2.6197	1240	14.1	74.9	13.3	1.5
2.6141	1245	14.1	79.7	13.2	1.6
2.7018	1250	14.3	71.3	13.4	1.[illegible]
2.6877	1255	14.2	77.7	13.5	1.9
2.6571	1300	14.2	72.4	13.2	1.9
[illegible]	1305	14.2	59.0	13.3	1.8
2.6773	1310	14.2	79.6	13.4	1.9
[illegible]	1315	14.1	71.1	13.3	1.9
[illegible]	1320	14.3	53.6	12.3	2.2
[illegible]	1325	14.2	79.0	13.3	2.1
2.6347	1330	14.2	76.0	13.2	2.1
[illegible]	1335	14.3	55.1	12.7	2.1
[illegible]	1340	14.1	66.1	13.4	1.8
[illegible]	1345	14.1	78.0	13.3	1.9
2.5767	1350	14.0	92.9	13.3	1.7
2.9429	1355	14.6	57.2	13.6	3.6
2.7519	1400	14.4	78.2	13.4	1.9
2.7575	1405	14.4	104.7	13.3	1.8
2.8236	1410	14.6	59.2	13.8	2.3
2.7273	1415	14.3	58.0	13.4	1.6
2.7720	1420	14.4	34.7	12.7	1.7

NO. PTS.	54	NO. PTS.	54	54	54	54
MEAN	2.8115	MEAN	14.5	110.8	13.2	1.9
STD. DEV.	0.2	STD. DEV.	0.3	48.4	0.4	0.6

* CO, CO_2 and THC values are corrected to 3% O_2. To obtain actual measured values, divide values in the table by the corresponding normalization factor.

TABLE A-2. RADIAN CEM DATA, RUN 2

FACTOR FOR 3% O2 NORMALIZATION OF OTHER PROCESS GASES	NORMALIZED / CORRECTED DATA - WITH ACTUAL O2 * TIME	O2 (%V)	CO (PPMV) @ 3% O2	CO2 (%V) @ 3% O2	THC (PPMV) @ 3% O2
2.4479	1440	13.6	23.1	13.0	1.1
2.4294	1445	13.5	1.3	13.0	1.1
2.5973	1450	14.0		11.9	1.0
2.4591	1455	13.7	7.8	13.2	0.8
2.4127	1500	13.5	7.2	12.9	0.8
2.3974	1505	13.4		13.3	0.7
2.3744	1510	13.4	18.0	13.0	0.9
2.3711	1515	13.4	6.6	13.1	1.0
2.4719	1520	13.7	5.4	13.5	1.3
2.3794	1525	13.4	32.5	13.2	1.3
2.3895	1530	13.4	1.7	13.1	1.5
2.4841	1535	13.7		13.5	1.6
2.3993	1540	13.4	16.9	13.1	1.5
2.5210	1545	13.7	1.2	12.5	1.6
2.5048	1550	13.9	24.6	13.1	1.9
2.4539	1555	13.6	11.2	13.2	1.7
2.4506	1600	13.6	31.5	13.2	1.6
2.4817	1605	13.7	33.5	13.1	2.3
2.4465	1610	13.6	41.6	13.3	3.5
2.5781	1615	14.2	5.1	12.9	3.9
2.4513	1620	13.6	22.7	13.5	2.9
2.4522	1625	13.6		13.0	3.2
2.5725	1630	14.2	11.0	12.1	3.2
2.4734	1635	13.7	47.7	13.6	2.7
2.4833	1640	13.7	74.5	13.9	2.2
2.5155	1645	13.9	30.1	12.7	2.4
2.4329	1650	13.7	68.9	13.5	2.7
2.4691	1655	13.6	67.2	13.6	2.5
2.4859	1700	13.7	95.5	13.6	3.8
2.3347	1705	13.6	54.0	13.6	2.6
[illegible]	1710	13.8	94.7	12.7	2.7
2.4843	1715	13.7	3.3	13.7	2.7
2.4606	1720	13.7	78.9	13.6	3.0
[illegible]	1725	14.3	57.3	13.2	3.4
2.4813	1730	13.7	13.8	13.6	2.9
2.4757	1735	13.7	54.7	13.3	3.1
[illegible]	1740	13.8	34.1	12.7	3.1
[illegible]	1745	13.[illegible]	47.3	13.6	2.3
[illegible]	1750	13.8	45.0	13.7	3.1
[illegible]	1755	13.8	49.7	13.8	2.8
[illegible]	1800	13.8	7.1	13.8	2.9
[illegible]	1805	14.2	38.5	13.0	2.6
[illegible]	1810	13.8	4.6	13.7	2.5
[illegible]	1815	13.8		13.7	2.3
[illegible]	1820	14.2	67.8	12.9	2.6
[illegible]	1825	14.0	54.2	13.8	2.4
[illegible]	1830	13.8	47.8	13.7	2.2
[illegible]	1835	14.2	18.[illegible]	12.7	2.[illegible]
[illegible]	1840	13.7	14.[illegible]	13.7	2.7
2.5212	1845	13.8	50.3	13.7	2.3

NO. PTS.	50	NO. PTS.	50	45	50	50
MEAN	2.5017	MEAN	13.7	33.6	13.3	2.3
STD. DEV.	0.1	STD. DEV.	0.2	25.5	0.4	0.8

* CO, CO2 and THC values are corrected to 3% O2. To obtain actual measured values, divide values in the table by the corresponding normalization factor.

TABLE A-1. RADIAN CEM DATA, RUN 1 (cont'd.)

CEMS DATA - SITE 09 - TEST 1

**	2.5285	**	1720	13.8	72.4	4.2	3.7
**	2.5133	**	1725	13.8		3.9	0.7
**	2.4828	**	1730	13.7		3.8	0.6
**	2.4403	**	1735	13.5		3.7	0.5
**	2.4570	**	1740	13.7	50.9	4.1	3.9
**	2.4762	**	1745	13.7	64.2	4.1	4.1
**	2.5010	**	1750	13.8	65.5	4.1	3.5
**	2.4676	**	1755	13.6	39.1	4.1	3.5
**	2.4595	**	1800	13.7		4.1	3.3
**	2.3278	**	1805	13.2		4.2	3.8
**	2.3511	**	1810	13.3	49.2	4.2	3.4
**	2.3659	**	1815	13.4	55.6	4.3	3.4
**	2.3372	**	1820	13.2	42.2	3.2	2.5
**	2.3141	**	1825	13.2	65.0	4.5	2.6
**	2.3585	**	1830	13.1	43.2	4.5	2.4
**	2.3260	**	1835	13.2	25.9	4.3	2.3
**	2.3980	**	1840	13.1	52.7	4.5	2.5
**	2.3921	**	1845	13.1	28.3	4.6	2.5
**	2.3143	**	1850	13.2	49.9	4.3	2.2
**	2.3381	**	1855	13.2	45.8	4.5	1.8
**	2.3090	**	1900	13.1	56.6	4.5	1.8

NO. PTS.	70	NO. PTS.	70	55	70	70
MEAN	2.4617	MEAN	13.5	121.1	4.1[a]	4.7
STD. DEV.	0.1	STD. DEV.	0.3	281.8	0.3	7.2

* CO, COC and THC values are corrected to 3% O_2. To obtain actual measured values, divide values in the table by the corresponding normalization factor.

[a] CO_2 for Run 1 is invalid.

TABLE A-1. RADIAN CEM DATA, RUN 1

CEMS DATA - SITE 09 - TEST 1

FACTOR FOR 3% O2 NORMALIZATION OF CEM OR PROCESS GASES	NORMALIZED / CORRECTED DATA - WITH ACTUAL O2 * TIME	O2 (%V)	CO (PPMV) @ 3% O2	CO2 (%V) @ 3% O2	THC (PPMV) @ 3% O2
1.4737	1315	13.7	47.7	3.8	4.0
1.4782	1320	13.7	34.4	3.8	4.1
1.5193	1325	13.8	15.2	4.4	6.5
1.5191	1330	13.8	162.6	4.5	6.4
1.5150	1335	13.9	157.6	4.5	5.3
1.5231	1340	13.9	130.5	4.4	5.8
1.4645	1345	13.7	136.9	4.4	6.2
1.4961	1350	13.7	124.6	4.3	5.2
1.4905	1355	13.7	110.7	4.4	5.1
1.4734	1400	13.7	124.5	4.4	5.2
1.4971	1405	13.7	122.1	4.4	5.4
1.4974	1410	13.7	190.7	3.8	5.7
1.1563	1415	12.6	2174.0	2.6	62.6
1.2333	1420	13.0	74.6	4.0	12.1
1.4003	1425	13.4	111.3	4.2	6.9
1.4415	1430	13.6	110.4	4.3	5.3
1.4612	1435	13.6	95.2	4.3	5.3
1.5196	1440	13.8	109.0	4.1	5.6
1.6061	1445	14.0	91.3	4.5	5.4
1.5329	1450	13.8	95.3	4.3	3.0
1.5217	1455	13.8		3.8	[illegible]
1.4871	1500	13.7		3.8	[illegible]
1.4964	1505	13.7		3.5	[illegible]
1.4976	1510	13.7	109.0	4.2	5.5
1.5087	1515	13.8	105.2	4.3	5.3
1.5117	1520	13.8	111.3	4.1	5.3
[illegible]	1525	13.8		3.7	[illegible]
[illegible]	1530	13.8		3.8	[illegible]
[illegible]	1535	13.9		[illegible]	[illegible]
1.4807	1540	13.7	103.6	4.2	[illegible]
1.5233	1545	13.8	96.7	4.1	5.1
[illegible]	1550	14.1	64.0	4.2	[illegible]
[illegible]	1555	13.7	119.9	4.2	4.4
[illegible]	1600	13.7	109.1	4.2	4.2
[illegible]	1605	13.7	94.8	3.5	3.8
[illegible]	1610	13.7	93.7	4.1	[illegible]
[illegible]	1615	13.8	[illegible]	4.1	[illegible]
[illegible]	1620	13.7	[illegible]	4.1	3.8
[illegible]	1625	13.9	[illegible]	4.2	[illegible]
[illegible]	1630	13.8	[illegible]	[illegible]	[illegible]
[illegible]	1635	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1640	13.7		[illegible]	[illegible]
[illegible]	1645	13.8	[illegible]	4.3	[illegible]
[illegible]	1650	13.7	70.5	4.2	[illegible]
[illegible]	1655	13.7		3.8	[illegible]
[illegible]	1700	13.7		[illegible]	[illegible]
[illegible]	1705	[illegible]		[illegible]	1.7
[illegible]	1710	13.7	[illegible]	[illegible]	[illegible]
[illegible]	1715	13.9	[illegible]	[illegible]	[illegible]

APPENDIX A.3

CEM Results

R A D I A N   S O U R C E   T E S T
E P A   M E T H O D S   2 - 5
F I N A L   R E S U L T S

PLANT : SITE #09
PLANT SITE :
SAMPLING LOCATION : AMBIENT LOCATION
TEST # : 09-AMB-1B
DATE : 5/29-30-31/85
TEST PERIOD :
29(1330-1915) 30(1134-1140 1430-1925) 31(1005-1345)

PARAMETER	RESULT
Vm(dscf)	402.6125
Vm(dscm)	11.40199
Vw gas(scf)	3.955885
Vw gas (scm)	.1120307
% moisture	.9729938
Md	.9902701
MWd	28.84004
MW	28.73457
Vs(fpm)	5035.26
Vs (mpm)	1535.14
Flow(acfm)	50779.37
Flow(acmm)	1438.072
Flow(dscfm)	48264.35
Flow(dscmm)	1366.846
% I	11.00016
% EA	-14583.23

Program Revision:1/16/84

RADIAN SOURCE TEST
EPA METHOD 2-5
(RAW DATA)

PLANT : SITE #09
PLANT SITE :
SAMPLING LOCATION : AMBIENT LOCATION
TEST # : 09-AMB-1B
DATE : 5/29-30-31/85
TEST PERIOD :
29(1330-1915) 30(1134-1140 1430-1925) 31(1005-1345)

PARAMETER	VALUE
Sampling time (min.)	1036
Barometric Pressure (in.Hg)	29.12
Sampling nozzle diameter (in.)	.368
Meter Volume (cu.ft.)	429.216
Meter Pressure (in.H2O)	.83
Meter Temperature (F)	89.7
Stack dimension (sq.in.)	1452.205
Stack Static Pressure (in.H2O)	.0001
Stack Moisture Collected (gm)	83.9
Absolute stack pressure(in Hg)	29.12001
Average stack temperature (F)	75.4
Percent CO2	.0001
Percent O2	21
Percent N2	79
Delps Subroutine result	33.80447
DGM Factor	1.0013
Pitot Constant	.84

R A D I A N   S O U R C E   T E S T
E P A   M E T H O D S   2 - 5
F I N A L   R E S U L T S

PLANT :

SITE #9 CORRECTED TO DELETE THE VOLUME SAMPLED DURING THE ENTIRE PERIOD OF THE BROKEN IMPINGER (WORST POSSIBLE CASE)

PLANT SITE :
SAMPLING LOCATION : AMBIENT LOCATION
TEST # : 09-AMB-1A
DATE : 5/29-30-31/85
TEST PERIOD :
29(1330-1915) 30(1135-1140 1430-1925) 31(1005-1345)

PARAMETER	RESULT
Vm(dscf)	356.6796
Vm(dscm)	10.10117
Vw gas(scf)	3.500955
Vw gas (scm)	9.914703E-02
% moisture	.9719999
Md	.99028
MWd	28.84004
MW	28.73468
Vs(fpm)	5035.249
Vs (mpm)	1535.137
Flow(acfm)	50779.26
Flow(acmm)	1438.069
Flow(dscfm)	48246.71
Flow(dscmm)	1366.347
% I	9.758161
% EA	-14583.23

Program Revision:1/16/84

R A D I A N   S O U R C E   T E S T
E P A   M E T H O D   2 - 5
(R A W   D A T A)

PLANT :

SITE #9 CORRECTED TO DELETE THE VOLUME SAMPLED DURING THE ENTIRE PERIOD OF THE BROKEN IMPINGER (WORST POSSIBLE CASE)

PLANT SITE :
SAMPLING_LOCATION : AMBIENT LOCATION
TEST # : 09-AMB-1A
DATE : 5/29-30-31/85
TEST PERIOD :
29(1330-1915) 30(1135-1140 1430-1925) 31(1005-1345)

PARAMETER	VALUE
Sampling time (min.)	1035
Barometric Pressure (in.Hg)	29.12
Sampling nozzle diameter (in.)	.368
Meter Volume (cu.ft.)	384.5
Meter Pressure (in.H2O)	.85
Meter Temperature (F)	92.1
Stack dimension (sq.in.)	1452.205
Stack Static Pressure (in.H2O)	.0001
Stack Moisture Collected (gm)	74.25142
Absolute stack pressure(in Hg)	29.12001
Average stack temperature (F)	75.6
Percent CO2	.0001
Percent O2	21
Percent N2	79
Delps Subroutine result	33.80447
DGM Factor	.9945
Pitot Constant	.84

APPENDIX A.2

Ambient Air Train Results

R A D I A N   S O U R C E   T E S T
E P A   M E T H O D S   2 - 5
F I N A L   R E S U L T S

PLANT	:	SITE #09
PLANT SITE	:	
SAMPLING LOCATION	:	BAGHOUSE EXHAUST
TEST #	:	09-MM5-BO-3
DATE	:	5/31/85
TEST PERIOD	:	1002-1202 1213-1413

PARAMETER	RESULT
Vm(dscf)	153.2522
Vm(dscm)	4.340101
Vw gas(scf)	82.92742
Vw gas (scm)	2.348505
% moisture	35.11202
Md	.6488798
MWd	29.26121
MW	25.30717
Vs(fpm)	2943.447
Vs (mpm)	897.3922
Flow(acfm)	36221.95
Flow(acmm)	1025.806
Flow(dscfm)	15131.17
Flow(dscmm)	428.5147
% I	100.4304
% EA	214.341

Program Revision:1/16/84

R A D I A N   S O U R C E   T E S T
E P A   M E T H O D   2 - 5
(R A W   D A T A)

PLANT	: SITE #09
PLANT SITE	:
SAMPLING LOCATION	: BAGHOUSE EXHAUST
TEST #	: 09-MM5-BO-3
DATE	: 5/31/85
TEST PERIOD	: 1002-1202 1213-1413

PARAMETER	VALUE
Sampling time (min.)	240
Barometric Pressure (in.Hg)	28.97
Sampling nozzle diameter (in.)	.308
Meter Volume (cu.ft.)	166.962
Meter Pressure (in.H2O)	1.45
Meter Temperature (F)	97.79
Stack dimension (sq.in.)	1772.059
Stack Static Pressure (in.H2O)	-.45
Stack Moisture Collected (gm)	1758.8
Absolute stack pressure(in Hg)	28.93691
Average stack temperature (F)	333.21
Percent CO2	4.23
Percent O2	14.61
Percent N2	81.16001
Delps Subroutine result	18.48665
DGM Factor	.9978
Pitot Constant	.84

RADIAN SOURCE TEST
EPA METHODS 2-5
FINAL RESULTS

PLANT	:	SITE #09
PLANT SITE	:	
SAMPLING LOCATION	:	BAGHOUSE EXHAUST
TEST #	:	09-MM5-BO-2
DATE	:	5/30/85
TEST PERIOD	:	1440-1640 1650-1850

PARAMETER	RESULT
Vm(dscf)	133.3566
Vm(dscm)	3.77666
Vw gas(scf)	74.7799
Vw gas (scm)	2.117767
% moisture	35.92829
Md	.6407171
MWd	29.334
MW	25.26189
Vs(fpm)	2580.386
Vs (mpm)	786.703
Flow(acfm)	31754.14
Flow(acmm)	899.2771
Flow(dscfm)	12956.23
Flow(dscmm)	366.9203
% I	102.0627
% EA	176.3498

Program Revision:1/16/84

RADIAN SOURCE TEST
EPA METHOD 2-5
(RAW DATA)

PLANT	:	SITE #09
PLANT SITE	:	
SAMPLING LOCATION	:	BAGHOUSE EXHAUST
TEST #	:	09-MM5-BO-2
DATE	:	5/30/85
TEST PERIOD	:	1440-1640 1650-1850

PARAMETER	VALUE
Sampling time (min.)	240
Barometric Pressure (in.Hg)	29.06
Sampling nozzle diameter (in.)	.308
Meter Volume (cu.ft.)	145.078
Meter Pressure (in.H2O)	1.1
Meter Temperature (F)	98.22
Stack dimension (sq.in.)	1772.059
Stack Static Pressure (in.H2O)	-.45
Stack Moisture Collected (gm)	1586
Absolute stack pressure(in Hg)	29.02691
Average stack temperature (F)	344.38
Percent CO2	4.91
Percent O2	13.71
Percent N2	81.38
Delps Subroutine result	16.21706
DGM Factor	.9978
Pitot Constant	.84

R A D I A N   S O U R C E   T E S T
E P A   M E T H O D S   2 - 5
F I N A L   R E S U L T S

PLANT : SITE #09
PLANT SITE :
SAMPLING LOCATION : BAGHOUSE EXHAUST
TEST # : 09-MM5-BO-1
DATE : 5/29/85
TEST PERIOD : 1450-1650 1704-1904

PARAMETER	RESULT
Vm(dscf)	138.5027
Vm(dscm)	3.922398
Vw gas(scf)	76.96766
Vw gas (scm)	2.179724
% moisture	35.72076
Md	.6427925
MWd	29.3372
MW	25.28747
Vs(fpm)	2444.376
Vs (mpm)	745.2366
Flow(acfm)	30080.41
Flow(acmm)	851.8771
Flow(dscfm)	12490.08
Flow(dscmm)	353.7191
% I	109.9573
% EA	189.9622

Program Revision:1/16/84

RADIAN SOURCE TEST
EPA METHOD 2-5
(RAW DATA)

PLANT	:	SITE #09
PLANT SITE	:	
SAMPLING LOCATION	:	BAGHOUSE EXHAUST
TEST #	:	09-MM5-BO-1
DATE	:	5/29/85
TEST PERIOD	:	1450-1650 1704-1904

PARAMETER	VALUE
Sampling time (min.)	240
Barometric Pressure (in.Hg)	29.31
Sampling nozzle diameter (in.)	.308
Meter Volume (cu.ft.)	150.343
Meter Pressure (in.H2O)	1.24
Meter Temperature (F)	101.96
Stack dimension (sq.in.)	1772.059
Stack Static Pressure (in.H2O)	-.45
Stack Moisture Collected (gm)	1632.4
Absolute stack pressure(in Hg)	29.27691
Average stack temperature (F)	339.81
Percent CO2	4.85
Percent O2	14.03
Percent N2	81.12
Delps Subroutine result	15.43609
DGM Factor	.9978
Pitot Constant	.84

RADIAN SOURCE TEST
EPA METHODS 2-5
FINAL RESULTS

PLANT : SITE #09
PLANT SITE :
SAMPLING LOCATION : BAGHOUSE INLET
TEST # : 09-MM5-BI-3
DATE : 5/31/85
TEST PERIOD : 1010-1410

PARAMETER	RESULT
Vm(dscf)	159.4247
Vm(dscm)	4.514908
Vw gas(scf)	59.66361
Vw gas (scm)	1.689673
% moisture	27.23268
Md	.7276732
MWd	29.6504
MW	26.47769
Vs(fpm)	5271.085
Vs (mpm)	1607.038
Flow(acfm)	53157.61
Flow(acmm)	1505.424
Flow(dscfm)	9555.144
Flow(dscmm)	270.6017
% I	94.97405
% EA	84.46114

Program Revision:1/16/84

RADIAN SOURCE TEST
EPA METHOD 2-5
(RAW DATA)

PLANT	:	SITE #09
PLANT SITE	:	
SAMPLING LOCATION	:	BAGHOUSE INLET
TEST #	:	09-MM5-BI-3
DATE	:	5/31/85
TEST PERIOD	:	1010-1410

PARAMETER	VALUE
Sampling time (min.)	240
Barometric Pressure (in.Hg)	28.97
Sampling nozzle diameter (in.)	.368
Meter Volume (cu.ft.)	173.972
Meter Pressure (in.H2O)	1.72
Meter Temperature (F)	103.29
Stack dimension (sq.in.)	1452.205
Stack Static Pressure (in.H2O)	-1.8
Stack Moisture Collected (gm)	1265.4
Absolute stack pressure(in Hg)	28.83765
Average stack temperature (F)	1600.14
Percent CO2	7.83
Percent O2	9.939999
Percent N2	82.23001
Delps Subroutine result	33.80447
DGM Factor	1.0053
Pitot Constant	.84

R A D I A N   S O U R C E   T E S T
E P A   M E T H O D S   2 - 5
F I N A L   R E S U L T S

PLANT : SITE #09
PLANT SITE :
SAMPLING LOCATION : BAGHOUSE INLET
TEST # : 09-MM5-BI-2
DATE : 05/30/85
TEST PERIOD : 1440-1840

PARAMETER	RESULT
Vm(dscf)	142.6047
Vm(dscm)	4.038564
Vw gas(scf)	52.81743
Vw gas (scm)	1.49579
% moisture	27.02736
Md	.7297265
MWd	29.7348
MW	26.5632
Vs(fpm)	4630.264
Vs (mpm)	1411.666
Flow(acfm)	46695.08
Flow(acmm)	1322.405
Flow(dscfm)	8691.128
Flow(dscmm)	246.1327
% I	93.39941
% EA	40.79573

Program Revision:1/16/84

RADIAN SOURCE TEST
EPA METHOD 2-5
(RAW DATA)

PLANT	:	SITE #09
PLANT SITE	:	
SAMPLING LOCATION	:	BAGHOUSE INLET
TEST #	:	09-MM5-BI-2
DATE	:	05/30/85
TEST PERIOD	:	1440-1840

PARAMETER	VALUE
Sampling time (min.)	240
Barometric Pressure (in.Hg)	29.11
Sampling nozzle diameter (in.)	.368
Meter Volume (cu.ft.)	157.1
Meter Pressure (in.H2O)	1.46
Meter Temperature (F)	111.02
Stack dimension (sq.in.)	1452.205
Stack Static Pressure (in.H2O)	-1.8
Stack Moisture Collected (gm)	1120.2
Absolute stack pressure(in Hg)	28.97765
Average stack temperature (F)	1544.89
Percent CO2	9.229999
Percent O2	6.45
Percent N2	84.32
Delps Subroutine result	29.81478
DGM Factor	1.0053
Pitot Constant	.84

R A D I A N   S O U R C E   T E S T
E P A   M E T H O D S   2 - 5
F I N A L   R E S U L T S

PLANT : SITE #09
PLANT SITE :
SAMPLING LOCATION : BAGHOUSE INLET
TEST # : 09-MM5-BI-1
DATE : 5/29/85
TEST PERIOD : 1445-1505 1520-1900

PARAMETER	RESULT
Vm(dscf)	138.0555
Vm(dscm)	3.909732
Vw gas(scf)	51.77542
Vw gas (scm)	1.46628
% moisture	27.27449
Md	.7272551
MWd	29.9864
MW	26.71717
Vs(fpm)	4437.217
Vs (mpm)	1352.81
Flow(acfm)	44748.25
Flow(acmm)	1267.27
Flow(dscfm)	8266.71
Flow(dscmm)	234.1132
% I	95.06211
% EA	53.98245

Program Revision:1/16/84

RADIAN SOURCE TEST
EPA METHOD 2-5
(RAW DATA)

PLANT	:	SITE #09
PLANT SITE	:	
SAMPLING LOCATION	:	BAGHOUSE INLET
TEST #	:	09-MM5-BI-1
DATE	:	5/29/85
TEST PERIOD	:	1445-1505 1520-1900

PARAMETER	VALUE
Sampling time (min.)	240
Barometric Pressure (in.Hg)	29.3
Sampling nozzle diameter (in.)	.368
Meter Volume (cu.ft.)	151.49
Meter Pressure (in.H2O)	1.27
Meter Temperature (F)	112.2
Stack dimension (sq.in.)	1452.205
Stack Static Pressure (in.H2O)	-1.8
Stack Moisture Collected (gm)	1098.1
Absolute stack pressure(in Hg)	29.16765
Average stack temperature (F)	1566.3
Percent CO2	10.52
Percent O2	7.58
Percent N2	81.9
Delps Subroutine result	28.7482
DGM Factor	1.0053
Pitot Constant	.84

APPENDIX A.1

Modified Method 5 and EPA Methods 1-4
Field Results

APPENDIX A

FIELD SAMPLING DATA

TABLE 7-7. PROOF BLANK AND FIELD BLANK DIOXIN/FURAN DATA FOR SITE CRF-A MM5 SAMPLES

Isomer/ Homologue	Amount Detected, Nanograms per Train					Ratio(%)[a]	
	Laboratory	Field Blank		Minimum Test Run Value			
	Proof Blank	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
Dioxins							
2378-TCDD	--	--	--	0.2	--	--	--
Other TCDD	ND (0.1)	ND (0.2)	ND (0.1)	3.7	0.3	0	0
Penta TCDD	ND (0.4)	ND (0.1)	ND (0.04)	1.9	0.5	0	0
Hexa TCDD	ND (0.2)	ND (0.3)	ND (0.2)	11.7	0.9	0	0
Hepta TCDD	0.7	ND (0.2)	0.3	17.9	1.0	0	30
Octa TCDD	0.8	0.4	0.5	9.6	1.0	4	50
Furans							
2378 TCDF	--	--	--	3.5	--	--	--
Other TCDF	0.9	0.6	0.6	51.1	1.4	1	43
Penta TCDF	0.7	ND (0.3)	0.3	34.3	0.6	0	50
Hexa CDF	1.9	ND (0.2)	0.3	40.7	0.8	0	38
Hepta CDF	2.6	ND (0.1)	ND (0.7)	28.5	0.7	0	0
Octa CDF	1.1	0.2	0.2	13.1	0.5	1.5	40

[a]Ratio of the field blank value to the minimum test run value expressed as a percentage.
ND = not detected.

TABLE 7-6. ANALYTICAL RESULTS FOR TROIKA QUALITY CONTROL SAMPLES FOR SITE CRF-A

Isomer/ Homologue	Amount detected (Nanograms per sample)			Difference[b]
	Troika Laboratory Blank	Fortified Laboratory QC Sample		
		Measured Value	True Value[a]	
Dioxins				
2378 TCDD	ND (0.04)	0.4	0.4	0
Other TCDD	ND (0.07)	ND (0.1)	ND	0
Penta TCDD	ND (0.02)	ND (0.1)	ND	0
Hexa TCDD	ND (0.1)	1.8	1.6	12.5
Hepta TCDD	ND (0.2)	2.0	2.4	-16.7
Octa TCDD	0.2	3.0	3.2	-6.3
Furans				
2378 TCDF	ND (0.1)	0.9	0.4	125
Other TCDF	0.3	ND (0.01)	ND	0
Penta TCDF	ND (0.2)	0.7	0.8	-12.5
Hexa TCDF	ND (0.1)	1.7	1.6	6.3
Hepta TCDF	ND (0.2)	1.7	2.4	-30
Octa TCDF	ND (0.1)	3.0	3.2	-6.3

[a]True values reperesent the amounts of each homologue spiked into the laboratory fortified QC samples.
[b]% = (measured value - true value)/true value x 100
ND = not detected (detection limit indicated in parenthesis)

The low surrogate recoveries for the acid fractions is believed to be due to the extraction and clean-up procedure rather than the analytical procedure. The base neutral fraction surrogate recovery values are within the Tier 4 QA criteria of 40 to 120 percent.

7.3.1.2 Sample Blanks Table 7-6 summarizes the analytical results reported by Troika for internal laboratory blanks and laboratory fortified quality control (QC) samples. Comparison of the measured and spiked values for the laboratory fortified QC samples showed agreement to within $\pm$25 percent for all target species except for 2378-TCDF. The measured value for the 2378-TCDF was 125 percent higher than the spiked value.

The analytical results of the quality control field and laboratory MM5 train blanks are summarized in Table 7-7.

Octa-CDD, TCDF, and octa-CDF were detected in the inlet field blank but at levels that were less than 5% of the inlet minimum test run value. For the outlet field blank, all the homologues were detected except for TCDD, penta-CDD, hexa-CDD, and hepta-CDF. The blank concentrations were less than 50 percent of the outlet minimum test run value. Thus, field recovery of the MM5 samples was considered adequate at Site MM5 samples was considered adequate at Site CRF-A.

The laboratory proof blank contained measureable quantities of all homologues except TCDD, penta-CDD and hexa-CDD. However, since the field blank results are considered reasonable, the test run data reported in Section 4 were not blank-corrected.

7.3.2 Total Chloride Analysis

Total chloride analyses were performed by Radian/Austin on the HCl train samples. QA/QC activities included total chloride analysis of field recovery blank HCl train samples and total chloride analysis of an aliquot of the KOH solution used in the sample train impingers. The NaOH blank, the HCl train probe rinse/filter blank, and the HCl train impinger blank rinses each contained less than 1 mg/L of chlorides. Therefore, the HCl results did not require correction.

TABLE 7-5. PERCENT SURROGATE RECOVERIES FOR SITE CRF-A FEED SAMPLES

Surrogate Compound	Percent Surrogate Recovery Spent Carbon Feed Samples Run 1	Run 2	Run 3	Average
Base Neutrals Fraction				
d_4-dichlorobenzene	14	24	27	22
bromobiphenyl	79	63	65	69
2', 5, 5' tetra bromobiphenyl	83	53	104	80
Acids Fraction				
d_6-phenol	16	15	16	16
d_4-2-chlorophenol	36	25	30	32
$^{13}C_6$-pentachlorophenol	3	ND	ND	1

TABLE 7-4. PERCENT SURROGATE RECOVERIES FOR SITE CRF-A DIOXIN/FURAN ANALYSES

Sample Type	$^{37}Cl_4$ TCDD	$^{13}C_{12}$ TCDD	$^{37}Cl_4$ Hepta-CDD	$^{13}C_{12}$ Octa-CDD
<u>MM5 Train Samples</u>				
Inlet				
Run 01	70	96	114	84
Run 02	80	86	122	66
Run 03	92	94	102	64
Outlet				
Run 01	84	90	80	82
Run 02	82	80	116	77
Run 03	68	94	90	105
Ambient Train	92	92	92	72
Proof Blank	82	80	116	79
Field Blank (Inlet/Outlet)	84/88	92/102	138/64	94/72
Laboratory Blank QC (MM5)	78	88	110	100
Laboratory Fortified QC (MM5)	50	60	70	74
<u>Baghouse Dust Samples</u>				
Run 01	-	86	-	51
Run 02	-	94	-	73
Run 03	-	116	-	78

7.3 LABORATORY ANALYSES

QA/QC activities were carried out for dioxin/furan, dioxin precursor, and total chloride analyses performed on Site CRF-A samples. The dioxin/furan analyses of MM5 train samples performed by Troika are considered in Section 7.3.1; the dioxin precursor analyses of the spent carbon feed samples performed by Radian/RTP are considered in Section 7.3.2; and the total chloride analyses of HCl train samples and process samples are considered in Section 7.3.3.

7.3.1 Dioxin/Furan Analyses

Two individual topics related to the dioxin/furan analyses at Site CRF-A are discussed in this section. Analytical recoveries of labeled surrogate compounds spiked onto MM5 train samples are reported in Section 7.3.1.1. Sample blank data are reported in Section 7.3.1.2.

7.3.1.1 Surrogate Recoveries of the Test Samples. Table 7-4 presents the analytical recovery data reported by Troika for four isotopically labeled surrogate compounds spiked onto the samples requiring dioxin/furan analysis. MM5 train samples were spiked with all four of the surrogates. Average surrogate recoveries the MM5 train samples was 89 percent for the spray cooler/baghouse inlet and 87 percent for the outlet. For the ambient train samples, the average recovery was 87 percent and for the blank samples the average recovery was 91 percent. These surrogate recovery values were within the Tier 4 QA criteria of 40 to 120 percent for the tetra-CDD surrogate and 40 to 120 percent for the hepta- and octa-CDD surrogates.

The baghouse ash samples were spiked with two isotopically labeled surrogate compounds. The average recovery of these compounds was 83 percent.

The spent carbon slurry samples were analyzed for dioxin/furan precursors and spiked with six isotopically labelled compounds. The analytical recovery efficiencies of these surrogate compounds are summarized in Table 7-5. The average recovery for the base neutral fractions was 60 percent and for the acids fractions was 16 percent.

Table 7-3. SUMMARY OF DRIFT CHECK AND CONTROL STANDARD RESULTS

			Drift Check			QC Standard			
Test Date	Test Run	Parameter	Input Concentration	Instrument Drift, %[a]	Meets QC?[b]	Input Concentration	Output Concentration	Difference From Running Mean, %	Meets QC?[c]
5/29/85	01	O_2	21.1% V	0.45	Yes	13.0% V	9.30	--	Yes
5/30/85	02	O_2	21.1% V	1.01	Yes	13.0% V	9.43	0.74	Yes
5/31/85	03	O_2	21.1% V	0.30	Yes	11.0% V	12.02	--[d]	Yes
5/29/85	01	CO	5580 ppmv	2.68	Yes	2006.0 ppmv	2166.0	--	Yes
5/30/85	02	CO	5580 ppmv	4.49	Yes	2006.0 ppmv	2217.9	1.15	Yes
5/31/85	03	CO	5170 ppmv	-1.03	Yes	2500.0 ppmv	2910.0	--[d]	Yes
5/29/85	01	CO_2	18.0% V	0.21	Yes	13.0% V	12.97	--	Yes
5/30/85	02	CO_2	18.0% V	1.98	Yes	13.0% V	12.90	-0.23	Yes
5/31/85	03	CO_2	18.0% V	9.75	Yes	9.7% V	9.79	--[d]	Yes
5/29/85	01	THC	90 ppmv	1.67	Yes	19.7 ppmv	19.96	--	Yes
5/30/85	02	THC	90 ppmv	5.00	Yes	19.7 ppmv	20.10	0.35	Yes
5/31/85	03	THC	90 ppmv	1.68	Yes	19.7 ppmv	19.37	-2.22	Yes

[a]Instrument drift is defined as the percent difference between the instrument drift response to the input concentration at the beginning and end of the test run.

[b]QC criteria was instrument drift within +/- 10 percent.

[c]QC criteria was output concentration within +/- 10 percent of the running mean concentration for this test site.

[d]Not available due to the fact that QC gas had to be chaned for calibration because original tank ran out.

logbook. All samples shipped to Troika or returned to Radian-RTP were also logged on chain-of-custody records that were signed by the field sample custodian upon shipment and also signed upon receipt at the laboratory. Each sample container lid was individually sealed to ensure that samples were not tampered with. No evidence of loss of sample integrity was reported for samples collected at this site.

7.2 CONTINUOUS MONITORING/MOLECULAR WEIGHT DETERMINATION

Flue gas parameters measured continuously at the outlet location during the MM5 test runs include CO, CO_2, O_2, total hydrocarbons (THC). The concentration of O_2, CO_2, and nitrogen (N_2) was also determined for integrated bag samples of the flue gas. Quality control results for these analyses are discussed in this section.

Drift check results for the continuously monitored flue gas parameters are summarized in Table 7-3. Data reduction was performed by assuming a linear drift of the instrument response over the test day based on drift checks at the beginning and end of the day. The largest calibration drifts were observed for the CO_2 analyzer, but did not exceed QC target goals for any test run. The smallest instrument drift was observed in the O_2 monitor.

The quality control standards for this program consisted of mid-range concentration standards that were intended for QC purposes and not for instrument calibration. The QC gases were analyzed immediately after calibration each day to provide data on day-to-day instrument variability. The acceptance criteria for the analysis of each QC standard was agreement within +/-10 percent (%) of the running mean value. This criteria was met for each of the monitored gases on each of the test days.

Molecular weight was determined by analyzing integrated bag samples of flue gas for O_2, CO_2, and N_2. Quality control for this analysis involved duplicate analyses of calibration gases immediately before and after sample analysis. Analysis of the calibration gases was repeated until two consecutive analyses within +/-5 percent were obtained. This same criteria of +/-5 percent applied to duplicate analyses required for sample quantification. These criteria were met for all molecular weight determinations.

Table 7-2. SUMMARY OF ISOKINETIC RESULTS

Run Number	MM5 Outlet[a] % Isokinetic	HCl Outlet[a] % Isokinetic	MM5 Inlet[a] % Isokinetic
01	109.9	105.3	95.0
02	102.0	104.3	93.4
03	100.4	97.9	94.9

[a]The quality assurance objective for MM5 and HCl sampling was isokinetics of 100±10 percent.

and #2. There may have been some obstruction under the pitot at these points during the first two tests.

In light of the Tier 4 Dioxin Testing Program objectives, it is not believed that the problems with the sampling locations will create any significant deviation between the sampling results and true stack concentrations of emissions.

A problem was encountered with one of the ambient sampling trains. It was also the train from which the resin trap was sent to Troika. The problem being that the bottom of the impinger broke during sampling on the second day. It is impossible to pinpoint the time of the break or the split in flow from the break and what may have been drawn through the resin trap. It is possible to determine a conservative estimate of the total cubic feet sampled by subtracting the cubic feet sampled during the time period of the break from the total cubic feet sampled during the test period. This procedure reduces the sampled volume from 12.66 dry standard cubic meters (DSCM) or 447.02 dry standard cubic feet (DSCDF) to 10.10 DSCM or 356.68 DSCF. If any dioxin is found by Troika this method will impart a slightly high bias to the ambient air values. At this time it is believed that this will not have more than a minor effect on the test results.

Results of the average isokinetic calculations for all the test runs are shown in Table 7-2. All the test runs fell within the required quality assurance value of 100±10 percent.

Initial, final and port change leak checks for the MM5 and HCl sample trains achieved the QA objectives for all of the test runs. None of the reported sample volumes required correction for sample train leakage. All leak check data were noted on the MM5 field data sheets.

7.1.3 Sample Custody

Sample custody procedures used during this program emphasized careful documentation of the samples collected and the use of chain-of-custody records for samples transported to the laboratory for analysis. Steps taken to identify and document samples collected included labeling each sample with a unique alphanumeric code and logging the sample in a master was maintained for the specific purpose of sample train assembly and recovery.

7.1.2 Procedural QC Activities/Manual Gas Sampling

Procedural QC activities during the manual gas sampling for dioxin/furan and HCl focused on:

- visual equipment inspections,
- utilization of sample train blanks,
- ensuring the proper location and number of traverse points,
- conducting pre-test and post-test sample train leak checks,
- maintaining proper temperatures at the filter housing, sorbent trap and impinger train,
- maintaining isokinetic sampling rates, and
- recording all data on preformatted field data sheets.

Unusual circumstances noted while carrying out the procedural QC activities are discussed below.

There were two inherent problems with the inlet sampling location. Number one was a build-up on the interior surface of the duct. This build-up was visible and fairly uneven. The interior diameter was estimated to be 43 inches. However, when sampling at the first two points into the stack it was noted that the temperatures were much lower than any of the other points. A theory, and only a theory, is that the probe was in a pocket of the slag or at least being shielded from the radiant heat. The second problem was the fact that there was only one sampling port which was horizontal into the horizontal duct. This could give a bias to the sample if there was stratification in the duct. It was not possible to have another vertical port installed due to the high temperature of the gas stream.

The outlet had one inherent problem. This was seen as a very low pitot reading at point B4 and B5 as compared to the rest of the sampling points. This was very noticeable from the data sheets during test #1

Table 7-1. GLASSWARE PRECLEANING PROCEDURE

NOTE: USE DISPOSABLE GLOVES AND ADEQUATE VENTILATION

1. Soak all glassware in hot soapy water (Alconox[R]) 50°C or higher.
2. Distilled/deionized H_2O rinse (X3).
3. Chromerge[R] rinse if glass, otherwise skip to 4.
4. High purity liquid chromatography grade H_2O rinse (X3).
5. Acetone rinse (X3), (pesticide grade).
6. Methylene chloride rinse (X3), (pesticide grade).
7. Cap glassware with clean glass plugs or methylene chloride rinsed aluminum foils.

[a](X3) = three times.

7.0 Quality Assurance/Quality Control (QA/QC)

This section summarizes results of quality assurance and quality control (QC/QC) activities for field sampling at Site CRF-A. Manual gas sampling methods are considered in Section 7.1, and continuous monitoring and molecular weight determinations are considered in Section 7.2

7.1 MANUAL GAS SAMPLING

Manual gas sampling methods at Site CRF-A included Modified Method 5 (MM5), EPA Methods 1 through 4, and HCl testing. These methods are discussed in Section 6.0. Quality assurance and quality control (QA/QC) activities for the manual sampling methods centered around (1) equipment calibration, (2) glassware pre-cleaning, (3) procedural QC checks and (4) sample custody procedures. Key activities and QC results in each of these areas are discussed in this section. Also discussed are problems encountered that may have affected data quality.

7.1.1 Equipment Calibration and Glassware Preparation

Pre-test calibrations or inspections were conducted on pitot tubes, sampling nozzles, temperature sensors and analytical balances. Both pre-test and post-test calibrations were performed on the dry gas meters. The calibration data sheets for Site CRF-A are included in Appendix D. All of the field test equipment met the calibration criteria specified in the Tier 4 Quality Assurance Project Plan (QAPP). Differences in the pre-test and post-test dry gas meter calibrations were less than 2.4 percent (%).

A pre-cleaning procedure was used for all sample train glassware and sample containers. This cleaning procedure, which is outlined in Table 7-1, was implemented to minimize the potential for sample contamination with substances that could interfere with the dioxin/furan analysis. To minimize the potential for contamination in the field, all sample train glassware was capped with foil prior to use. A sample trailer

6.4 TOTAL CHLORINE ANALYSIS

Total chlorine concentrations in feed samples were determined by Parr bomb combustion followed by ion chromatography (IC). A 0.5g sample was placed in the Parr bomb with 10 mL of a 50 g/L Na_2CO_3 solution. After combustion of the samples according to standard procedures (ASTM 2015), the contents of the bomb were rinsed into a 100 mL flask and diluted to 100 mL. The resulting solution was analyzed for chloride concentration (Cl^-) by IC using standard anion conditions. For samples difficult to combust (such as sludges), 25 drops of paraffin oils were added to the bomb prior to combustion.

TABLE 6-3. ANALYTICAL CONDITIONS FOR TOX ANALYSIS

Hall Detector Conditions

Reactor temperature - 850°C
Solvent - n-propanol
Hydrogen flow rate - 35 mL/min

GC Conditions (Varian 3700)

Injection volume (1 - 5 uL)
Helium carrier gas flow rate - 60 mL/min
Column - 3-ft packed column with 1 in 10% OV 101
Column temperature - 200°C isothermal

TABLE 6-2. COMPONENTS OF THE CALIBRATION SOLUTION

Base/Neutrals	Acids
4-chlorobiphenyl	2,5-dichlorophenol
3,3'-dichlorobiphenyl	2,3-dichlorophenol
2,4',5-trichlorobiphenyl	2,6-dichlorophenol
3,3'4,4'-tetrachlorobiphenyl	3,5-dichlorophenol
2,2',6,6'-tetrachlorobiphenyl	3,4-dichlorophenol
2,2,4,5,6-pentachlorobiphenyl	2,3,5-trichlorophenol
2,2',4,4',5,5'-hexachlorobiphenyl	2,3,6-trichlorophenol
2,2',3,4,4',5',6-heptachlorobiphenyl	3,4,5-trichlorophenol
2,2',3,3',4,4',5,5'-octachlorobiphenyl	2,4,5-trichlorophenol
2,2',3,3',4,4',5,6,6'-nonachlorobiphenyl	2,3,4-trichlorophenol
decachlorobiphenyl	2,3,5,6-tetrachlorophenol
p-dichlorobenzene	pentachlorophenol
1,2,4-trichlorobenzene	d_6-phenol (SS)
1,2,3,5-tetrachlorobenzene	d_4-2-chlorophenol (SS)
pentachlorobenzene	$^{13}C_6$-pentachlorophenol (SS)
hexachlorobenzene	d_8-naphthalene (QS)
d_4-1,4-dichlorobenzene (SS)[1]	2,4,6-tribromophenol (QS)
3-bromobiphenyl (SS)	d_{10}-phenanthrene (QS)
2,2',5,5'-tetrabromobiphenyl (SS)	d_{12}chrysene (QS)
2,2',4,4',6,6'-hexabromobiphenyl (SS)	
octachloronaphthalene (QS)[2]	
d_{10}-phenanthrene (QS)	
d_{12}-chrysene (QS)	

[1]Surrogate standard.

[2]Quantitation standard.

Components of the calibration solution are shown in Table 6-2. For multi-point calibrations, this solution was injected at levels of 10, 50, 100, and 150 ng/ml.

Compound identification was confirmed by comparison of chromatographic retention times and mass spectra of unknowns with retention times and mass spectra of reference compounds. Since the selected ion monitoring technique was necessary for the samples analyzed, care was taken to monitor a sufficiently wide mass region to avoid the potential for reporting false positives.

The instrument detection limit for the analytes of interest (i.e., CP, CB, and PCB) was estimated to be approximately 500 pg on column. For a 50 g sample and 100 percent recovery of the analyte, this corresponds to a feed sample detection limit of 10 ppb.

6.3 TOX ANALYSIS

Incinerator feed samples were analyzed for total organic halide (TOX) by short-column GC and a Hall detector (GC/Hall). Solid samples were extracted with benzene for at least 16 hours in a Soxhlet apparatus. The extracts were washed three times with 100 mL portions of reagent-grade water concentrated to 10 mL.

An attempt to use a fused silica capillary column to separate surrogates from target compounds was unsuccessful due to the complexity of the sample constituents. Determinations for TOX were therefore performed on samples without surrogates and no measure of extraction efficiency is available.

Instrument conditions are shown in Table 6-3. Sample quantitation was based on an average response factor developed from a mixture of chlorinated benzenes and brominated biphenyls. Individual CP, CB and PCBs were also injected at various concentrations to develop a calibration curve for comparison to the mixture response factors.

TABLE 6-1. ANALYTICAL CONDITIONS FOR THE GC/MS

Parameter	Chlorobenzenes/ Polychlorinated biphenyls	Chlorophenols
Column	30 m WB DB-5 (1.0 u film thickness) fused silica capillary	same
Injector Temperature	290°C	290°C
Separator Oven Temperature	290°C	290°C
Column Head Pressure	9 psi	9 psi
He flow rate	1 mL/min	1 mL/min
GC program	40(4)-290°C, 10°/ min & hold	40(1)-290°C, 12°/min & hold
Emission Current	0.50 mA	0.50 mA
Electron Energy	70 eV	70 eV
Injection Mode	Splitless 0.6 min, then 10:1 split	
Mode	Electron ionization, Selected Ion Monitoring	

Na_2SO_4, exchanged to hexane and concentrated. Final cleanup of the sample by column chromatography involved the following procedure.

A glass macro-column, 20 mm o.d. x 230 mm in length, tapered to 6 mm o.d. on one end was prepared. The column was packed with a plug of silanized glass wool, followed successively by 1.0 g silica, 2.0 g silica containing 33% (w/w) 1 <u>N</u> NaOH, and 2.0 g silica. After wetting the chromatography column with hexanes, the concentrated extract was quantitatively transferred to the column and eluted with 90 mL hexanes. The entire eluate was collected and concentrated to a volume of 1 mL in a centrifuge tube.

A disposable liquid chromatography mini-column was constructed by cutting off a 5-mL Pyrex disposable pipette at the 2.0 mL mark and packing the lower portion of the tube with a small plug of silanized glass wool, followed by 1 g of Woehlm basic alumina. The alumina had been previously activated for at least 16 hours at 600°C in a muffle furnace and cooled in a desiccator for 30 minutes just before use. The concentrated eluate from above was quantitatively transferred onto the liquid chromatography column. The centrifuge tube was rinsed consecutively with two 0.3-mL portions of a 3 percent $MeCl_2$: hexanes solution, and the rinses were transferred to the liquid chromatography column.

The liquid chromatography column was eluted with 20 mL of a 50 percent (v/v) $MeCl_2$:hexanes solution, and the eluate was concentrated to a volume of approximately 1 mL by heating the tubes in a water bath while passing a stream of prepurified N_2 over the solutions. The quantitation standard was added and the final volume was adjusted to 1.0 mL prior to GC/MS analysis.

6.2.1.2 <u>Analysis</u> Analyses for CP, CB and PCBs present in the feed sample extracts were performed with a Finnigan Model 5100 mass spectrometer using selected ion monitoring. A fused silica capillary column was used for chromatographic separation of the compounds of interest. Analytical conditions for the GC/MS analysis are shown in Table 6-1.

Tuning of the GC/MS was performed daily as specified in the Tier 4 QA Project Plan. An internal-standard calibration procedure was used for sample quantitation. Compounds of interest were calibrated against a fixed concentration of either d_{12}-chrysene (for CB, PCB) or d_8-naphthalene (for CP).

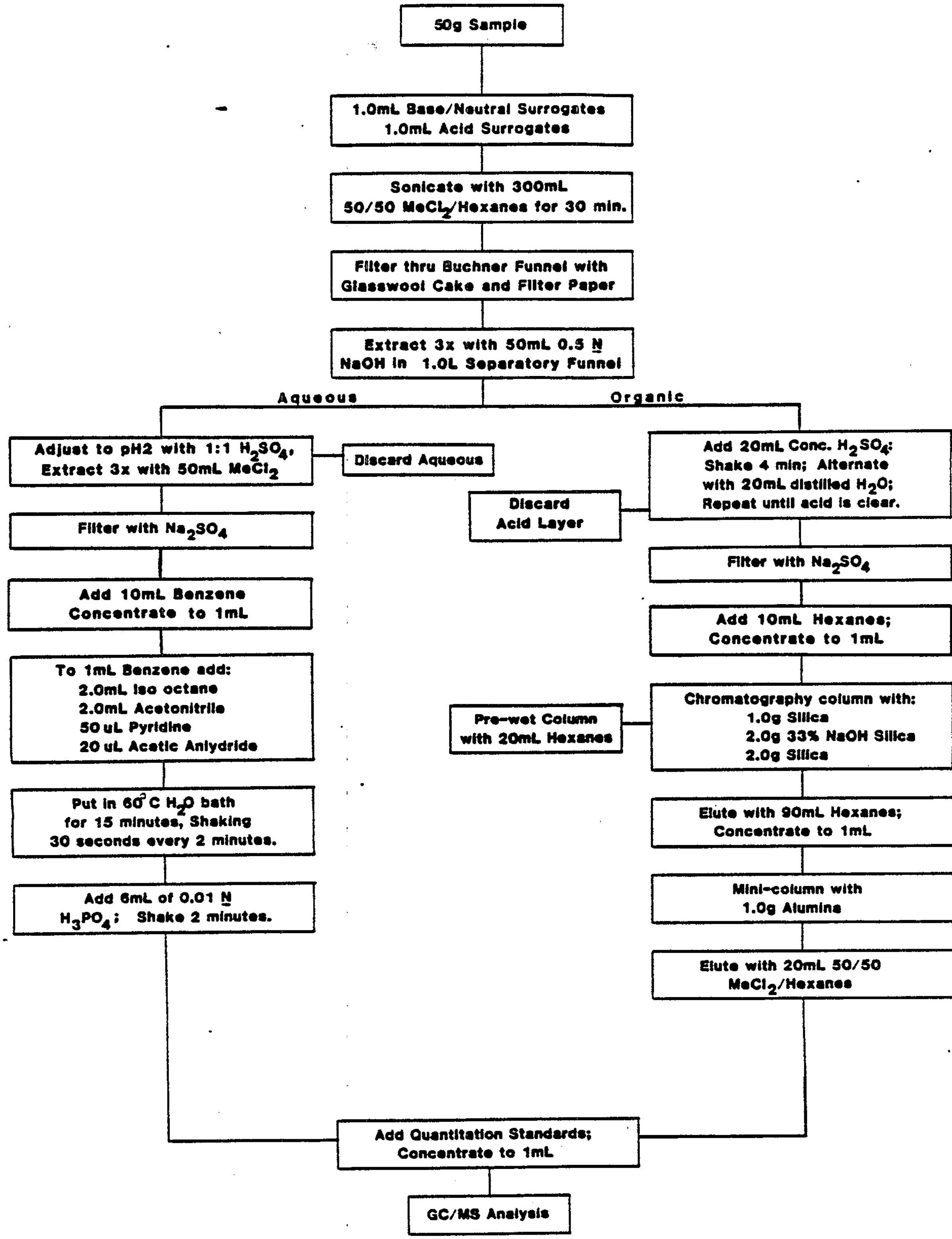


Figure 6-1. Sample preparation flow diagram for CRF-A precursor analyses.

are derivatized prior to injection. Details on the procedures used for Site 02 samples are provided in the sections below.

6.2.1.1 Sample Preparation A flow chart for the sample preparation procedure used for Site CRF-A feed samples is shown in Figure 6-1. The first step in the procedure involved adding labeled surrogate compounds to provide a measure of extraction method efficiency. The next step involved adding a mixture of 0.5 N NaOH and $MeCl_2$ to the sample and sonicating the sample for 30 minutes. The NaOH and $MeCl_2$ mixture converts the acid compounds to their salts and collects base/neutrals in the organic solvent. The sonicated sample was filtered and rinsed with 0.5 N NaOH. The filtrate was extracted three times in a separatory funnel with $MeCl_2$ and the aqueous and organic fractions were saved for derivatization and/or further cleanup. The aqueous fraction (or acids portion) was acidified to pH2 with HCl and then extracted three times with $MeCl_2$. The $MeCl_2$ from this extraction was dried with anhydrous Na_2SO_4, exchanged to benzene, and concentrated using a nitrogen blowdown apparatus. Acetylation of any CP present in the sample involved the following steps:

1. 2.0 mL isooctane, 2.0 mL acetonitrile, 50 uL pyridine, and 20 uL acetic anhydride were added to the extract. The test tube containing the extract was placed in a 60°C water bath for 15 minutes and was shaken 30 seconds every 2 minutes.

2. 6 mL of 0.01 N H_3PO_4 to the test tube, and the sample was agitated for 2 minutes on a wrist action shaker.

3. The organic layer was removed and the quantitation standard was added. The sample was concentrated in a Reacti-Vial at room temperature (using prepurified N_2) to 1 mL prior to GC/MS analysis.

Cleanup of the organic (or base/neutrals) layer from the first $MeCl_2$ extraction involved successively washing the extract with concentrated H_2SO_4 and deionized distilled water. The acid or water was added in a 30 mL portion and the sample was shaken for two minutes. After the aqueous (or acid) and organic layers were completely separated, the aqueous (or acid) layer was discarded. The acid washing procedure was repeated until the acid layer was colorless. The organic fraction from the final wash was dried with anhydrous was repeated three times, with the organic fractions ultimately being combined and concentrated for chromatographic cleanup.

The cleanup procedure involved using liquid chromatographic columns to separate the compounds of interest from other compounds present in the samples. Four different types of columns were used: a combination acid and base modified silica gel column, a basic alumina column, a PX-21 carbon/celite 545 column and a silica/diol micro column. These were used in successive steps, with the last two being used only if necessary.

The cleaned samples were analyzed using high resolution gas chromatography/high resolution mass spectrometry (GC/MS). Conditions for the analyses were as follows:

<u>Gas Chromatograph</u> - Injector configured for capillary column, splitless injection; injector temperature 280°C; helium carrier gas at 1.2 ml/min; initial column temperature 100°C: final column temperature 240°C; interface temperature 270°C.

<u>Mass Spectrometer</u> - Varian/MAT Model 311A; electron energy 70ev; filament emission 1mA; mass resolution 8000 to 10,000; ion source temperature 270°C.

6.2 DIOXIN/FURAN PRECURSORS

Feed samples for Site CRF-A were analyzed by Radian/RTP for chlorophenols (CP), chlorobenzenes (CB) and polychlorinated biphenyls (PCBs) by GC/MS; total organic halides (TOX) by GC/Hall detector; total chlorine by Parr bomb combustion followed by ion chromatography. Analytical procedures are discussed in the following sections.

6.2.1 GC/MS Analyses

The analytical procedures used for determining CP, CB, and PCB concentrations in feed samples are modified versions of procedures typically used for the analysis of MM5 train components. These procedures involve initial extraction of the sample with an appropriate solvent, preliminary separation of the compounds of interest by solvent partitioning and liquid chromatography, and analysis of the processed fractions. Solutions containing CB and PCB are injected directly into the GC/MS, and solutions containing CP

6.0 ANALYTICAL PROCEDURES

Laboratory procedures used to quantify dioxins/furans and dioxin/furan precursors in the Tier 4 samples are described in this section. MM5 train samples were analyzed by EPA's EMSL-RTP and ECl-Bay St. Louis laboratories for dioxin/furan content. Procedures used for these analyses are described in detail in the Analytical Procedures and QA Plan for the Analysis of Tetra-through Octa-CDD's and CDF's in Samples from Tier 4 Combustion and Incineration Processes (addendum to EPA/600/385-/019, April, 1985). These procedures are summarized in Section 6.1.

Combustion device feed samples from Site CRF-A were analyzed by Radian to determine concentrations of chlorinated phenols (CP), chlorobenzenes (CB), polychlorinated biphenyls (PCBs), total organic halogen (TOX) and total chlorine. Procedures used for these analyses are detailed in Section 6.2.

6.1 DIOXINS/FURANS

The analytical procedures summarized in this section were used by Troika for dioxin/furan analysis of MM5 train samples from Site CRF-A. Samples consisting of organic solvents, aqueous solutions, and solids were prepared for analysis using slightly different procedures. The organic solvent samples consisted of rinses from the MM5 probe, nozzle, filter housing and condenser coil. Aqueous samples consisted of impinger catch solutions, and solid samples included filters and XAD resin. Isotopically-labeled surrogate compounds were added to all samples prior to extraction to allow determination of method efficiency and for quantification purposes.

Organic liquid samples (e.g., acetone and methylene chloride-based MM5 train rinses) were concentrated using a nitrogen blowdown apparatus. The residue, which contained particulate matter from the MM5 train probe and nozzle, was combined with the filter and handled as a solid sample. Solid samples were extracted with benzene in a Soxhlet apparatus for a period of at least 16 hours. The extract was concentrated by nitrogen blowdown and subjected to chromatographic cleanup procedures.

Aqueous solutions (e.g., MM5 train impinger samples) were extracted with hexane by vigorous shaking for a three hour period. This extraction procedure

5.3.2 Reactivated Carbon Product

During each test day a 500 g composite of reactivated product was prepared from hourly grab samples. The grab sample was collected from a sampling chute located between the bottom hearth of the furnace and the product quench tank. The sample was collected hot into a 2 quart stainless steel can and was covered and placed in a bucket of water to quench the temperature of the sample. After cooling, the top half of the can contents was discarded and the remainder was placed into a large stainless steel bucket. At the end of the test day the grab samples were mixed well and a 500 g daily sample was prepared.

5.3.3 Baghouse Dust Sampling

During each test day, a 500 g composite sample of baghouse dust was prepared from individual hourly samples. The hourly samples were collected from the four dust storage boxes beneath the baghouse hoppers and composited in a large container. At the end of the test day the composite was thoroughly mixed, and a 500 g daily sample was prepared. These samples were shipped to Troika for dioxin/furan analysis.

The purposes of the continuous monitoring effort were to observe fluctuations in flue gas parameters, and provide an indication of combustion conditions. Sample acquisition was accomplished using an in-stack filter probe and Teflon[R] sample line connected to a mobile laboratory. The heat-traced sample line was maintained at a temperature of at least 120°C (250°F) to prevent condensation in the sample line. The stack gas sample was drawn through the filter and sample line using pumps located in the mobile laboratory. Sample gas analyzed for CO, CO_2, and O_2 was pumped through a sample gas conditioner which removes moisture and thus provides a dry gas stream for analysis. A separate unconditioned gas stream was supplied to the THC analyzer for analysis on a wet basis.

An Anarad Model 412 nondispersive infrared analyzer was used to measure CO and CO_2; a Beckman model 755 paramagnetic analyzer was used to measure O_2; and a Beckman Model 402 flame ionization analyzer was used to measure THC.

5.3 SOLID SAMPLING

At Site CRF-A, solid samples were collected of spent carbon feed, reactivated carbon, and baghouse dust. The sampling locations and methods are discussed in the following sections.

5.3.1 Feed Sampling

Three composite samples of the spent carbon slurry were prepared from individual hourly samples during each test day. The hourly samples were collected from a tap valve prior to the one-hour surge tank that feeds the furnace. Spent carbon slurry leaving the tap valve was screened with a 50 mesh shovel to remove excess water, and the screened sample was placed in a container for compositing. At the end of the test day the composite was thoroughly mixed, and three samples were prepared. A 500 g sample was sent to Troika for dioxin/furan analysis, another 500 g sample was returned to Radian/RTP for dioxin precursor analysis, and a 100 g sample was shipped to Radian/Austin for total chloride analysis.

Recovery of the ambient XAD sample trains was performed in a manner similar to that of the MM5 train. The probes were rinsed with acetone and methylene chloride three times each, and this rinse and the condensate (if any) were stored in a single sample container. The sorbent trap was capped with ground glass caps. The ambient air sample consists of the rinse and the sorbent trap. The samples were shipped from the field to Troika for dioxin/furan analysis and returned to Radian for dioxin precursor analysis.

5.2.2.4 Volumetric Gas Flow Rate Determination. The volumetric gas flow rate was determined using EPA Method 2. Based on this method, the volumetric gas flow rate is determined by measuring the average velocity of the flue gas an the cross-sectional area of the duct. The average flue gas velocity is calculated from the average gas velocity pressure (P) across an S-type pitot tube, the average flue gas temperature, the wet molecular weight, and the absolute static pressure.

5.2.2.5 Flue Gas Moisture Determination. The moisture content of the flue gas was determined using EPA Method 4. Bsaed on this method, a known volume of particulate-free gas was pulled through a chilled impinger train. The quantity of condensed water was determined gravimetrically and then related to the volume of gas sample to determine the moisture content.

5.2.2.6 Flue Gas Molecular Weight Determination. The integrated sampling technique described in EPA Method 3 was used to obtain a composite flue gas sample for fixed gas (O_2, CO_2, N_2) analysis. The fixed gas analysis was used to determine the molecular weight of the gas stream. A small diaphragm pump and a stainless steel probe were used to extract single point flue gas samples. The samples were collected at the sampling ports using Tedlar[R] bags. Moisture was removed from the gas sample by a water-cooled condenser so that the fixed gas analysis would be on a dry basis.

The composition of the gas sample was determined using a Shimadzu Model 3Bt analyzer instead of the Fyrite or Orsat analyzer prescribed in Method 3. The Shimadzu instrument employs a gas chromatograph and a thermal conductivity detector to determine the fixed gas composition of the sample.

5.2.2.7 Continuous Emissions Monitoring. Continuous emissions monitoring was performed in the exhaust stack for O_2, CO_2, CO and THC throughout the period that dioxin sampling was being conducted each test day.

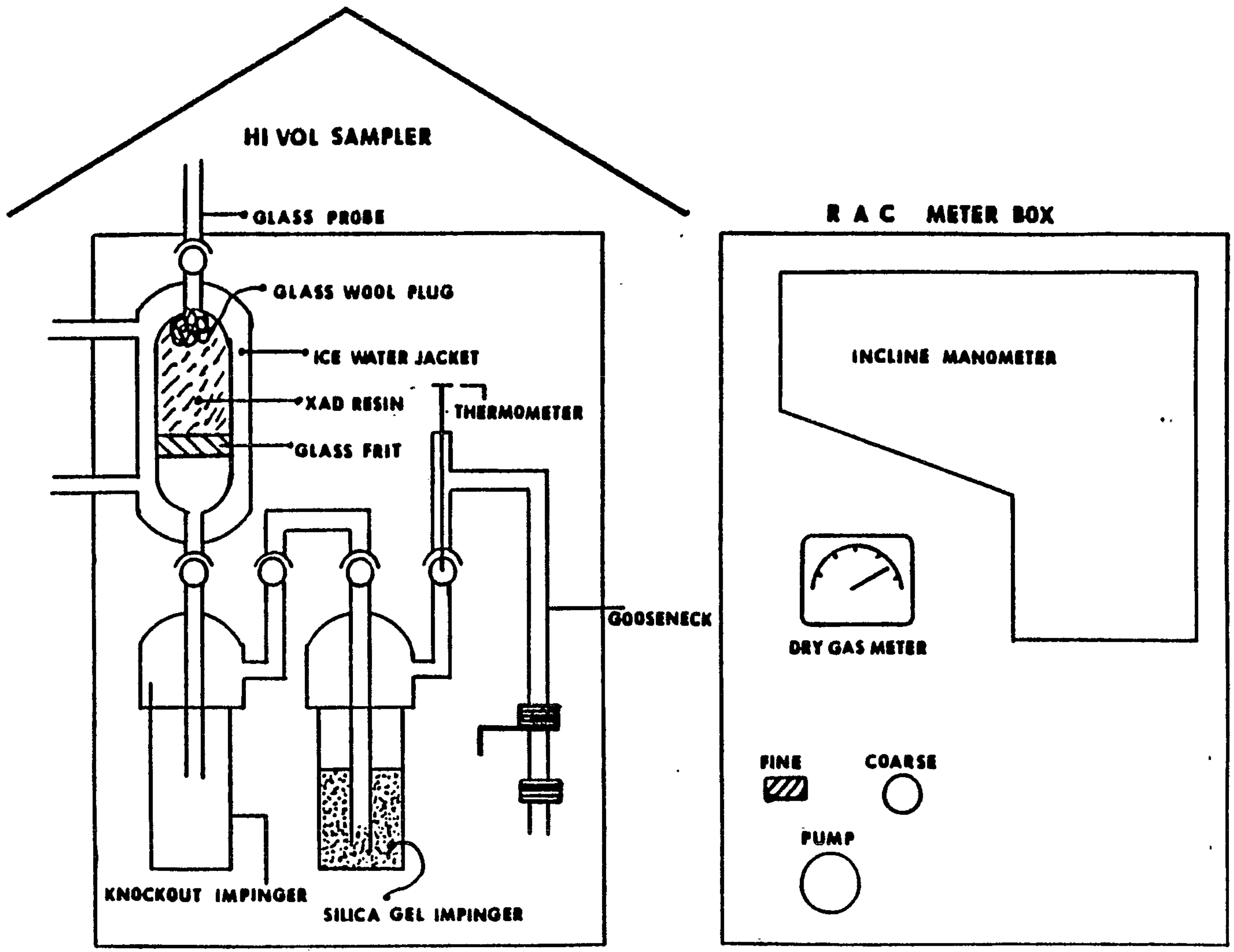


Figure 5-6. Components of ambient air sampling train.

5.2.2.2 HCl Determination. HCl concentration in the baghouse outlet exhaust stack was determined using another modification of EPA Method 5. The sample train components and operation were identical to those of EPA Method 5 with the following exceptions:

1. Water in the first two impingers was replaced with 0.1 NaOH.
2. Sampling was single point isokinetic with the nozzle placed at a point in the stack with approximate average velocity.
3. The moisture/NaOH in the impingers was saved for laboratory analysis by ion chromatography. The impinger catch was analyzed for total chlorides by Radian.
4. The sampling period was 120 minutes for Runs 01 and 02, and 60 minutes for Run 03.

Recovery of the HCl train provided a sample consisting of three components: probe rinse, filter, and back-half rinse/impinger catch. These components were shipped from the field to Radian's Austin, Texas laboratory where they were analyzed for HCl.

5.2.2.3 Ambient Air Sampling. A schematic diagram of the "ambient XAD" sample train is shown in Figure 5-6. The ambient train consisted of a short glass probe, sorbent trap, knockout impinger (optional) silica gel impinger, umbilical line, pump, and dry gas meter. Ambient air was drawn into the sorbent module, where is was cooled to $20^{o}C$ ($68^{o}F$) or lower, and the organic constituents were adsorbed by the XAD resin. The gas was then dried with the silica gel and the sample volume measured by the dry gas meter.

Both ambient XAD sample trains were leak tested before and after each test run at 2.5 kPa (10 inches H_2O) to ensure that the total leakage was less than 0.02 cfm. The dry gas meter reading was recorded twice daily at the beginning and end of each test period. The dry gas meter temperature, ice bath temperatures, pressure, and volume were recorded once per hour during the sampling periods. Although the sampling pump was only operated during MM5 sampling, the sorbent traps were cooled continuously (24 hours/day) to $20^{o}C$ ($68^{o}F$) or lower.

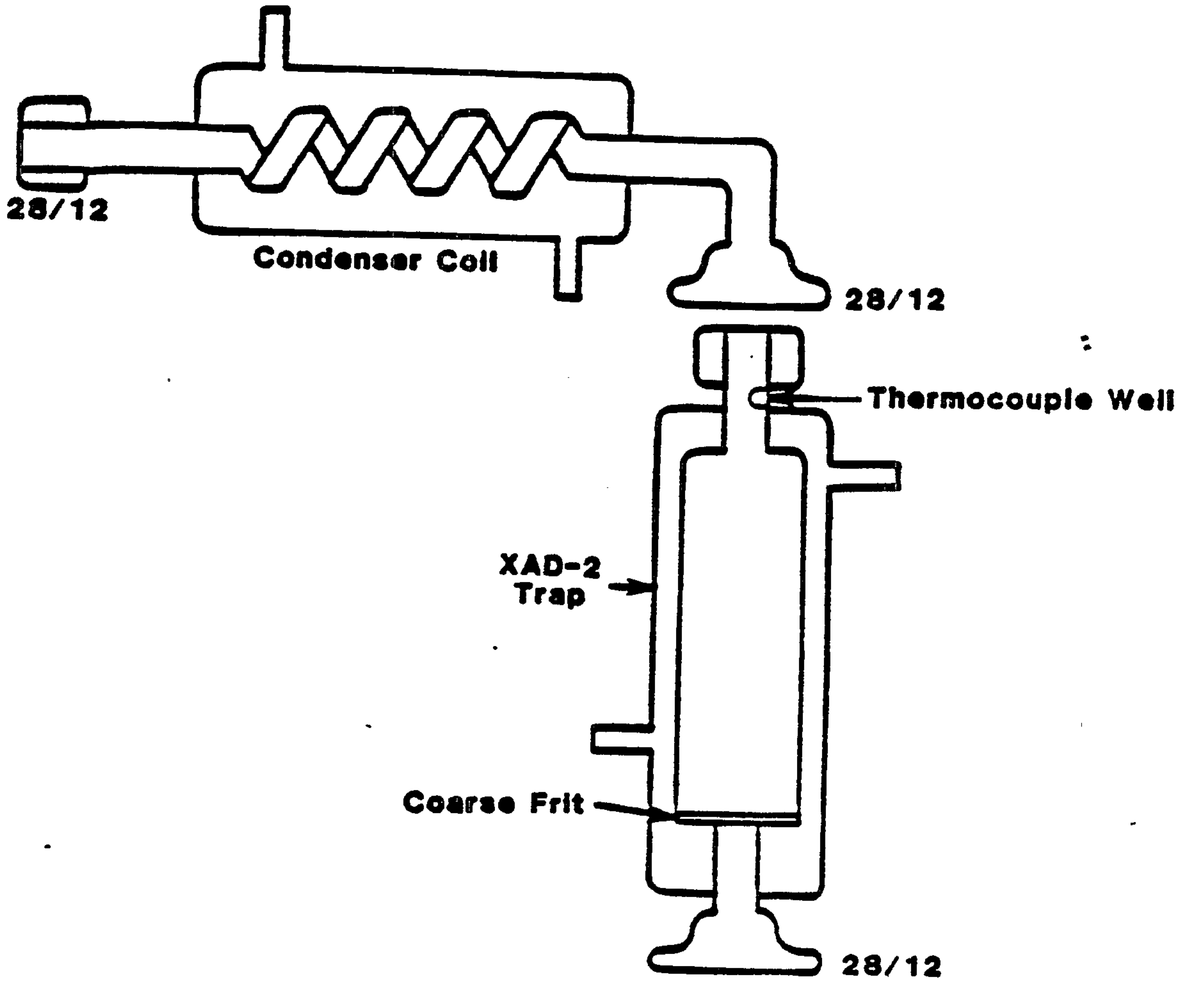


Figure 5-5. Adsorbent sampling system.

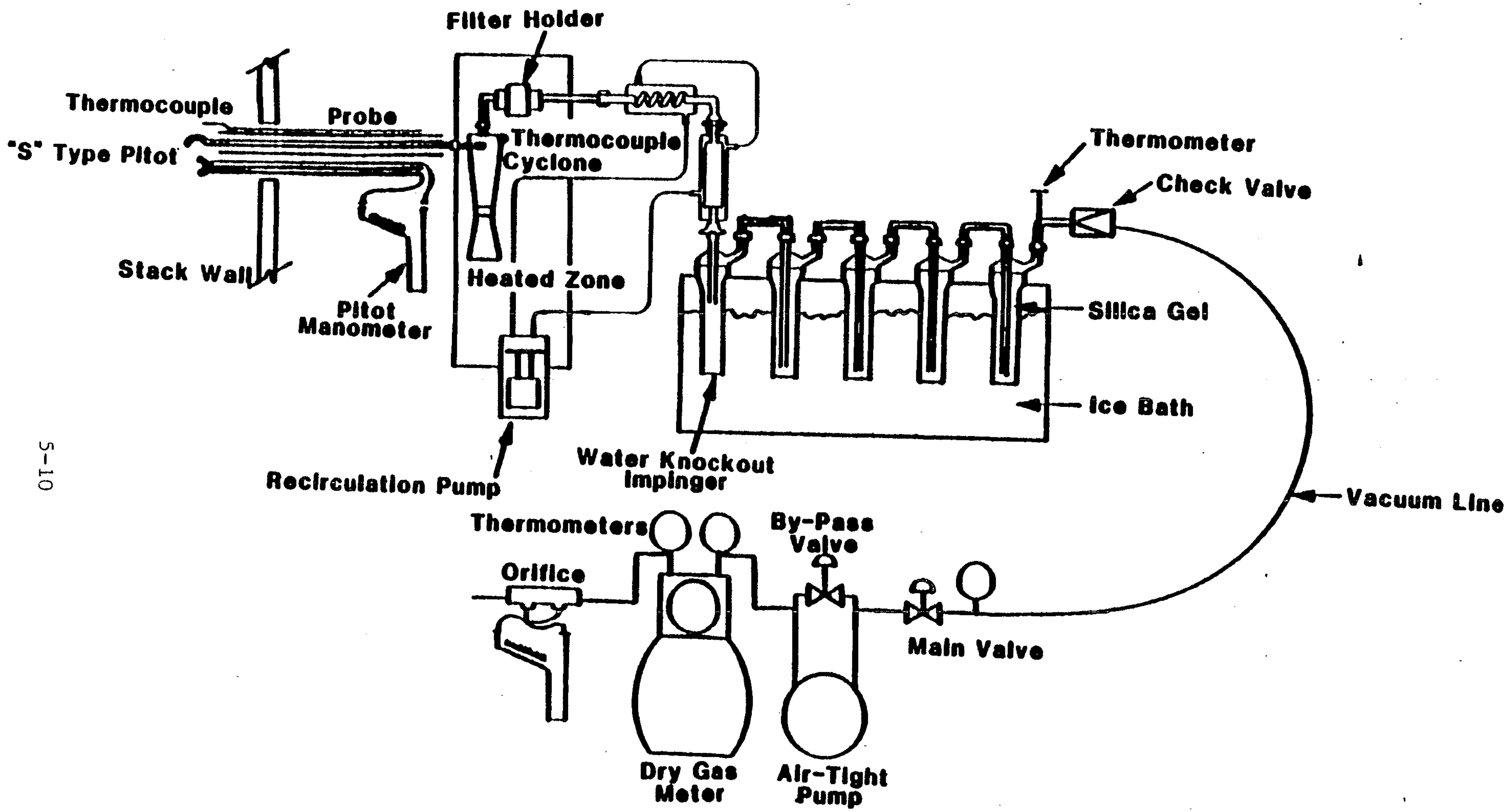


Figure 5-4. Modified Method 5 train.

version of EPA Method 5 that includes a solid sorbent module for trapping vapor phase organics. The only differences in the sampling protocol which were not discussed in the Tier 4 QAPP are as follows:

1. Benzene was substituted for hexane or toluene as both the cleanup and extractant solvent for both the MM5 filters and the XAD-2 resin. This was caused by a discrepancy between the draft ASME sampling protocol and the draft ASME analytical protocol. (November 16, 1985)

2. Methylene chloride was substituted for hexane as the final field rinse solvent for the MM5 train. Methylene chloride was also substituted for hexane in the glassware cleaning procedure. This was caused by a high field train blank. (February 27, 1985)

The MM5 samples were collected isokinetically over a 4-hour sampling period at the exhaust stack location in order to provide a sample volume greater than the minimum of 3.4 dscm (120 dscf). At the spray cooler inlet, the MM5 samples were collected isokinetically over a 4 hour sampling period to provide a sample volume greater than the minimum of 2.5 dscm (90 dscf). The MM5 sampling rates at both locations were between 0.014 to 0.021 scmm (0.5 and 0.75 scfm).

Following sample recovery, the various parts of the sample (filter, solvent rinses, sorbent trap, etc.) were sent to the EPA's EMSL-RTP and ECL, Bay St Louis ~~Troika~~ laboratories to quantify 2,3,7,8-TCDD, the tetra- through octa-PCDD homologues, and the tetra- through octa-PCDF homologues present in the samples.

A schematic diagram of the MM5 sampling train is shown in Figure 5-4. Flue gas was pulled from the stack through a nozzle and a glass-lined probe. Particulate matter was removed from the gas stream by means of a glass fiber filter housed in a Teflon-sealed glass filter holder maintained at $120^{o}C \pm 14^{o}C$ ($248^{o}F \pm 25^{o}F$). The gas passed through a sorbent trap similar to that illustrated in Figure 5-5 for removal of organic constituents. The trap consisted of separate sections for 1) cooling the gas stream, and 2) adsorbing the organic compounds on Amberlite XAD-2^{R} resin (XAD). A chilled impinger train following the sorbent trap was used to remove water from the flue gas, and a dry gas meter is used to measure the sample gas flow.

Table 5-2. Summary of Gas Sampling Methods Used at Site CRF-A

Sample Location	Sample Type or Parameter	Sample Collection Method
Baghouse Outlet Exhaust Stack (Point A in Fig. 5-1)	Dioxin/furan	Modified EPA Method 5
	Volumetric flow	EPA Method 2
	Molecular weight	EPA Method 3
	Moisture	EPA Method 4
	HCl	HCl Train
	CO, CO_2, O_2, NO_x, SO_2, and THC monitoring	Continuous Monitors
Spray Cooler Inlet (Afterburner Outlet, Point B in Fig. 5-1)	Dioxin/furan	Modified EPA Method 5
	Volumetric flow	EPA Method 2
	Molecular Weight	EPA Method 3
	Moisture	EPA Method 4
Multiple-Hearth Furnace Outlet (Afterburner Inlet, Point C in Fig. 5-1)	Molecular Weight	EPA Method 3
Ambient Air Sampling (Near Atomizing Air Intake, Point D in Fig. 5-1)	Dioxin/furan	Ambient Air Train
	Dioxin precursors	Ambient Air Train

is located on the side of the duct. The port was approximately 11.0 m (9.8 duct diameters) downstream of a 90^0 bend leading from the main afterburner section and 1.3 m (1.1 duct diameters) upstream of a 90^0 bend leading to the spray cooler. According to EPA Method 1, a minimum of 16 traverse points were required for a two-dimensional particulate traverse. However, since only one sample port was available the complete traverse was not possible. Twelve traverse points located across the diameter of the duct were used, and sampling was carried out for 20 minutes per point for an on-line sampling period of 240 minutes. A water-cooled probe was required because of the high temperature of the gas stream.

5.2.1.3 Multiple Hearth Furnace Outlet (Afterburner Inlet). The multiple hearth furnace outlet (afterburner inlet) sampling location is shown as Point C in Figure 5-1. This location was used only for integrated bag sampling to develop information on excess air conditions at the furnace exhaust. A single 2-inch diameter sample port is located in the exhaust gas breeching leading from the multiple hearth furnace to the afterburner. The sample port was accessible by standing on the grating above the furnace. Integrated bag samples were taken from the sample port twice per test run and analyzed for oxygen, CO, CO_2, and N_2 using a gas chromatograph with a thermal conductivity detector.

5.2.1.4 Ambient Air Sampling. The ambient atomizing air added to the afterburner exhaust gas in the spray cooler was sampled for dioxin/furan and dioxin precursors. The ambient atomizing air sampling location is shown as Point D in Figure 5-1. The trains were positioned on a platform on the spray cooler near the atomizing air intake point. The platform was approximately 30 feet above grade level.

5.2.2 Gas Sampling Procedures

Gas sampling procedures used during this program are discussed in detail in the Tier 4 QAPP.[1] A summary of the gas sampling methods used at Site CRF-A is given in Table 5-2, and a brief description of each method is provided in the following sections.

5.2.2.1 Modified Method 5 (MM5). Gas sampling for dioxins was conducted according to the October 1984 draft of the ASME chlorinated organic compound sampling protocol with two exceptions. This sampling method is a modified

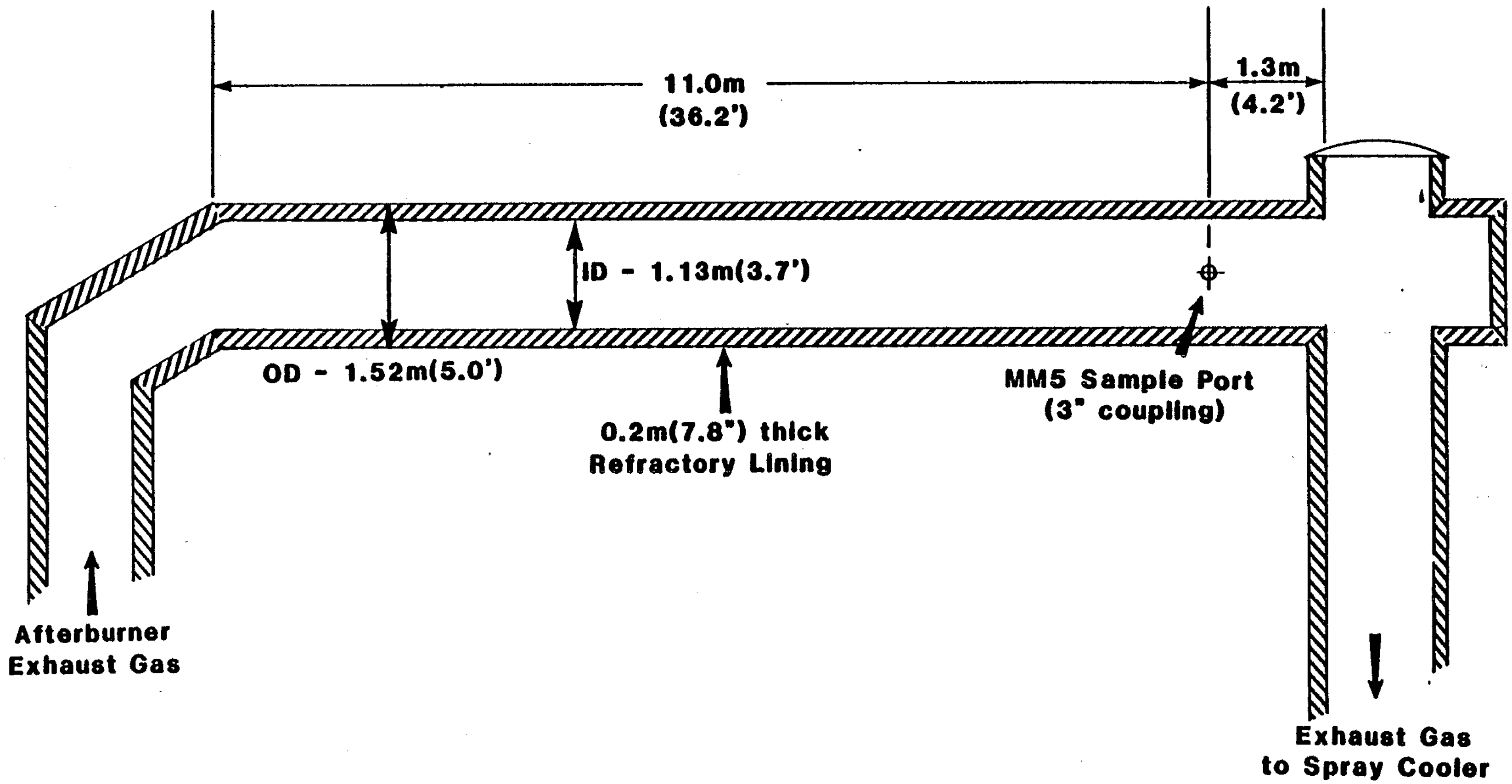


Figure 5-3. Spray Cooler Inlet (Afterburner Outlet) Sampling Location.

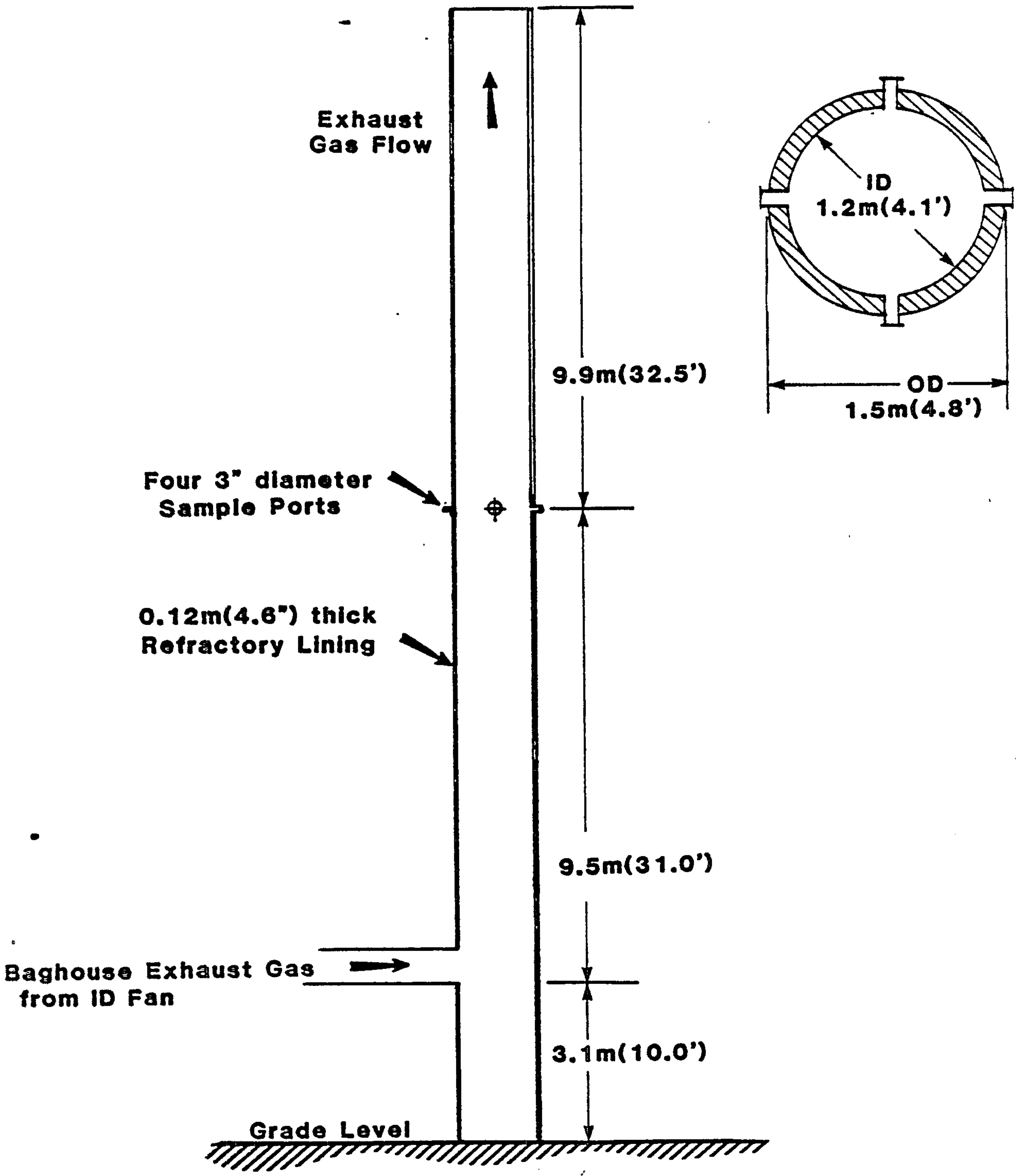


Figure 5-2. Baghouse Outlet Exhaust Stack Sampling Location.

according to MM5 procedures described in Section 4.2.2, and also for continuous monitoring of O_2, CO, CO_2, and THC. EPA Methods 2, 3, and 4 were performed to determine the volumetric flow rate, molecular weight of the exhaust gas, and moisture content of the exhaust gas, respectively.

The sample port locations and dimensions are shown in Figure 5-2. The inside diameter of the stack was 1.2 m (4.1 ft). Four, 3 inch diameter sample ports with 3 inch long nipples were oriented 90' apart at a sample platform located approximately 12.6 m (40 ft) above grade level. The sample ports were approximately 9.5 m (7.6 duct diameters) downstream of the breaching where the exhaust from the baghouse ID fan enters the stack, and 9.9 m (7.9 duct diameters) upstream of the top of the stack. According to EPA Method 1, a minimum of 20 traverse points were required. In this case, 24 traverse points were used, and sampling was conducted for 10 minutes per traverse point for a total of 240 minutes of on-line sampling. Two of the four ports were used for the traverse.

Samples for HCl measurement were collected at a single point. The nozzle was located at a point of approximately average velocity and the sample was collected isokinetically over a period of 120 minutes.

Continuous monitoring was performed at this location using a port not in service for the dioxin/furan or HCl trains. Due to limited space at the plant, the mobile laboratory housing the continuous monitoring instruments was located approximately 38 m (125 ft) from the base of the exhaust stack. The length of heat-traced sample line needed to access the mobile laboratory from the stack was approximately 53 m (175 ft).

5.2.1.2 Spray Cooler Inlet (Afterburner Outlet). The spray cooler inlet sampling location (i.e., afterburner outlet) is shown as Point B on Figure 5.1.

This sampling location consisted of a single 3 inch diameter sample port located near the downstream end of a long horizontal run of circular, refractory-lined duct. The duct was considered by the host plant to be part of the afterburner because of the elevated temperatures and the presence of available oxygen (1 to 5 percent O_2 by volume). Dimensions of the sampling location are shown in Figure 5-3. The outside diameter of the duct was 1.5 m (5.0 ft) and the inside diameter was 1.1 m (3.7 ft). The 3 inch sample port

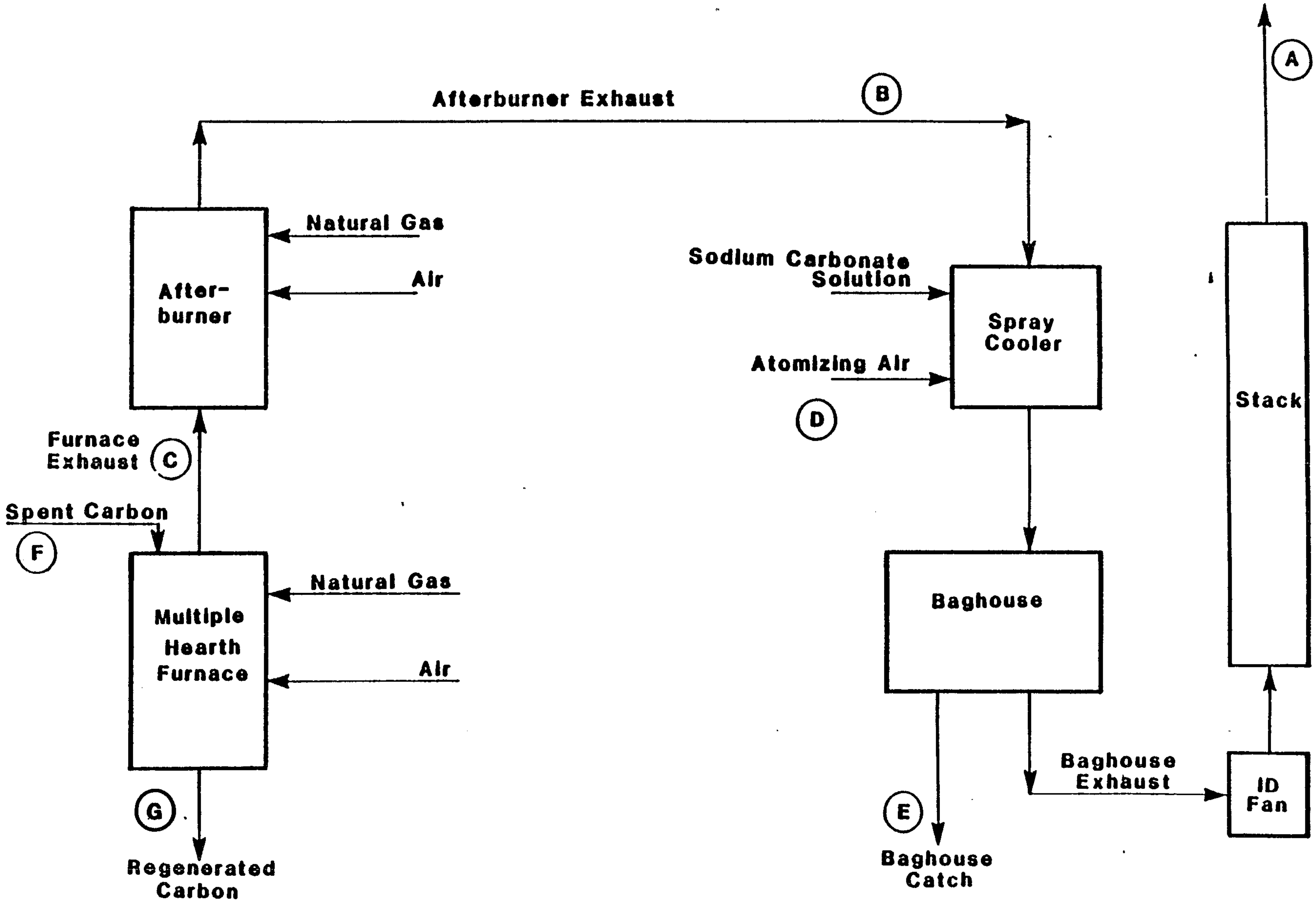


Figure 5-1. Sample Point Diagram for Carbon Regeneration Furnace CRF-A.

TABLE 5-1. SOURCE SAMPLING AND ANALYSIS MATRIX FOR SITE CRF-A

Sample Location Description	Location Identification[a]	Sample Type	Number of Samples	Distribution of Samples[b,c]	Analysis[d,e,f]
Gaseous Samples					
1. Baghouse Outlet Exhaust Stack	A	MM5 Dioxin	3 sets of 6	3 sets to Troika	Dioxin/furan
		MM5 Field Recovery Blank	1 set of 6	1 set to Troika	Dioxin/furan
		MM5 Lab Train Blank	1 set of 6	1 set to Troika	Dioxin/furan
		MM5 Solvent Blank	1 set of 3	1 set to Troika	Dioxin/furan
		HCl Train	3 sets of 3	3 sets to Radian	HCl
		HCl Train Blank	1 set of 3	1 set to Radian	HCl
		EPA Methods 2,4	3 sets	--	Gas Flow, H_2O
		EPA Method 3	3 sets of 2	Field analysis	N_2, O_2, CO_2
		Continuous Monitoring	3 sets	--	CO, CO_2, O_2, THC, NO_x, SO_2,
2. Spray Cooler Inlet (Afterburner Outlet)	B	MM5 Dioxin	3 sets of 6	3 sets to Troika	Dioxin/furan
		MM5 Field Recovery Blank	1 set of 6	1 set to Troika	Dioxin/furan
		EPA Methods 2,4	3 sets	--	Gas Flow, H_2O
		EPA Method 3	3 sets of 2	Field analysis	N_2, O_2, CO_2
3. Multiple-Hearth Furnace Outlet (Afterburner Inlet)	C	EPA Method 3	3 sets of 2	Field analysis	N_2, O_2, CO_2
4. Ambient Air Near Spray Cooler	D	Ambient XAD Train	2 sets of 2	1 set to Troika 1 set to Radian	Dioxin/furan Dioxin precursors
Solid Samples					
5. Baghouse Hopper	E	One 500g composite of hourly grab samples per test	1 set of 3	1 set to Troika	Dioxin/furan
6. Spent Carbon Feed to Furnace	F	Two 500g composites of hourly grab samples per test.	2 sets of 3	1 set to Troika 1 set to Radian	Dioxin/furan Dioxin precursors
		One 100g composite of hourly grab samples per test.	1 set of 3	1 set to Radian	Total chloride
7. Reactivated Carbon Product	G	One 500g composite of hourly grab samples per test.	1 set of 3	1 set to Troika	Dioxin/furan

[a] Location identifications as shown in Figure 5-1.
[b] Troika refers to the ERL-Duluth, ECL-Bay St. Louis, and EMSL-Research Triangle Park EPA laboratories as a collective unit.
[c] Radian refers to Radian's laboratory in Research Triangle Park, N.C.
[d] Dioxin means that 2,3,7,8-TCDD and tetra- through octa-dioxin homologue analyses were performed.
[e] Dioxin Precursors means that Cl-phenols, Cl-benzenes, PCB, and total chlorine analyses were performed.
[f] Archive means that samples were stored for possible future dioxin and/or dioxin precursor analyses.

5.0 SAMPLING LOCATIONS AND PROCEDURES

Samples were collected from seven different locations at Site CRF-A. Four of the locations were for gaseous sampling and three were for solids sampling. The test matrix is described in Section 5.1, and the process data collection procedures are described in Section 5.2. The sampling locations and procedures are presented in Sections 5.3 and 5.4, respectively.

5.1 TEST DESCRIPTION

The source sampling and analytical matrix used at Site CRF-A is shown in Table 5-1, and the sampling locations are identified in Figure 5-1. Three test runs (Runs 01-03) were performed on three contiguous days. During each run, dioxin/furan samples were collected at the afterburner exhaust and after the spray dryer/baghouse system. Also at the baghouse outlet exhaust stack, samples were collected for total chloride measurement and continuous monitoring of combustion gases was conducted. Samples collected at the furnace exhaust, afterburner exhaust, and baghouse stack were analyzed for gas molecular weight calculations. During each emission test series, samples of the spent carbon feed, reactivated carbon product, and baghouse dust were collected for dioxin/furan or precursor analysis. The furnace operating conditions were documented during each run by recording key variables. The measurements, locations and procedures used are discussed in detail below.

5.2 GASEOUS SAMPLING

Four types of gaseous samples were taken during this test program: Modified Method 5 (MM5), HCl, EPA Method 3, and continuous emissions monitoring (CEM). The sampling locations and methods are further discussed in this section.

5.2.1 Gaseous Sampling Locations

5.2.1.1 Baghouse Outlet Exhaust Stack. The exhaust stack sampling location for the carbon regeneration furnace baghouse is shown as Point A in Figure 5-1. This location was used for dioxin/furan sampling and HCl sampling

TABLE 4-20. AMBIENT DIOXIN/FURAN CONCENTRATIONS IN VICINITY OF ATOMIZING AIR INTAKE POINT TO SPRAY COOLER

Homologue	ng/dscm
Dioxins	
2378 TCDD	ND (0.01)
Other TCDD	ND (0.01)
Penta-CDD	ND (0.01)
Hexa-CDD	ND (0.02)
Hepta-CDD	ND (0.03)
Octa-CDD	0.02
Total PCDD	0.02
Furans	
2378 TCDF	NR
Other TCDF	0.04
Penta-CDF	ND (0.02)
Hexa-CDf	ND (0.01)
Hepta-CDF	ND (0.01)
Octa-CDF	ND (0.02)
Total PCDF	0.04

ND = not detected, minimum detection limit is indicated in parenthesis.

NR = not reported by Troika.

TABLE 4-19. RESULTS OF DIOXIN/FURAN ANALYSIS OF BAGHOUSE ASH SAMPLES AT SITE CRF-A

Homologue	Parts per Billion (ppb) Run 1	Run 2	Run 3	Average
<u>Dioxins</u>				
2378 TCDD	NR	NR	ND (0.01)	ND
Other TCDD	0.2	0.1	0.1	0.1
Penta-CDD	0.2	0.2	0.1	0.2
Hexa-CDD	0.4	0.4	0.3	0.4
Hepta-CDD	0.3	0.3	0.3	0.3
Octa-CDD	0.1	0.1	0.2	0.1
Total PCDD	1.2	1.1	1.0	1.1
<u>Furans</u>				
2378 TCDF	NR	NR	ND (0.03)	ND
Other TCDF	0.3	0.4	0.3	0.3
Penta-CDF	0.1	0.2	0.06	0.1
Hexa-CDF	ND (0.02)	ND (0.04)	0.1	0.05
Hepta-CDF	ND (0.05)	0.04	ND (0.06)	ND
Octa-CDF	ND (0.05)	0.03	0.02	0.03
Total PCDF	0.4	0.7	0.5	0.5

NR = not reported by Troika.

ND = not detected, minium detection limit is in parenthesis.

4.8 DIOXIN/FURAN RESULTS OF BAGHOUSE ASH

The results of the dioxin/furan analysis of the baghouse ash samples are summarized in Table 4-19. 2378 TCDD and 2378 TCDF were not detected in the baghouse ash. Hexa-CDF, hepta-CDF and octa-CDF were not detected in some runs and were close to the detection limit in other runs. The total average PCDD and total average PCDF were 1.1 ppb and 0.5 ppb, respectively. The results were consistent between runs.

4.9 DIOXIN/FURAN RESULTS AND PRECURSOR RESULTS OF AMBIENT AIR SAMPLING

The ambient air in the general vicinity of the atomizing air intake point to the spray cooler was sampled for dioxin/furans. The sample was a composite taken over the three day test period. The results of the dioxin/furan analysis are summarized in Table 4-20. A small amount of octa-CDD and tetra-CDF were detected, but at concentrations very near the detection limit. Total PCDD was measured at 0.02 ng/dscm (0.001 ppt) and total PCDF was measured at 0.04 ng/dscm (0.003 ppt).

Due to a broken impinger in the ambient air train on the second date of sampling, the sample volume was adjusted. Approximately 20 percent of the sample volume was believed to have not been drawn through the sorbent module. Therefore, these dioxin/furan concentrations may have a slightly high bias.

4.10 DIOXIN/FURAN RESULTS OF SOIL SAMPLING

The soil sample was archived pending evaluation of analytical data.

4.11 DIOXIN/FURAN RESULTS OF REACTIVATED CARBON SAMPLING

The reactivated carbon sample was archived pending evaluation of analytical data.

TABLE 4-18. CHLORIDE CONCENTRATIONS AT THE OUTLET STACK FOR SITE CRF-A

Sample Component	Test Run	mg/dscm	ppmv[a]	mg/dscm @ 3% O_2	Emissions Rate (kg/hr)
Train Total	01	1.049	0.71	1.72	0.023
	02	1.707	1.16	2.89	0.040
	03	2.019	1.37	5.65	0.056
	Average	1.592	1.08	3.44	0.040
Front Half	01	0.588	0.399	0.97	0.013
	02	1.043	0.708	1.76	0.024
	03	0.878	0.596	2.46	0.024
	Average	0.836	0.568	1.73	0.023
Back Half	01	0.461	0.313	0.76	0.010
	02	0.664	0.451	1.12	0.016
	03	1.141	0.775	3.19	0.032
	Average	0.755	0.513	1.69	0.019

[a]ppmv = parts per million chloride by volume, dry basis at actual stack oxygen concentration.

[b]Concentration corrected to 3% O_2 using the following correction factor:

$(20.9 - 3) \div (20.9 - \%O_2 \text{ measured})$

Oxygen values are from Radian CEM data in Table 4-7.

TABLE 4-17. SUMMARY OF DIOXIN PRECURSOR DATA FOR SITE CRF-A FEED SAMPLES

Precursor Categories	Precursor Concentration, ug/g (ppm) Spent Carbon Feed Samples			
	Run 1	Run 2	Run 3	Average
Total Chlorinated Benzenes[a]	1.76	0.16	6.63	2.85
Total Chlorinated Biphenyls	0	0	0	0
Total Chlorinated Phenols	0	0	0	0
Total Chlorides	4950	8387	5900	6400
Total Organic Halogen (TOX)	NA	NA	154	154

[a]Mostly trichlorobenzenes were detected with a small amount of dichlorobenzenes and tetrachlorobenzenes. See Appendix E for compound-specific data.
NA = not analyzed.

which when present in the feed will contribute to the formation of dioxin/furans during combustion.

The results of the precursor analyses are summarized in Table 4-17. Chlorinated biphenyls and chlorinated phenols were not detected in the feed samples, but an average of 2.9 ppm of chlorinated benzenes were detected. Mostly trichlorobenzenes were detected with a small amount of dichlorobenzenes and tetrachlorobenzenes. The compound-specific precursor results are included in Appendix E. Run 03 carbon feed samples contained significantly more chlorobenzenes (6.6 ppm) then Run 01 or Runs 02 samples (1.8 and 0.2 ppm, respectively)

The average chlorides content of the spent carbon slurry was 6400 ppm. Also, the total organic halogen (TOX) analysis detected 154 ug/g of TOX in the spent carbon slurry feed.

4.7 HCl TRAIN CHLORIDES EMISSIONS DATA

At Site CRF-A, HCl emissions are controlled by a sodium carbonate spray cooler which neutralizes HCl in the flue gas entering the baghouse. The HCl train emissions data measured at the baghouse outlet exhaust stack are summarized in Table 4-18. The data are reported as front half, back half and train total chloride emissions. The front half emissions represent chlorides captured in the probe rinse and filter fractions of the HCl train and the back half emissions represent chlorides captured in the HCL sample train impingers. The train total emissions represent the sum of the front half and back half emissions.

The average front half chlorides concentration was 1.73 mg/dscm @ 3% O_2 and the average back half chlorides concentration was 1.69 mg/dscm @ 3% O_2. The average total chlorides concentration was 3.44 mg/dscm @ 3% O_2. The average total chlorides emission rate was 0.040 kg/hr.

Compared with other Tier 4 test sites, the chlorides emissions for Site CRF-A are in the low range. For all test sites for which HCL sampling was performed the chlorides emissions ranged from 2.4 to 880 mg/dscm @ 3% O_2 (0.001 to 3.8 gr/dscf @ 3% O_2).

TABLE 4-16. SRAY COOLER/BAGHOUSE SYSTEM REMOVAL EFFICIENCIES AT SITE CRF-A

Homologue	Baghouse Removal Efficiency (%) Run 1	Run 2	Run 3	Average
Dioxins				
2378 TCDD	100.0	100.0	100.0	100.0
Other TCDD	-23.6	100.0	96.1	76.6
Penta-CDD	63.5	43.8	100.0	82.2
Hexa-CDD	80.5	78.1	90.1	83.3
Hepta-CDD	88.9	89.0	90.0	89.2
Octa-CDD	91.5	94.6	81.2	91.6
Total PCDD	82.0	89.8	91.7	87.2
Furans				
2378 TCDF	100.0	100.0	100.0	100.0
Other TCDF	91.5	93.9	96.0	94.1
Penta-CDF	96.7	93.8	100.0	97.5
Hexa-CDF	94.8	96.6	97.2	96.3
Hepta-CDF	91.2	96.2	96.9	95.2
Octa-CDF	86.8	94.6	87.3	89.9
Total PCDF	93.1	95.1	96.9	95.3

TABLE 4-15. DIOXIN/FURAN EMISSION FACTORS AT THE OUTLET STACK FOR SITE CRF-A

Dioxin/Furan Isomer	Dioxin/Furan Emission Factors (ug/kg)			
	Run 01	Run 02	Run 03	Avg.
DIOXINS				
2378 TCDD	ND(4.18E-03)	ND(9.84E-04)	ND(1.03E-03)	.00E+00
Other TCDD	1.37E-02	ND(1.48E-03)	1.54E-03	5.09E-03
Penta-CDD	8.96E-03	2.46E-03	ND(2.57E-03)	3.81E-03
Hexa-CDD	1.43E-02	5.90E-03	4.62E-03	8.29E-03
Hepta-CDD	1.08E-02	6.39E-03	5.13E-03	7.43E-03
Octa-CDD	9.56E-03	5.41E-03	5.13E-03	6.70E-03
Total PCDD	5.74E-02	2.02E-02	1.64E-02	3.13E-02
FURANS				
2378 TCDF	ND(3.59E-03)	ND(2.95E-03)	ND(2.05E-03)	.00E+00
Other TCDF	1.25E-02	9.84E-03	7.19E-03	9.86E-03
Penta-CDF	3.59E-03	5.41E-03	ND(2.57E-03)	3.00E-03
Hexa-CDF	6.57E-03	3.94E-03	4.11E-03	4.87E-03
Hepta-CDF	7.77E-03	3.94E-03	3.59E-03	5.10E-03
Octa-CDF	5.38E-03	2.46E-03	5.65E-03	4.49E-03
Total PCDF	3.59E-02	2.56E-02	2.05E-02	2.73E-02

ND = not detected (detection limit in parentheses).
ug = 1.0E-06g
8760 operating hours per year

NOTE: Emission factors are based on the bare carbon production rate of the furnace (kg/hr).

Dioxin and furan emission factors for the baghouse outlet exhaust stack are summarized in Table 4-15. The emission factors are reported as micrograms of isomer per kilogram of bare carbon produced. The average emission factors for total PCDD and total PCDF were 0.031 ug/kg and 0.027 ug/kg, respectively. The emission factors have the same variability as the dioxin/furan concentrations since the production rates were consistent between test runs.

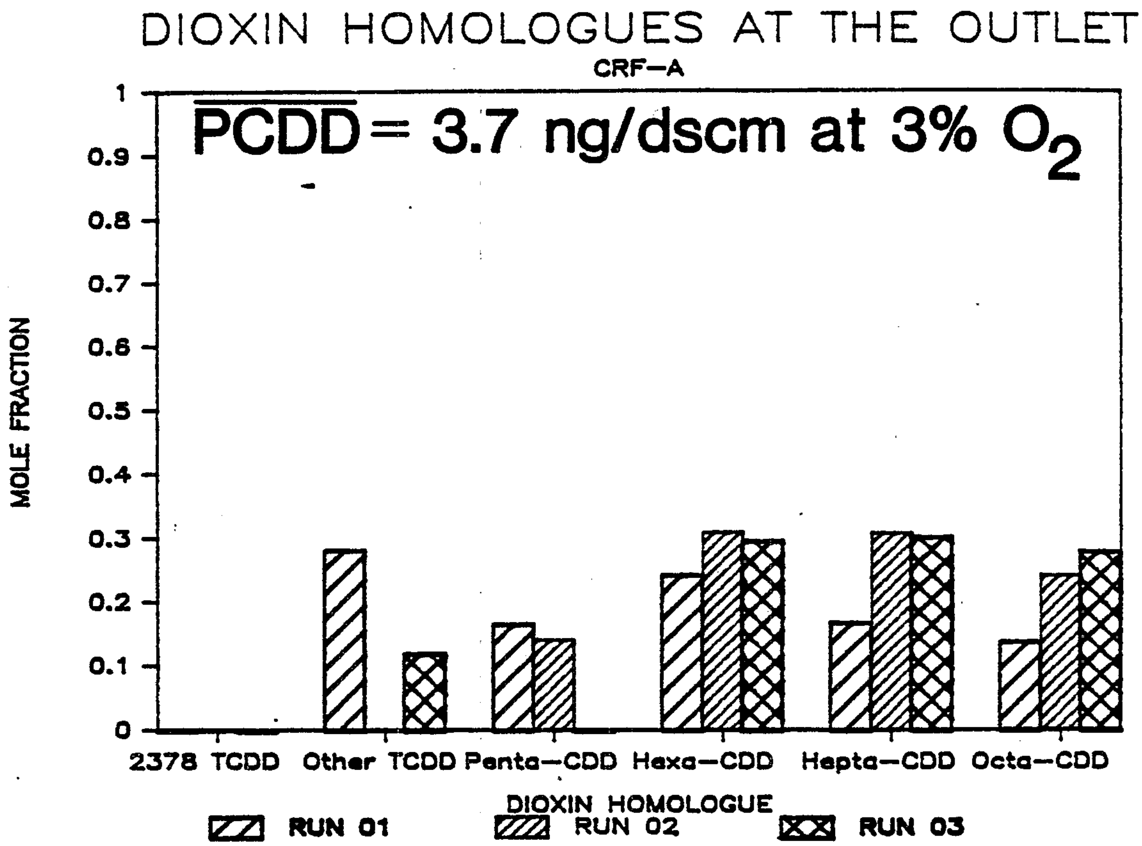
4.5.3 Reduction of Dioxin/Furan Concentrations Due to the Particulate Control Device

Some of the dioxin/furans contained in the stack gas are removed by the spray cooler/baghouse system. The dioxin/furan removal efficiency of the spray cooler/baghouse system is calculated from the difference betweem the inlet and outlet concentration of each dioxin/furan homologue divided by the inlet concentration of each homologue. Each flue gas concentration value is considered to have an analytical uncertainty of $\pm$ 50%. An analysis of the corresponding uncertainty of the measured control device efficiency values (contained in Appendix I) indicates that with a measured efficiency of greater than 66.7%, the true removal efficiency is most likely positive. With a measured efficiency between 66.7% and -200%, a definite conclusion cannot be drawn concerning the true removal efficiency and below -200%, the true removal efficiency is most likely negative.

The spray cooler/baghouse removal efficiencies for each dioxin/furan homologue are summarized in Table 4-16. The measured removal efficiencies for all the homologues are above 66.7% indicating that the baghouse positively controls dioxin/furan emissions at Site CRF-A (i.e., analytical uncertainties do not obscure the ability to adequately measure the control device efficiency). The average measured removal efficiencies for total PCDD and total PCDF were 87 percent and 95 percent respectively.

4.6 SPENT CARBON FEED PRECURSOR DATA

The spent carbon feed slurry which is fed into Furnace CRF-A was analyzed for chlorinated benzenes, chlorinated phenols, total organic halogens and total chlorides. These compounds are believed to be dioxin/furan precursors



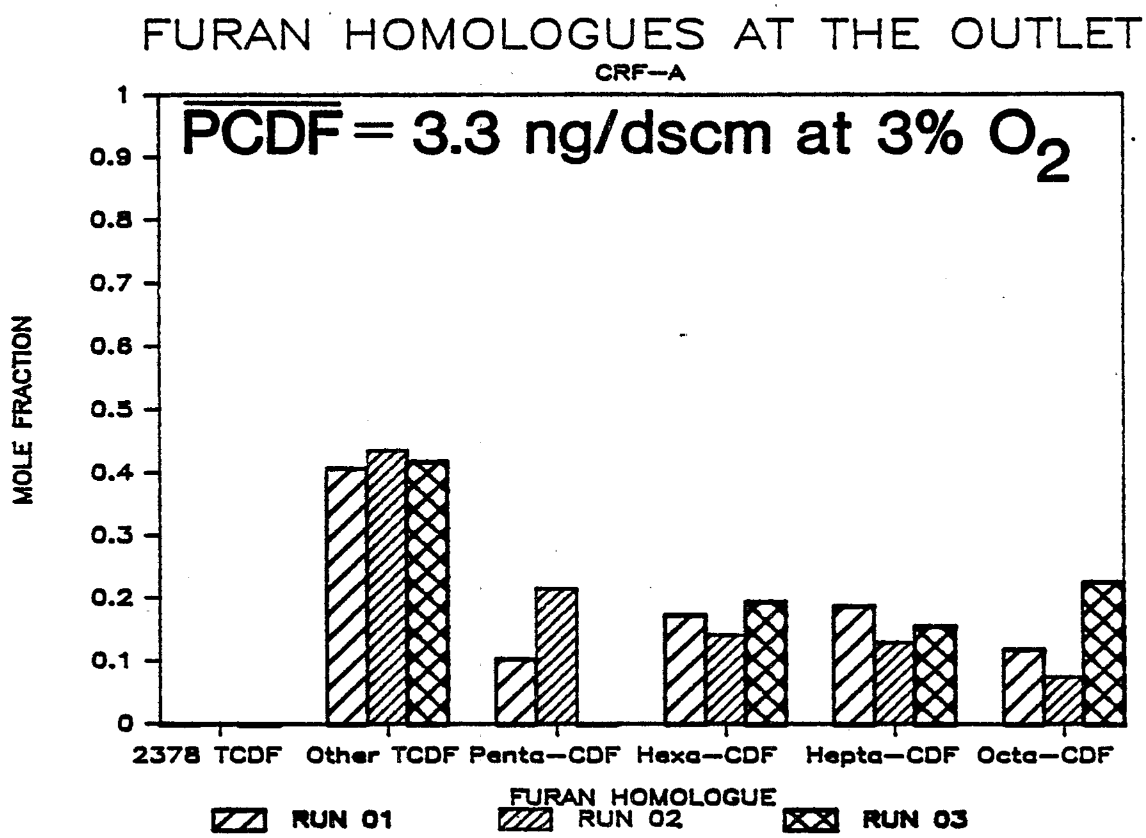


Figure 4-10. Homologue distribution at the baghouse outlet.

TABLE 4-14. SUMMARY OF DIOXIN/FURAN EMISSIONS DATA AT THE OUTLET STACK FOR SITE CRF-A (Concentrations Corrected to 3% Oxygen)

Dioxin/Furan Isomer	Isomer Concentration in Flue Gas (ng/dscm @ 3% oxygen) Run 01	Run 02	Run 03	Avg.
DIOXINS				
2378 TCDD	ND(4.61E-01)	ND(1.31E-01)	ND(1.30E-01)	.00E+00
Other TCDD	1.52E+00	ND(1.96E-01)	1.95E-01	5.70E-01
Penta-CDD	9.88E-01	3.27E-01	ND(3.25E-01)	4.38E-01
Hexa-CDD	1.58E+00	7.84E-01	5.84E-01	9.83E-01
Hepta-CDD	1.19E+00	8.49E-01	6.49E-01	8.95E-01
Octa-CDD	1.05E+00	7.19E-01	6.49E-01	8.07E-01
Total PCDD	6.32E+00	2.68E+00	2.08E+00	3.69E+00
FURANS				
2378 TCDF	ND(3.95E-01)	ND(3.92E-01)	ND(2.60E-01)	.00E+00
Other TCDF	1.38E+00	1.31E+00	9.09E-01	1.20E+00
Penta-CDF	3.95E-01	7.19E-01	ND(3.25E-01)	3.71E-01
Hexa-CDF	7.25E-01	5.23E-01	5.19E-01	5.89E-01
Hepta-CDF	8.56E-01	5.23E-01	4.54E-01	6.11E-01
Octa-CDF	5.93E-01	3.27E-01	7.14E-01	5.44E-01
Total PCDF	3.95E+00	3.40E+00	2.60E+00	3.32E+00

NOTE: Isomer concentrations shown are corrected to 3% oxygen.

ND = not detected (detection limit in parentheses).
ng = 1.0E-09g
8760 operating hours per year

TABLE 4-13. SUMMARY OF DIOXIN/FURAN EMISSIONS DATA AT THE OUTLET STACK FOR SITE CRF-A

Dioxin/Furan Isomer	Isomer Concentration in Flue Gas (ng/dscm) Run 01	Run 02	Run 03	Avg.
DIOXINS				
2378 TCDD	ND(1.79E-01)	ND(5.29E-02)	ND(4.61E-02)	.00E+00
Other TCDD	5.87E-01	ND(7.94E-02)	6.91E-02	2.19E-01
Penta-CDD	3.83E-01	1.32E-01	ND(1.15E-01)	1.72E-01
Hexa-CDD	6.12E-01	3.17E-01	2.07E-01	3.79E-01
Hepta-CDD	4.59E-01	3.44E-01	2.30E-01	3.45E-01
Octa-CDD	4.08E-01	2.91E-01	2.30E-01	3.10E-01
Total PCDD	2.45E+00	1.08E+00	7.37E-01	1.42E+00
FURANS				
2378 TCDF	ND(1.53E-01)	ND(1.59E-01)	ND(9.22E-02)	.00E+00
Other TCDF	5.36E-01	5.29E-01	3.23E-01	4.62E-01
Penta-CDF	1.53E-01	2.91E-01	ND(1.15E-01)	1.48E-01
Hexa-CDF	2.81E-01	2.12E-01	1.84E-01	2.26E-01
Hepta-CDF	3.32E-01	2.12E-01	1.61E-01	2.35E-01
Octa-CDF	2.30E-01	1.32E-01	2.53E-01	2.05E-01
Total PCDF	1.53E+00	1.38E+00	9.22E-01	1.28E+00

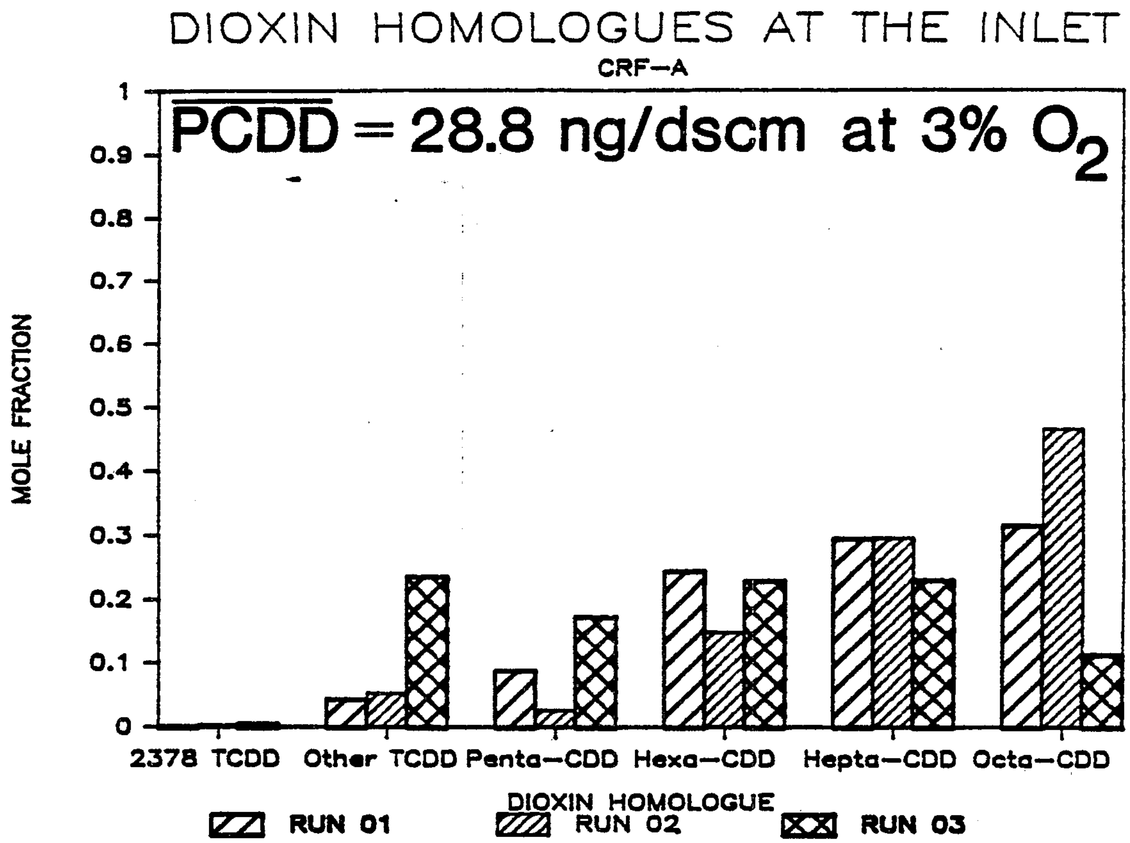
NOTE: Isomer concentrations shown are at as-measured oxygen conditions.

ND = not detected (detection limit in parentheses).
ng = 1.0E-09g
8760 operating hours per year

TABLE 4-12. DIOXIN/FURAN MASS FLOW FACTORS AT THE SPRAY COOLER INLET FOR SITE CRF-A

Dioxin/Furan Isomer	Dioxin/Furan Emission Factors (ug/kg)			
	Run 01	Run 02	Run 03	Avg.
DIOXINS				
2378 TCDD	7.93E-04	6.17E-04	1.25E-03	8.86E-04
Other TCDD	1.43E-02	1.08E-02	4.34E-02	2.28E-02
Penta-CDD	3.13E-02	5.87E-03	3.53E-02	2.41E-02
Hexa-CDD	9.36E-02	3.61E-02	5.12E-02	6.03E-02
Hepta-CDD	1.23E-01	7.81E-02	5.58E-02	8.58E-02
Octa-CDD	1.42E-01	1.33E-01	2.99E-02	1.02E-01
Total PCDD	4.06E-01	2.64E-01	2.17E-01	2.96E-01
FURANS				
2378 TCDF	1.39E-02	1.45E-02	1.31E-02	1.38E-02
Other TCDF	1.89E-01	2.15E-01	1.97E-01	2.00E-01
Penta-CDF	1.36E-01	1.17E-01	1.76E-01	1.43E-01
Hexa-CDF	1.61E-01	1.53E-01	1.60E-01	1.58E-01
Hepta-CDF	1.13E-01	1.39E-01	1.26E-01	1.26E-01
Octa-CDF	5.19E-02	6.08E-02	4.87E-02	5.38E-02
Total PCDF	6.65E-01	6.99E-01	7.21E-01	6.95E-01

ND = not detected (detection limit in parentheses).
ug = 1.0E-06g
8760 operating hours per year



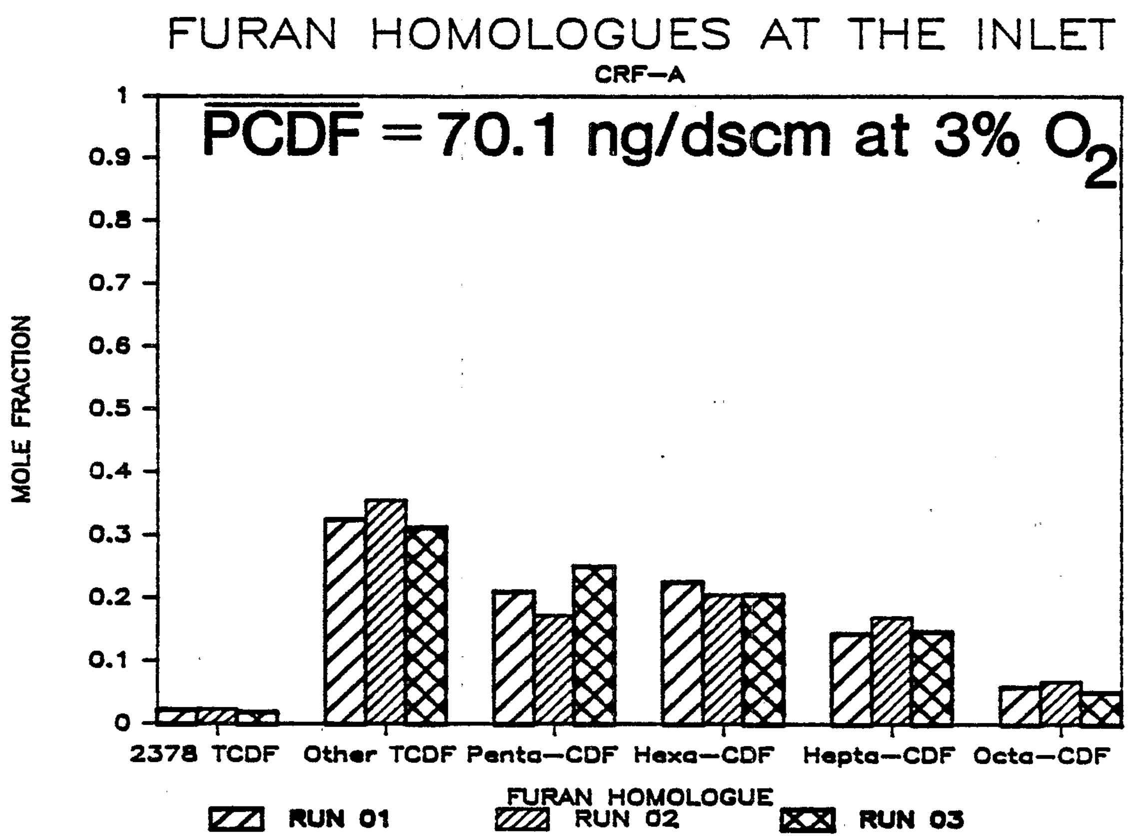


Figure 4-9. Homologue distribution at the spray cooler inlet.

All dioxin and furan homologues were detected at the spray cooler inlet. The relative distribution of the dioxin and furan isomers are shown graphically in Figure 4-9. Hepta- and octa-TCDD were the most prevalent dioxin homologues and accounted for 30 mole % each of the total PCDDs. Hexa-CDD was next at 20 mole %, followed by penta-CDD and other TCDD each at 10 mole%. 2378 TCDD accounted for less than one percent of the dioxin homologues. For the furan homologues other TCDF was the most predominant homologue at 30 mole %, while 2378 TCDF made up only 2 mole %. Penta-CDF, hexa-CDF and hepta-CDF each shared 20 mole % of the homologues and octa- CDF made up the remaining 8 mole %.

Isomer and homologue specific mass flow factors for the spray cooler inlet are summarized in Table 4-12. The mass flow factors are reported as micrograms of isomer per kilograms of bare carbon produced. The average mass flow factors for total PCDD and total PCDF were 0.30 ug/kg and 0.70 ug/kg, respectively. Since the production rates of bare carbon are consistent between test runs, the dioxin/furan mass flow factors have the same variability as the dioxin/furan concentrations.

4.5.2. Isomer and Homologue Specific Data at the Baghouse Outlet

Isomer and homologue specific emission concentration data, at the baghouse outlet stack are summarized in Table 4-13 and 4-14 for the three test runs. 2378 TCDD and 2378 TCDF were not detected at the baghouse outlet stack. Also, other TCDDs were not detected during Run 2. Penta-CDD was not detected during Run 3, and penta-CDD concentration were very near the detection limit for Runs 1 and 2.

Run-specific data tables showing homologue emission concentrations in both ng/dscm, parts-per-trillion and emission rates in ug/hr units are included in Appendix H.

The relative distributions of the dioxin and furan homologues are shown graphically in Figure 4-10. For the dioxin homologues, hexa-CDD, hepta-CDD and octa-CDD were evenly distributed each at 25 mole %. Other TCDD made up 15 mole % and penta-CDD made up 10 mole % of the dioxin homologues. For the furan homologues, other TCDF dominated with 40 mole %. Penta-CDF, hexa-CDF, hepta-CDF and octa-CDF equally shared the remaining 60 mole %.

TABLE 4-11. SUMMARY OF DIOXIN/FURAN FLUE GAS DATA AT THE SPRAY COOLER INLET FOR SITE CRF-A (Concentrations Corrected to 3% Oxygen)

Dioxin/Furan Isomer	Isomer Concentration in Flue Gas (ng/dscm @ 3% oxygen)			
	Run 01	Run 02	Run 03	Avg.
DIOXINS				
2378 TCDD	6.86E-02	6.12E-02	1.44E-01	9.14E-02
Other TCDD	1.23E+00	1.07E+00	5.02E+00	2.44E+00
Penta-CDD	2.71E+00	5.82E-01	4.08E+00	2.46E+00
Hexa-CDD	8.10E+00	3.58E+00	5.92E+00	5.87E+00
Hepta-CDD	1.07E+01	7.75E+00	6.46E+00	8.29E+00
Octa-CDD	1.23E+01	1.32E+01	3.46E+00	9.65E+00
Total PCDD	3.51E+01	2.62E+01	2.51E+01	2.88E+01
FURANS				
2378 TCDF	1.20E+00	1.44E+00	1.52E+00	1.39E+00
Other TCDF	1.63E+01	2.14E+01	2.28E+01	2.02E+01
Penta-CDF	1.18E+01	1.16E+01	2.04E+01	1.46E+01
Hexa-CDF	1.40E+01	1.52E+01	1.85E+01	1.59E+01
Hepta-CDF	9.78E+00	1.37E+01	1.46E+01	1.27E+01
Octa-CDF	4.49E+00	6.03E+00	5.63E+00	5.39E+00
Total PCDF	5.75E+01	6.93E+01	8.34E+01	7.01E+01

NOTE: Isomer concentrations shown are corrected to 3% oxygen.

ND = not detected (detection limit in parentheses).
ng = 1.0E-09g
8760 operating hours per year

TABLE 4-10. SUMMARY OF DIOXIN/FURAN FLUE GAS DATA AT THE SPRAY COOLER INLET FOR SITE CRF-A

Dioxin/Furan Isomer	Isomer Concentration in Flue Gas (ng/dscm) Run 01	Run 02	Run 03	Avg.
DIOXINS				
2378 TCDD	5.12E-02	4.95E-02	8.87E-02	6.31E-02
Other TCDD	9.21E-01	8.66E-01	3.08E+00	1.62E+00
Penta-CDD	2.02E+00	4.70E-01	2.51E+00	1.67E+00
Hexa-CDD	6.04E+00	2.90E+00	3.64E+00	4.19E+00
Hepta-CDD	7.95E+00	6.26E+00	3.97E+00	6.06E+00
Octa-CDD	9.18E+00	1.06E+01	2.13E+00	7.32E+00
Total PCDD	2.62E+01	2.12E+01	1.54E+01	2.09E+01
FURANS				
2378 TCDF	8.95E-01	1.16E+00	9.31E-01	9.97E-01
Other TCDF	1.22E+01	1.73E+01	1.40E+01	1.45E+01
Penta-CDF	8.77E+00	9.36E+00	1.25E+01	1.02E+01
Hexa-CDF	1.04E+01	1.23E+01	1.14E+01	1.13E+01
Hepta-CDF	7.29E+00	1.11E+01	8.96E+00	9.12E+00
Octa-CDF	3.35E+00	4.88E+00	3.46E+00	3.90E+00
Total PCDF	4.29E+01	5.60E+01	5.12E+01	5.01E+01

NOTE: Isomer concentrations shown are at as-measured oxygen conditions.

ND = not detected (detection limit in parentheses).
ng = 1.0E-09g
8760 operating hours per year

TABLE 4-9. SUMMARY OF DIOXIN AND FURAN MASS FLOW RATE DATA FOR SITE CRF-A

Run Number	Mass Flow Rate (ug/hr) 2378-TCDD	Total PCDD	Total PCDF
Spray Cooler Inlet:			
Run 1	0.72	368	602
Run 2	0.73	313	828
Run 3	1.44	250	832
Average	0.96	310	754
	Emission Rate (ug/hr)		
Baghouse Outlet:			
Run 1	ND	52.0	32.5
Run 2	ND	23.9	30.3
Run 3	ND	19.0	23.7
Average	ND	31.6	28.8

ND = not detected

TABLE 4-8. OVERVIEW OF DIOXIN AND FURAN FLUE GAS CONCENTRATION DATA FOR SITE CRF-A

Run Number	Flue Gas Concentration (ng/dscm) 2378 TCDD	Total PCDD	Total PCDF
ng/dscm (as-measured)			
Baghouse Outlet:			
Run 1	ND	2.45	1.53
Run 2	ND	1.08	1.38
Run 3	ND	0.74	0.92
Average	ND	1.42	1.28
Spray Cooler Inlet:			
Run 1	0.05	26.2	42.9
Run 2	0.05	21.2	56.0
Run 3	0.09	15.4	51.2
Average	0.06	20.9	50.1
ng/dscm @ 3% O_2			
Baghouse Outlet:			
Run 1	ND	6.32	3.95
Run 2	ND	2.68	3.40
Run 3	ND	2.08	2.60
Average	ND	3.69	3.32
Spray Cooler Inlet:			
Run 1	0.07	35.1	57.5
Run 2	0.06	26.1	69.3
Run 3	0.14	25.1	83.4
Average	0.09	28.8	70.1

ND - not detected
ng = 1×10^{-9} g

4.5 DIOXIN/FURAN EMISSIONS DATA

Dioxin/furan concentrations and mass flow rates measured at the spray cooler inlet and baghouse outlet stack are summarized in Tables 4-8 and 4-9 for the 2378 TCDD, total PCDD, and total PCDF species. The entire MM5 train, which included the filter, primary XAD sorbent trap, impingers, and sample train clean-up was analyzed. All dioxin/furan analyses for Site CRF-A samples were performed by EMSL-RTP and ECL-Bay St. Louis, Mississippi, laboratories. two of the three EPA laboratories known as the Troika.

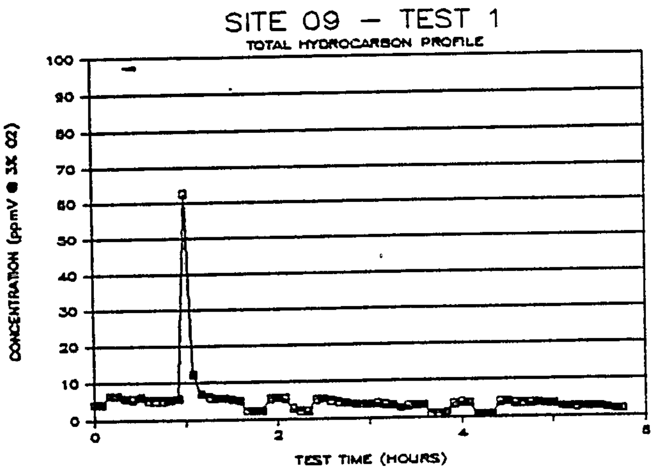
At the spray cooler inlet, the average as-measured concentrations were 0.06 ng/dscm for 2378 TCDD, 20.9 ng/dscm for total PCDD and 50.1 ng/dscm for total PCDF. The concentrations were corrected to 3% O_2 using the Radian EPA Method 3 data and were 0.09 ng/dscm @ 3% O_2 for 2378 TCDD, 28.8 ng/dscm @ 3% O_2 for total PCDD and 70.1 ng/dscm @ 3% O_2 for total PCDD. The average mass flow rates were 0.96 ug/hr for 2378 TCDD, 310 ug/hr for total PCDD and 754 ug/hr for total PCDF.

At the baghouse outlet exhaust stack, 2378 TCDD was not detected in the flue gas. However, the as-measured concentrations for total PCDDs and total PCDFs were 1.42 ng/dscm and 1.28 ng/dscm respectively. The concentrations were corrected to 3% oxygen using Radian CEM data and were 3.69 ng/dscm @ 3% O_2 for total PCDD and 3.32 ng/dscm @ 3% O_2 for total PCDF. The average emission rates were 31.6 ug/hr for total PCDD and 28.8 ug/hr for total PCDF.

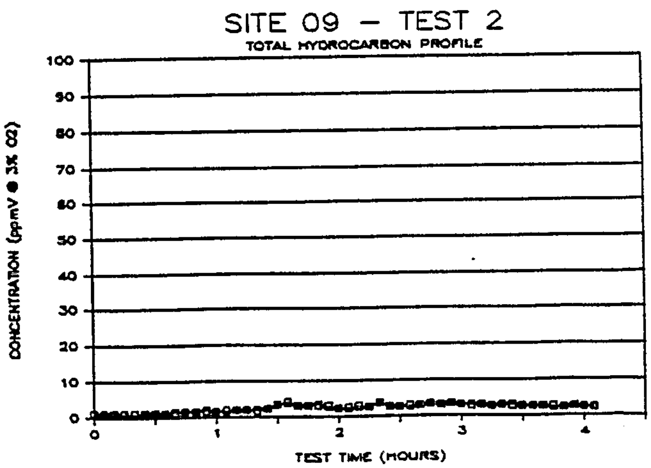
The inlet and outlet dioxin/furan concentrations are corrected to 3 percent oxygen for comparison. For both total PCDD and total PCDF, the inlet concentrations were significantly higher than the outlet concentration. The inlet total PCDD concentration was 28.8 ng/dscm @ 3% O_2 and the outlet total PCDD concentration was 3.69 ng/dscm @ 3% O_2. For total PCDF the inlet concentration was 70.1 ng/dscm @ 3% O_2 and the outlet concentration was 3.32 ng/dscm @ 3% O_2.

4.5.1 Isomer and Homologue Specific Data at the Spray Cooler Inlet

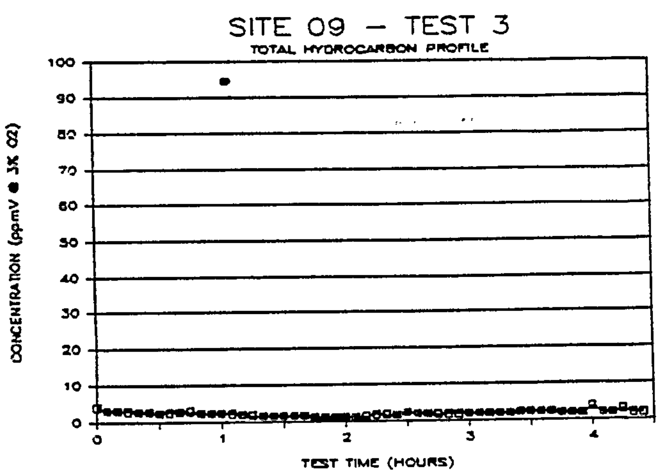
Isomer and homologue specific dioxin/furan concentration data at the spray cooler inlet are summarized in Table 4-10 and 4-11 for the three test runs. Run-specific data tables showing homologue emissions concentration in ng/dscm, parts-per-trillion, and ug/hr units are included in Appendix H.



MEAN: 4.7 ppmV THC @ 3% O2
STD. DEV.: 7.2 ppmV
INSTRUMENT RANGE: 0-100 ppmV THC

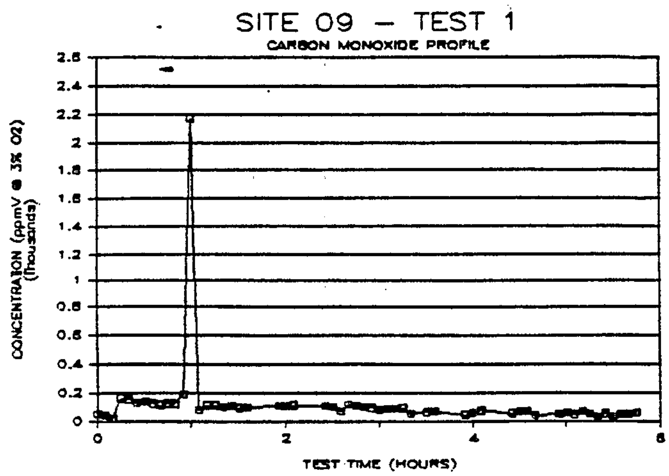


MEAN: 2.3 ppmV THC @ 3% O2
STD. DEV.: 0.8 ppmV
INSTRUMENT RANGE: 0-100 ppmV THC

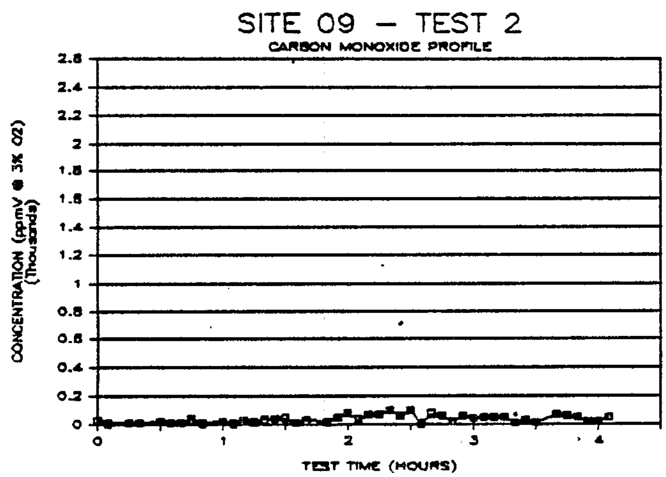


MEAN: 1.9 ppmV THC @ 3% O2
STD. DEV.: 0.6 ppmV
INSTRUMENT RANGE: 0-100 ppmV THC

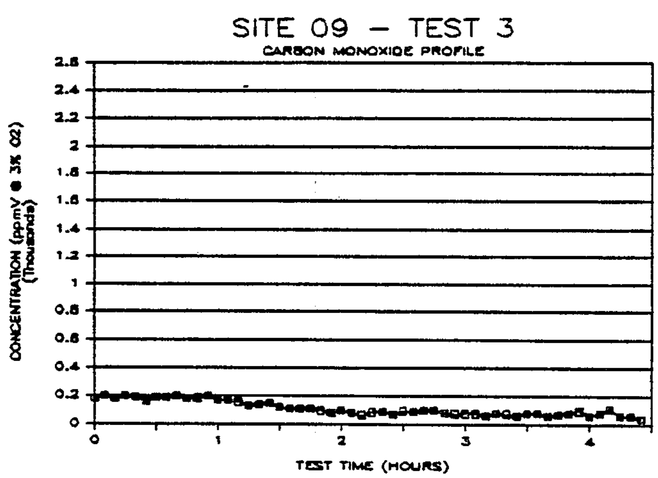
Figure 4-8. Total Hydrocarbon Concentration History at the Baghouse Outlet



MEAN: 121.1 ppmV CO @ 3% O2
STD. DEV.: 281.8 ppmV
INSTRUMENT RANGE: 0-6000 ppmV CO

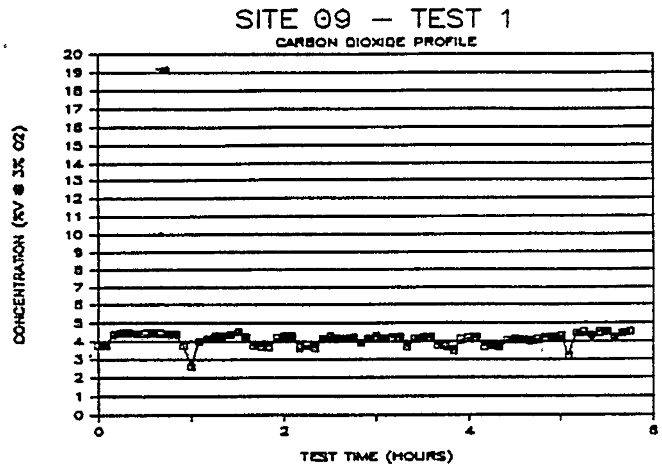


MEAN: 33.6 ppmV CO @ 3% O2
STD. DEV.: 25.5 ppmV
INSTRUMENT RANGE: 0-6000 ppmV CO

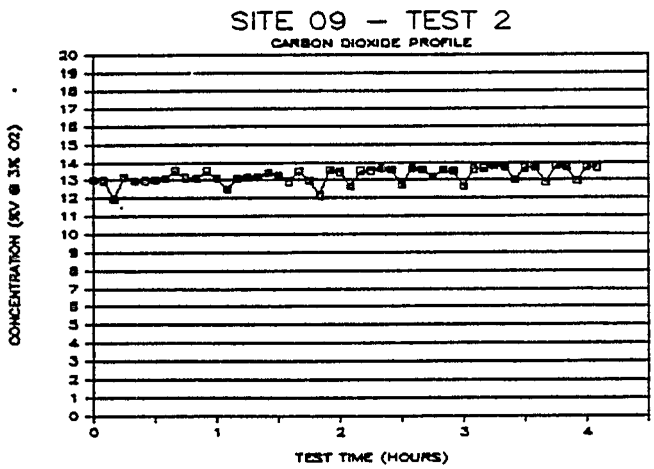


MEAN: 110.8 ppmV CO @ 3% O2
STD. DEV.: 48.4 ppmV CO
INSTRUMENT RANGE: 0-6000 ppmV CO

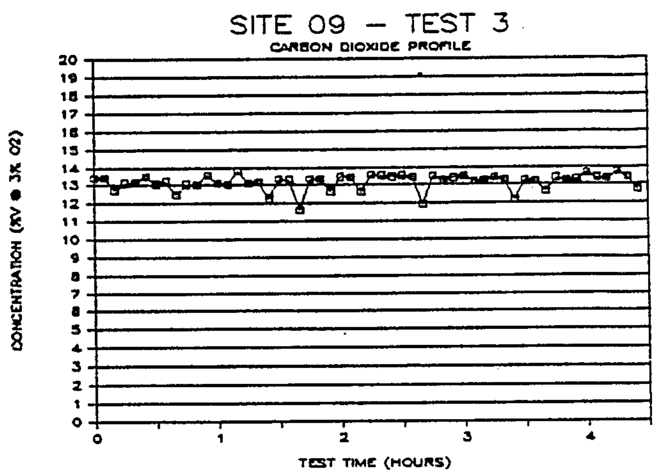
Figure 4-7. Carbon Monoxide Concentration History at the Baghouse Outlet



MEAN: 4.1% V CO2 @ 3% O2
STD. DEV.: 0.3% V
INSTRUMENT RANGE: 0-20% V CO2

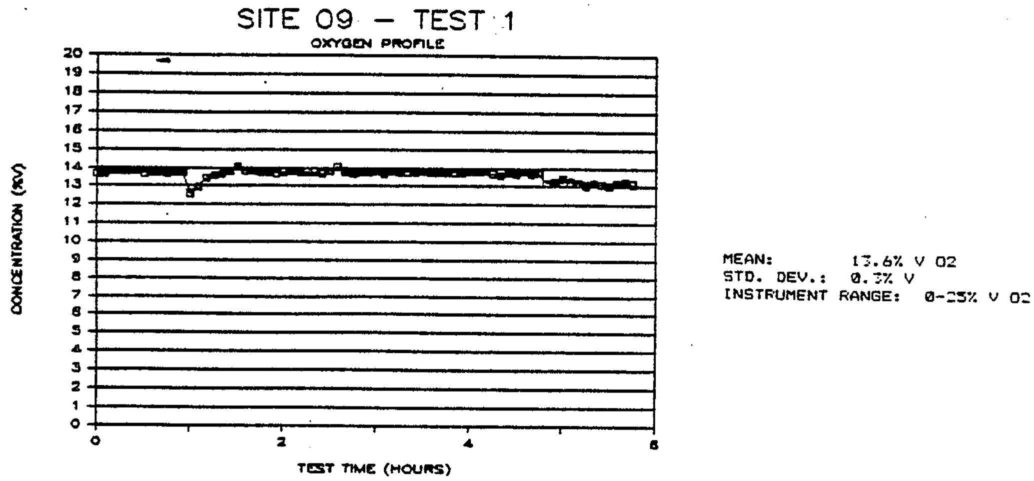


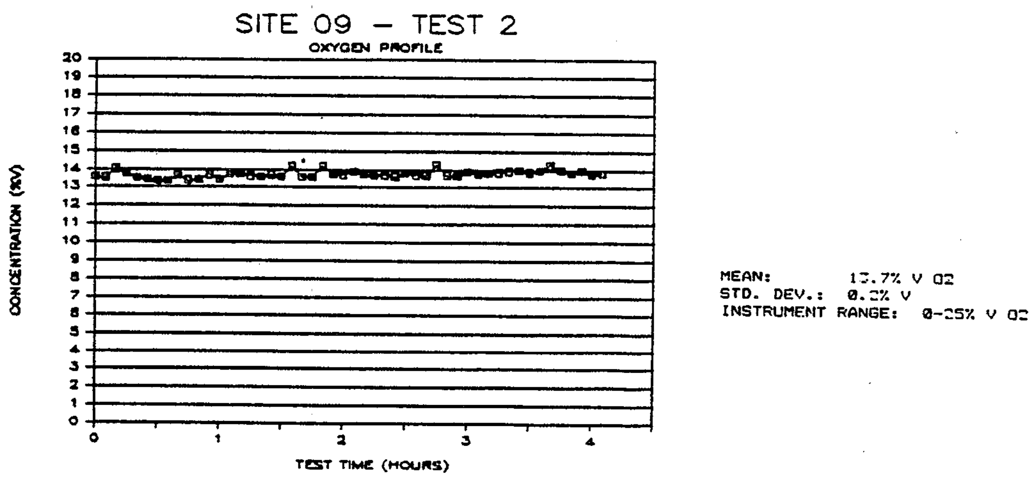
MEAN: 13.3% V CO2 @ 3% O2
STD. DEV.: 0.4% V
INSTRUMENT RANGE: 0-20% V CO2



MEAN: 13.2% V CO2 @ 3% O2
STD. DEV.: 0.4% V CO2
INSTRUMENT RANGE: 0-20% V CO2

Figure 4-6. Carbon Dioxide Concentration History at the Baghouse Outlet





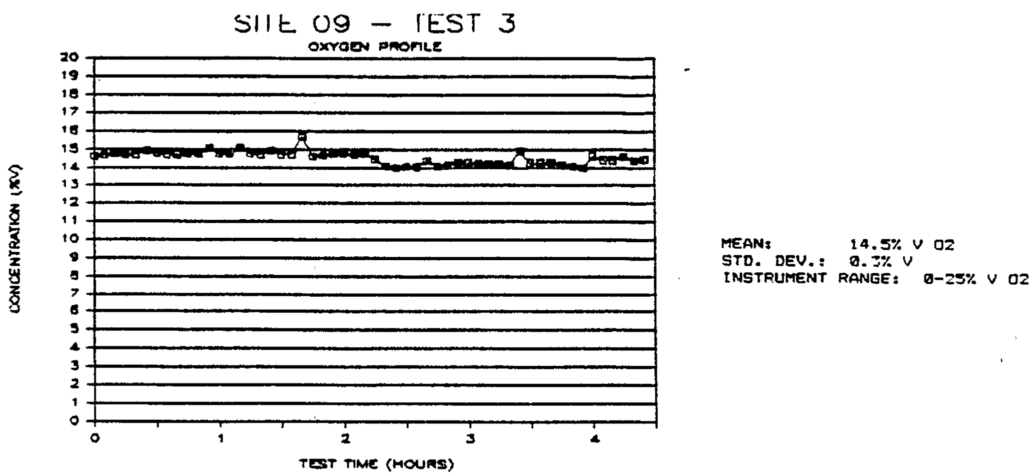


Figure 4-5. Oxygen Concentration History at the Baghouse Outlet

TABLE 4-7. MEAN VALUES AND STANDARD DEVIATIONS OF CONTINUOUSLY MONITORED COMBUSTION GASES AT OUTLET LOCATION

Parameter[a,b,c]	Run 01	Run 02	Run 03	Average
O_2 (% vol)	13.5	13.7	14.5	13.9
Standard Deviation	(0.3)	(0.2)	(0.3)	
CO (ppmv @ 3% O_2)	121.1	33.6	110.8	88.5
Standard Deviation	(281.8)	(25.5)	(48.4)	
CO_2 (% vol @ 3% O_2)	4.1[d]	13.3	13.2	13.2
Standard Deviation	(0.3)	(0.4)	(0.4)	
THC (ppmv @ 3% O_2)	4.7	2.3	1.9	3.0
Standard Deviation	(7.2)	(0.8)	(0.6)	

[a]Gas sampling for the continuous monitors was performed at the afterburner exhaust outlet location.

[b]All concentrations expressed on a dry volume basis except for total hydrocarbon concentrations, which are expressed on a wet volume basis.

[c]Total hydrocarbon data are expressed in units of ppmv (wet) as propane.

[d]Invalid data record, not included in average.

13.9 volume percent and by EPA Method 3 at 14.1 volume percent. The CEM and EPA Method 3 data agreed within the measurement error of the methods.

The volumetric flowrate at both the inlet and outlet have the same increasing variation, but the variation was less than 10 percent from the mean value. Therefore, the flue gas parameters are considered consistent between runs.

4.4 CONTINUOUS EMISSIONS MONITORING DATA

The mean values and standard deviations of the combustion gases at the baghouse outlet are shown for each Run in Table 4-7. The average results for the three test runs are: oxygen, 13.9 percent by volume (dry); carbon dioxide, 13.2 percent by volume (dry, normalized to 3% O_2); carbon monoxide, 88 ppm by volume (dry, @ 3% O_2); and total hydrocarbons, 3 ppm by volume (wet; at 3% O_2). The combustion gas results have been adjusted to a 3% oxygen basis for comparions to other combustion sources in the Tier 4 program.

The mean oxygen and carbon dioxide concentrations were relatively consistent between runs. The calculated result for carbon dioxide (4.1%) for Run 1 is not valid because of a hardware failure in the computer data system. This result is not included in the test overall average. The carbon monoxide results were more variable than any other combustion product. During Run 01, a significant increase in the CO concentration occurred, and was accompanied by an increase in the total hydrocarbon concentration. A decrease in the oxygen and carbon dioxide concentration also occurred. However, this was the only case where there was a detectable correlation between CO and THC concentrations, and the oxygen concentration.

The five minute average values of the combustion products are listed in Appendix A.3. The results are presented versus time in trend plots in Figures 4-5 to 4-8.

TABLE 4-6. SUMMARY OF FLUE GAS PARAMETERS AT SITE CRF-A

Flue gas parameters	Run 01	Run 02	Run 03	Average
<u>Furnace Outlet</u>:				
Oxygen content (vol %) dry	7.6	6.5	7.8	7.4
Carbon dioxide content (vol%, dry, corrected to 3% O_2)	14.1	11.4	13.5	13.0
<u>Spray cooler inlet</u>:				
Temperature (^oC)	852	840	871	854
Moisture (Vol %)	27	27	27	27
Volumetric Flowrate				
Actual (acmm)	1270	1320	1500	1360
Dry standard (dscmm)	235	245	270	250
EPA Method 3:				
Oxygen content (vol%) dry	9.3	8.4	8.9	8.9
Carbon dioxide content (vol%, corrected to 3% O_2, dry)	11.6	10.9	11.8	11.4
<u>Baghouse outlet</u>:				
Temperature (^oC)	171	174	167	170
Moisture (vol%)	36	36	35	36
Volumetric Flowrate				
Actual (acmm)	850	900	1025	925
Dry standard (dscmm)	355	365	430	380
Oxygen content (vol%, dry)				
Radian CEM	13.5	13.7	14.5	13.9
EPA Method 3	14.0	13.7	14.6	14.1
Carbon dioxide content (vol%, corrected to 3% O_2, dry)				
Radian CEM	-	13.3	13.2	13.2
EPA Method 3	12.7	12.2	11.9	12.3

Metric units are reported for all flue gas measurement data. To convert to English units:

$$^oF = 1.8 \times {}^oC + 32$$
$$cfm = cmm \times 35.3$$

Standard EPA conditions are 20^oC (69^oF) and 1 atm.

TABLE 4-5. SUMMARY OF EVAPORATIVE COOLER--BAGHOUSE OPERATING DATA

		Evaporative Cooler			Baghouse	
Run No.	Time	Water Flow (gpm)	Inlet Temp. °F	Outlet Temp. °F	P (in H_2O)	Outlet Temp. °F
1	1400	22	1740	400	4.5	350
5/29/85	1500	22	1710	400	4.0	350
	1600	22	1710	400	4.5	350
	1700	22	1710	400	6.0	350
	1800	24	1720	400	5.0	350
	1900	24	1740	400	5.5	350
	2000	24	1740	400	5.5	350
	Average	23	1724	400	5.0	350
2	1400	23	1700	400	5.0	350
5/30/85	1500	23	1690	400	7.5	350
	1600	24	1690	400	6.0	350
	1700	24	1700	400	6.5	350
	1800	24	1700	400	6.0	350
	1900	24	1710	400	6.0	350
	2000	24	1710	400	6.0	350
	Average	24	1700	400	6.1	350
3	0900	24	1670	400	6.0	350
5/31/85	1000	24	1670	400	6.0	350
	1100	24	1650	400	5.5	350
	1200	25	1670	400	5.5	350
	1300	24	1700	400	6.0	350
	1400	25	1700	400	5.0	350
	Average	24	1677	400	5.7	350
Test Average		24	1700	400	5.6	350

4.2.3 Evaporative Cooler - Baghouse Operation

The operating levels of key variables in the emission control system are summarized in Table 4-5. The data show that the emission control system was operated similarly during the three test runs.

The baghouse cleaning cycle was controlled by the total pressure drop across the bags. During the test periods, the average pressure drop across the baghouse was 5.6 inches of water. The average dust collection rate for the 24-hour periods during which testing was conducted was 200 pounds per hour. This rate was determined by weighing each dust collection container and recording the time at which it was replaced.

The evaporative cooler water injection rate averaged 24 gallons per minute during the tests. The alkali soultion makeup rate was constant at 3.5 gallons per minute.

4.3. FLUE GAS PARAMETER DATA

The characteristics of flue gas at the sampling locations are summarized in Table 4-6. The oxygen and carbon dioxide content of the flue gas was measured at the top of the furnace before the afterburner. The average oxygen content was 7.4 volume percent and the CO_2 content was 13.0 volume percent corrected to 3% O_2. The excess oxygen was calculated to be 75 percent at the furnace outlet. [The plant reports 1-5% O_2 at the top hearth.]

At the spray cooler inlet, the average volumetric flowrate at actual conditions was 1360 acmm and at dry standard conditions, the average volumetric flowrate was 250 dscmm. The average moisture content at the spray cooler inlet was 27 volume percent and the average temperature was 854^{o}C. The average oxygen content was measured at 8.9 volume percent.

At the baghouse outlet, the average volumetric flowrate at actual conditions and dry, standard conditions were 925 acmm and 380 dscmm respectively. The average moisture content of the flue gas was 36 volume percent, and the average temperature was 170^{o}C. The oxygen concentration in the flue gas at the baghouse outlet was measured by the Radian CEM system at

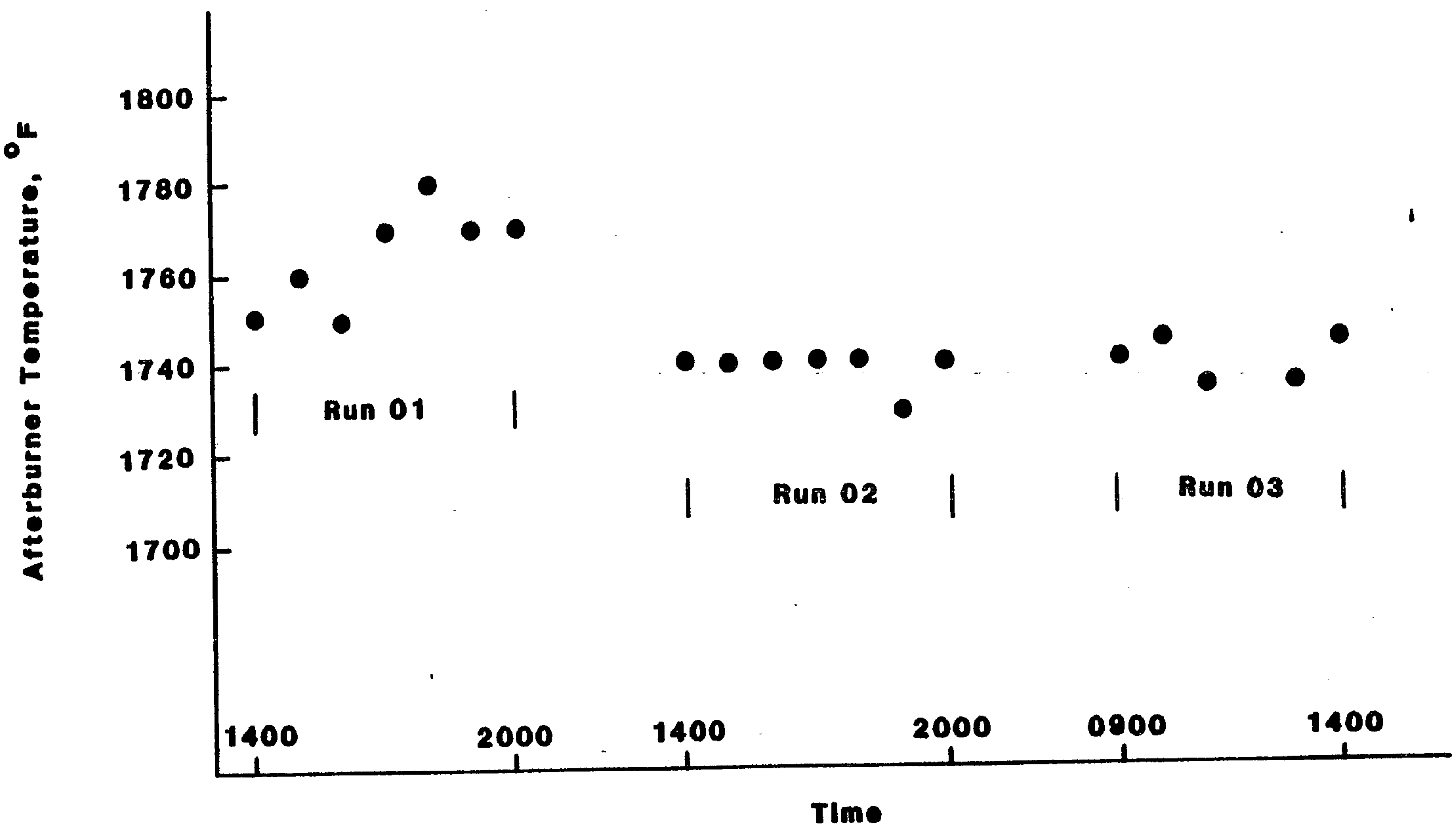


Figure 4-4. Afterburner Temperature vs. Test Time
Site CRF-A

TABLE 4-4. SUMMARY OF AFTERBURNER OPERATING DATA

Run No.	Time	Afterburner Temp. °F	Afterburner Draft, "H_2O
1	1400	1750	1.0
5/29/85	1500	1760	1.0
	1600	1750	1.0
	1700	1770	1.5
	1800	1780	1.0
	1900	1770	1.7
	2000	1770	1.0
	Average	1764	1.2
2	1400	1740	1.0
5/30/85	1500	1740	1.1
	1600	1740	1.4
	1700	1740	0.7
	1800	1740	0.7
	1900	1730	1.0
	2000	1740	1.5
	Average	1739	1.1
3	0900	1740	.70
5/31/85	1000	1745	1.5
	1100	1735	1.5
	1200	--	--
	1300	1735	1.2
	1400	1745	1.2
	Average	1740	1.2
Test Average		1748	1.2

TABLE 4-3. SUMMARY OF REGENERATOR FURNACE FEED CONDITIONS AT SITE CRF-A

Run No./ Date	Production Rate (kg/hr)	Total Volatiles % w/w	Moisture (% w/w)	Organics (% w/w)
1 (5/29/85)	906	52.5	36.4	16.1
2 (5/30/85)	1184	48.8	37.2	11.6
3 (5/31/85)	1154	48.4	36.0	12.4
Average	1080	49.9	36.5	13.4

Note: All data reported on a bare carbon basis.

TABLE 4-2. FURNACE CRF-A HEARTH TEMPERATURE HISTORY[a]
- DEVIATION FROM TEST AVERAGE (%)

Hearth	Run 1	Run 2	Run 3
Hearth 1	7.3	2.1	-11.0
Hearth 2	0.7	5.1	- 7.0
Hearth 3	0.4	0.7	- 1.2
Hearth 4	9.4	2.8	-14.2
Hearth 5	0.3	-0.8	0.5
Hearth 6	5.4	-0.7	- 5.6
Hearth 7	-2.2	0.8	1.6
Flue Gas	3.2	4.4	- 8.7

[a]The host plant considers the hearth temperature data confidential.

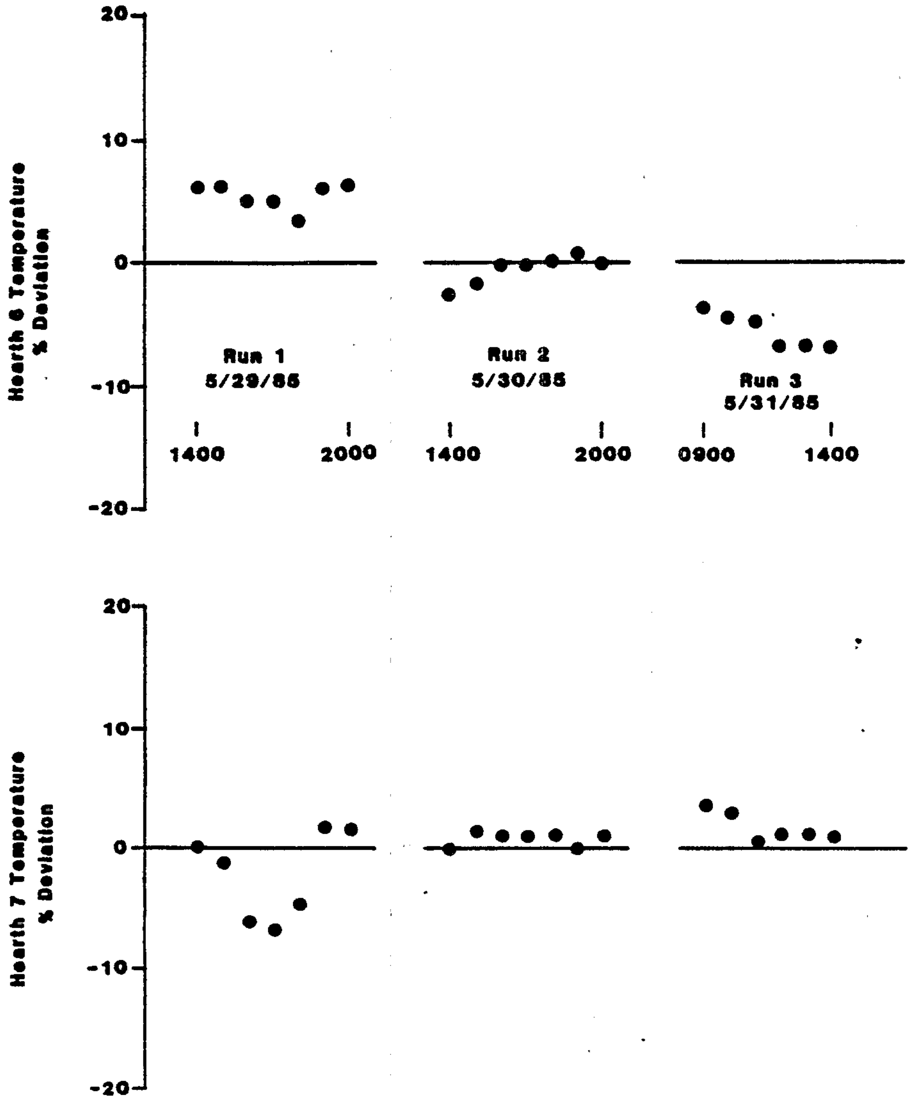


Figure 4-3. Hearth Temperature Variation, Hearths 6 & 7

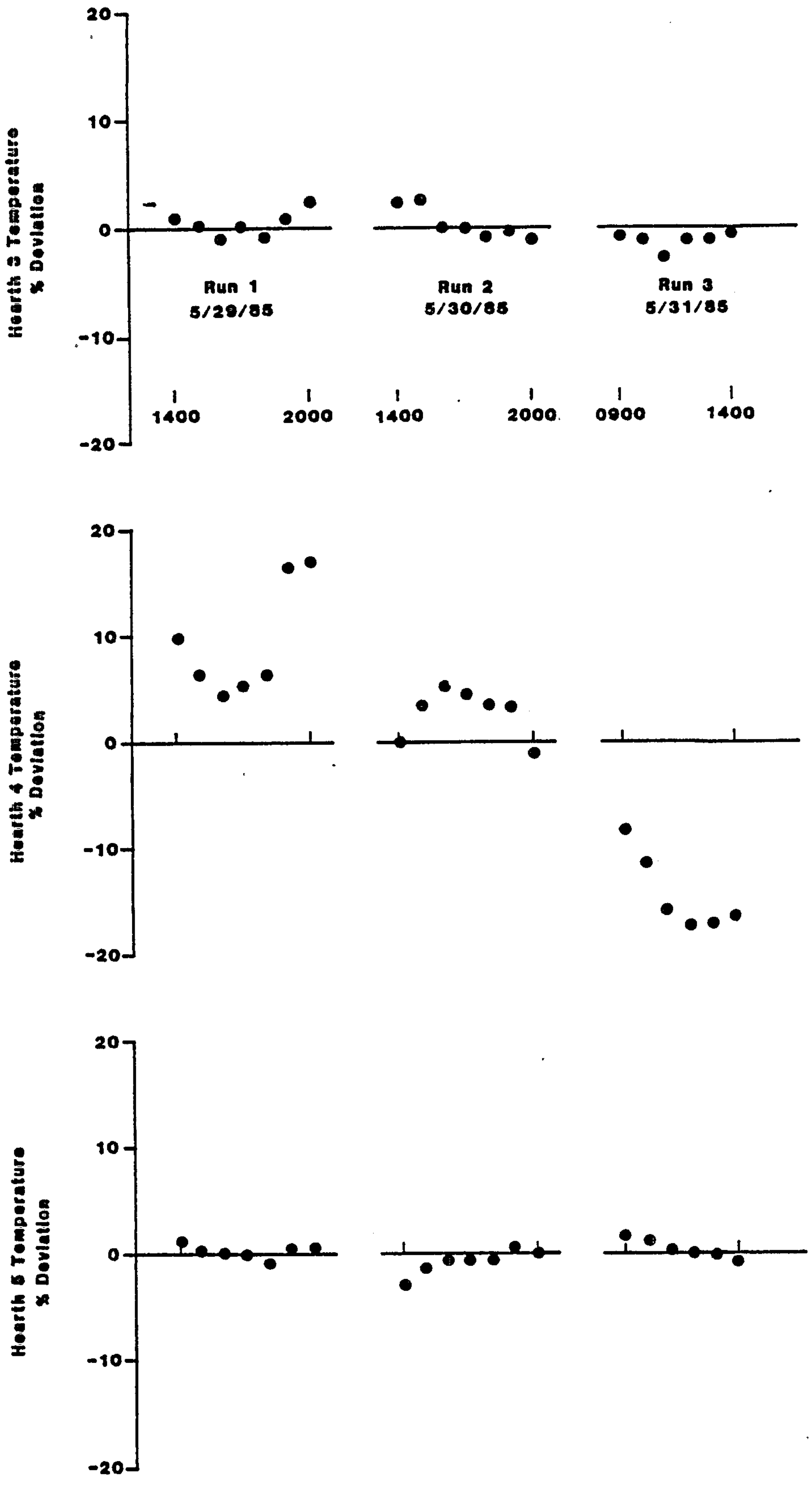


Figure 4-2. Hearth Temperature Variation, Hearths 3, 4, & 5

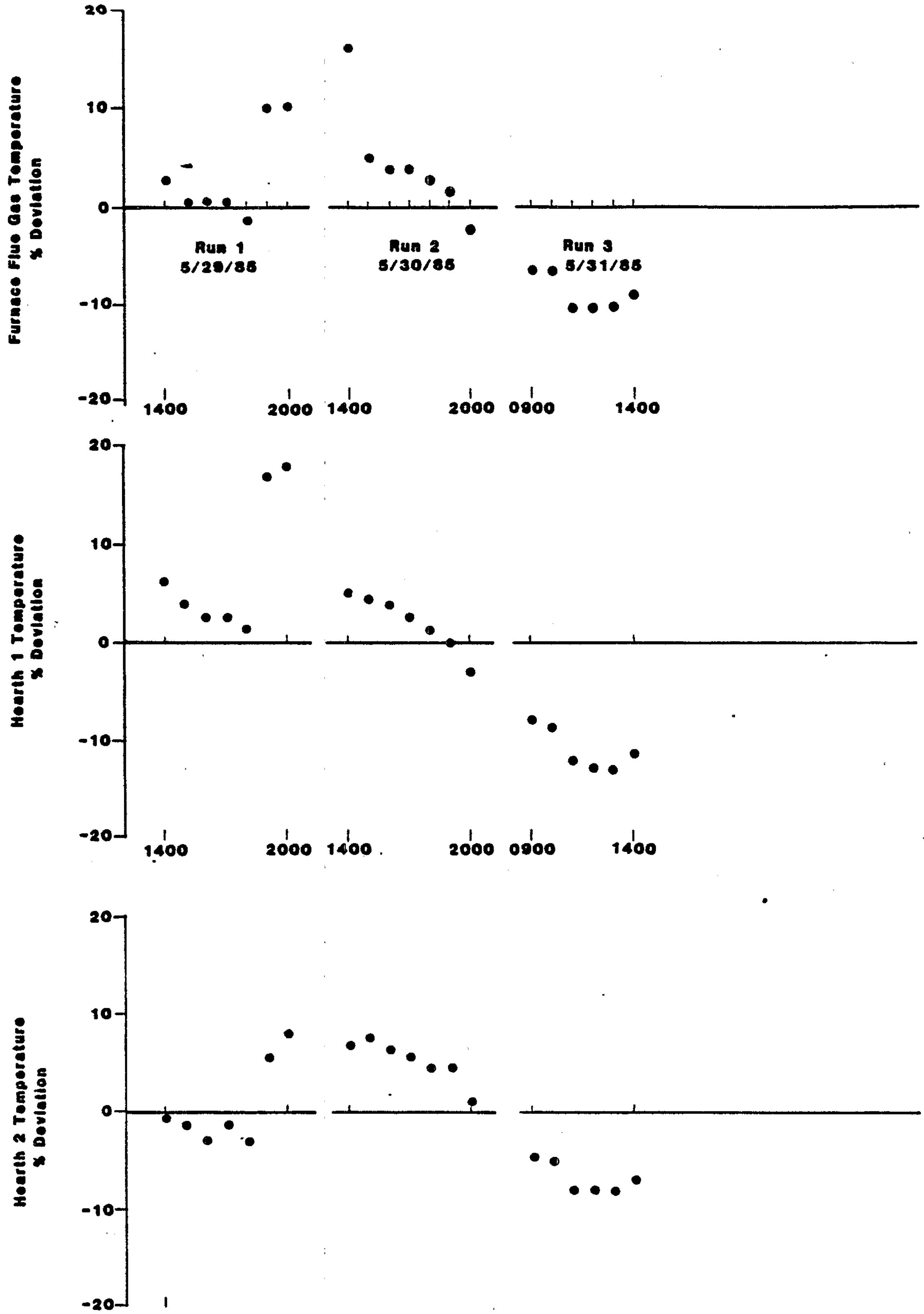


Figure 4-1. Hearth Temperature Variation, Hearths 1 & 2, and Furnace Flue Gas

4.2.1 Carbon Regeneration Furnace Operation

The primary variables that were recorded to monitor the operating condition of the furnace were the hearth temperatures. The host facility considers the absolute value of the hearth temperatures to be proprietary. The operating data were normalized based on the overall test average temperature at each hearth to allow presentation of variation data while maintaining confidentiality of the temperature values. The average temperature was calculated using all the 1 hour data points that bracketed the test run intervals. The percentage deviation from that average for each hearth is shown in Figures 4-1 to 4-3, and is summarized in Table 4-2. During the test runs the temperature distribution for the hearths was in the normal range, which is 900 - 2000^{o}F. The typical variation between runs is about $\pm$ 10%, with the temperatures during Run 03 being generally lower. For all runs, the temperature on Hearths 3, 5, and 7 showed the least variation. This is expected since the process burners are located at these levels and are temperature controlled. The spent carbon feed is fed to Hearth 1, and the regenerated carbon falls from Hearth 7.

The furnace flue gas temperature changed between 10 to 20% at the end of Run 01 and at the beginning of Run 02. The average daily carbon regeneration rate and percent volatiles in the spent carbon for each day of testing are presented in Table 4-3. During each test period the carbon feed conveyor was operated at a constant, fixed rate.

A furnace breakdown occurred between the first and second test runs. Repairs to the furnace rabble arms were completed on the morning of the second test day. Testing was postponed until the afternoon to allow the furnace to return to normal operating rates.

4.2.2 Afterburner Operation

The afterburner temperatures and induced draft at the afterburner are listed in Table 4-4, and the trends are illustrated in Figure 4-4. The average afterburner temperature was 24^{o}F higher during Run 01 than during Runs 02 and 03. The afterburner operation was steady during the test periods and no malfunctions occurred that required interruption of testing.

TABLE 4-1. SUMMARY OF TEST TIMES FOR EACH RUN, SITE CRF-A

	Test Start/Stop Times		
Location/Sample Type	Run 1 5/29/85	Run 2 5/30/85	Run 3 5/31/85
Afterburner Outlet			
MM5	1445 - 1505	1440 - 1840	1010 - 1410
	1520 - 1900		
Baghouse Outlet			
MM5	1450 - 1650	1440 - 1640	1002 - 1202
	1704 - 1904	1650 - 1850	1213 - 1413
HCl	1453 - 1653	1443 - 1643	1105 - 1205
CEM	1315 - 1900	1440 - 1840	0955 - 1420
Process Samples	1430	1430	1030
	1530	1530	1130
	1630	1630	1230
	1730	1730	1330
	1830	1830	1430

4.0 Test Results

The results of the Tier 4 emission test program at Carbon Regeneration Furnace CRF-A are presented in this section. Three test runs (Runs 01-03) were conducted. During each run, process operating data were collected, the combustion gas products were continuously monitored, and samples were collected for dioxin/furan, dioxin/furan precursor, and HCl analyses. The overall test log is presented in Section 4.1. The process operating data are summarized in Section 4.2, and the combustion gas monitoring results are presented in Section 4.3. The dioxin/furan emission results are presented in Section 4.4. The results of sampling the exhaust gas for HCl and the analysis of the spent carbon feed for total chlorine are presented in Section 4.5. Finally, the results of analysis for organic dioxin/furan precursors in the spent carbon feed and the baghouse dust are presented in Section 4.6.

4.1 DESCRIPTION OF TEST PERIODS

Testing at carbon regeneration furnace CRF-A was conducted on three consecutive days. During each test day gaseous samples were collected at the baghouse exhaust, the afterburner exhaust and the furnace exhaust. The time intervals during which each type of sample was collected are summarized in Table 4-1. Grab samples of the spent carbon feed, the regenerated carbon product, and the baghouse dust were collected at one hour intervals, beginning at the start of each test run.

4.2 PROCESS DATA

Process data were obtained to document the regeneration furnace, afterburner, and spray dryer/baghouse system operation during the test periods. The purpose of collecting this information is to document the between-run variations in operating conditions. The data are discussed separately below.

about 40 percent by weight, and the volatiles content is about 20 percent by weight. The spent carbon feed may contain chlorinated organics from the various wastewater treatment processes that use the carbon.

Spent carbon slurry is fed from a surge tank to a dewatering screw using an on/off slurry valve. The dewatering screw feeds the spent carbon to the top hearth of the furnace. In the furnace, the spent carbon is dried and the organics on the carbon are distilled and burned as the carbon is reactivated. The regenerated carbon drops from the bottom hearth of the furnace to a quench tank and is stored as a slurry. Plant personnel report that residual organic compounds are not detectable on the surface of the reactivated carbon.

The following parameters are recorded hourly in the regeneration furnace control room: individual hearth temperatures, furnace draft, natural gas usage for the furnace, and spent carbon slurry surge tank level.

3.3 EMISSIONS CONTROL SYSTEM

Emissions from furnace CRF-A are controlled by an afterburner, an alkaline spray cooler, and a baghouse. The afterburner consists of a short vertical section with natural gas fired burners and a long horizontal section of refractory lined duct with no burners. Temperatures in the afterburner are required by the operating permit to be in excess of 871°C (1600°F), and the residence time of the afterburner chamber is a nominal 0.5 seconds. Afterburner operating parameters monitored in the control room include temperature, draft, and natural gas usage.

Exhaust gases from the afterburner are cooled by an alkaline spray cooler. In the cooler, an atomized dilute alkaline solution is mixed with the exhaust gas from the afterburner. The alkaline medium neutralizes acid gases to permit compliance with regulatory emission limits.

From the spray cooler, the exhaust gases enter a four module baghouse. The baghouse is rated for gas flows up to 620 SCMM (21,800 scfm). The baghouse uses Teflon bags to remove fly ash and reaction products from the upstream components. Collected particulate matter drops from the baghouse hoppers to cardboard boxes. The dust is ultimately disposed of in a landfill.

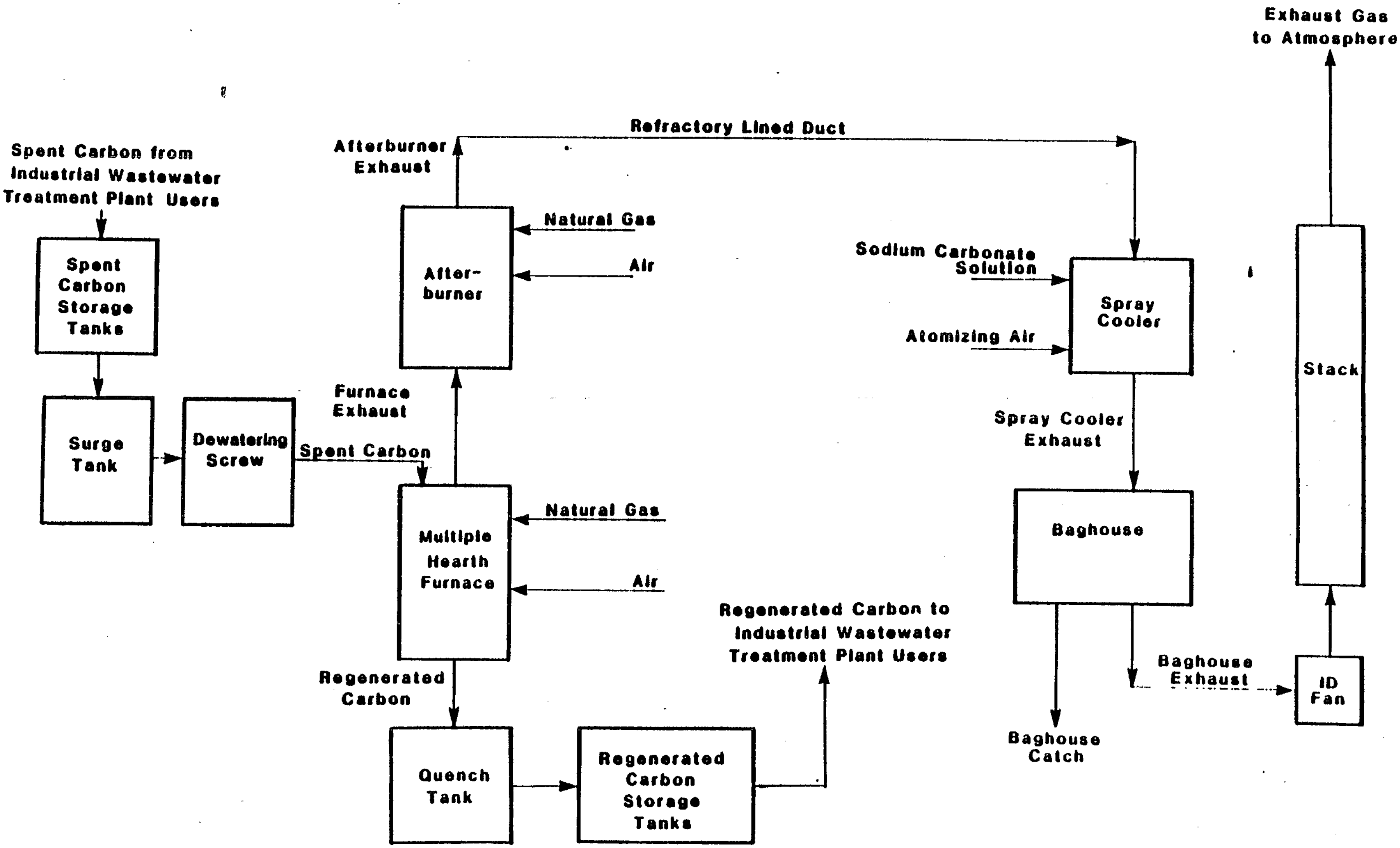


Figure 3-1. Process Flow Diagram of Carbon Regeneration Process.

3.0 PROCESS DESCRIPTION

This section describes the host site (Site CRF-A), the carbon regeneration furnace, and the emission control system that was tested. Data summarizing the operations of the furnace and the control equipment are presented in Section 4.0.

3.1 HOST SITE DESCRIPTION

The host site is an industrial carbon regeneration plant, permitted to process up to 49,500 Kg/day (109,000 lbs/day) of spent carbon (bare carbon basis). The spent carbon is returned from numerous plants that use activated carbon for industrial wastewater treatment. The host site operates 24 hrs/day, 7 days/week for approximately 310 days/year. A 3 week shutdown period is scheduled every year for reactivation furnace maintenance.

A flow diagram of the carbon regeneration process at Site CRF-A is shown in Figure 3-1. Spent carbon is reactivated in a multiple-hearth furnace, cooled in a quench tank, and stored prior to shipment. The furnace exhaust gases pass through an afterburner, a spray cooler and a baghouse before being exhausted to the atmosphere. The carbon regeneration furnace and afterburner/spray cooler/baghouse emissions control system are described in more detail in the following sections. The carbon regeneration furnace is referred to as Furnace CRF-A in the remainder of the test plan.

3.2 CARBON REGENERATION FURNACE

Furnace CRF-A is a Herreschoff multiple-hearth furnace that was rebuilt in 1980. The furnace fires an average of 13,000 cubic meters/day (460,000 cu ft/day) of natural gas. The hearth temperatures can be controlled over a range from 480^{o}C to 1093^{o}C (900^{o}F to 2000^{o}F). Some level of excess oxygen is typically present throughout the furnace.

About four days worth of spent carbon feed is stored on-site in a water slurry form. The carbon varies in size, but has a nominal 12x30 mesh distribution. The moisture content of the spent carbon fed to the furnace is

Dioxin and furan homlogues were detected at low concentration in the baghouse ash. All the dioxin homologues but 2378 TCDD were detected and the tetra- and penta- and octa- chlorinated furan homlogues were detected. The total average concentration were 1.1 ppb for TCDD and 0.5 ppb for TCDF. The baghouse treated an average of 380 dscmm of flue gas at a temperature of 204°C (400°F). The average pressure drop across the baghouse was 5.6 in H_2O.

The ambient air in the general vicinity of the spray cooler intake contained low concentrations of octa-CDD and tetra-CDF homlogues. The concentration of octa-CDD was measured at 0.02 ng/dscm and the concentration of tetra-CDF was measured at 0.04 ng/dscm both which are near the detection limit.

Chloride emissions at the baghouse outlet exhaust stack were measured at 1.6 mg/dscm which corresponds to 3.4 mg/dscm @ 3% O_2. The average chlorides emissions factor was calculated to be 39 milligrams of chloride emitted per kilogram of reactivated carbon produced.

The furnace produced an average of 1080 kg/hr of reactivated carbon. The spent carbon slurry contained 49.9 w% total volatiles, 36.5 w% moisture and 13.4 w% organics. Precursor analysis of the spent carbon slurry detected 2.9 ug/g of chlorobenzenes but polychlorinated biphenyls and chlorophenols were not detected. The spent carbon slurry contained 6400 ug/g of total chlorides.

The plant considered the hearth temperatures confidential but the average afterburner temperature was 950°C (1750°F). Average flue gas concentrations measured at the baghouse outlet exhaust stack using Radian CEMs were: O_2, 13.9 vol%, dry; CO_2, 13.2 vol % @ 3%, dry; CO, 88.5 ppmv @ 3% O_2, dry; and THC, 3.0 ppmv @ 3% O_2, wet.

TABLE 2-2. SUMMARY OF MEAN DIOXIN AND FURAN EMISSIONS DATA FOR SITE CRF-A

Parameter	2378 TCDD	Total PCDD	Total PCDF
INLET:			
Emissions Concentration (ng/dscm)			
As-measured	0.06	21	50
Corrected to 3% O_2	0.09	29	70
Emissions Rate (ug/hr)	0.96	310	750
OUTLET:			
Emissions Concentration (ng/dscm)			
As-measured	ND	1.4	1.3
Corrected to 3% O_2	ND	2.7	3.3
Emissions Rate (ug/hr)	ND	32	29

Dioxin/Furan Emissions Data (B)(C)

Species	Concentration (ng/dscm @ 3% O_2)	Emission Rate (ug/hr)	Emission Factor (ng/kg)
INLET:			
2378 TCDD	0.09	0.96	0.89
Total PCDD	28.8	310	300
Total PCDF	50.1	754	700
OUTLET:			
2378 TCDD	ND	ND	ND
Total PCDD	3.69	31.6	31.3
Total PCDF	3.32	28.8	27.3

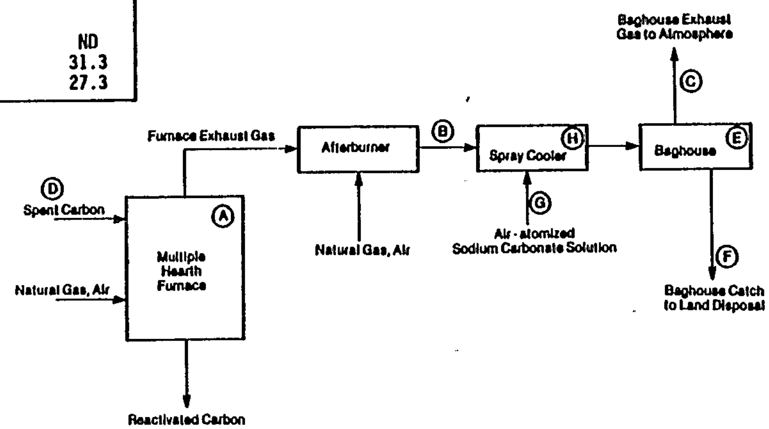
ND = not detected.

Chloride Emissions Data (C)

Train Component	Concentration (mg/dscm @ 3% O_2)	Emission Rate (kg/hr)	Emission Factor (mg/kg, reactivated carbon produced)
Front half	1.73	0.023	21
Back half	1.69	0.019	18
Train total	3.44	0.042	39

Continuous Monitoring Data (C)

O_2	13.9 %vol, dry
CO_2	13.2 %vol @ 3% O_2, dry
CO	88.5 ppmv @ 3% O_2, dry
THC	3.0 ppmv @ 3% O_2, wet



Spent Carbon Slurry Precursor Data (D)

Chlorobenzenes	2.85 ug/g (ppm)
PCBs	ND
Chlorophenols	ND
Total chlorides	6400 ug/g (ppm)

ND = not detected

Spray Cooler Operating Data (H)

Inlet temperature	1700°F (927°C)
Outlet temperature	400°F (204°C)
Water flowrate	24 gpm (90 lpm)

Baghouse Operating Data (E)

Inlet Temperature:	400°F (204°C)
Gas flowrate:	380 dscmm
P	5.6 in H_2O

Flue Gas Parameter Data (B)(C)

Spray Cooler Inlet:	
Flowrate	250 dscmm
Temperature	854°C
Moisture	27 vol%
Baghouse Outlet:	
Flowrate	380 dscmm
Temperature	170°C
Moisture	36 vol%

Incinerator Operation (A)

Production Rate of Regenerated Carbon:	1080 kg/hr
Feed characteristics:	
Total volatiles	49.9% w/w
Moisture	36.5% w/w
Organics	13.4% w/w
Afterburner temperature:	1750°F (950°C)

Ambient Air (G)

Species	Concentration (ng/dscm)
2378 TCDD	ND (0.01)
Total PCDD	0.02
Total PCDF	0.04

ND = not detected

Baghouse Ash (F)

Species	Concentration (ppb)
Total PCDD	1.1
Total PCDF	0.5

Figure 2-2. Data summary for Site CRF-A.

Samples of the spent carbon feed to the regeneration furnace were collected and analyzed for dioxin precursors. Samples of the regenerated carbon product and the baghouse dust were collected and analyzed for dioxin/furan. The dioxin/furan analyses were performed by EMSL-RTP and ECL-Bay St. Louis, two of the three labs known as Troika, and the dioxin precursor analyses were performed by Radian. Specific dioxin precursors analyzed for were chlorophenols, chlorobenzenes, polychlorinated biphenyls and total chlorides.

Continuous emissions monitors (CEM) were operated during the test periods to measure CO_2, O_2, CO, and total hydrocarbon (THC) concentrations in the exhaust gas from the baghouse. The continuous monitoring data were used in conjunction with the process data to document the stability of combustion conditions during the test.

2.2 SUMMARY OF RESULTS

The data obtained at Site CRF-A during the Tier 4 test is summarized in Figure 2-2. Detectable quantities of all targeted dioxin and furan species except 2378 TCDD and 2378 TCDF were found in the stack gas at the baghouse outlet exhaust stack. The mean dioxin and furan emissions data is summarized in Table 2-2. Average as-measured stack gas concnetrations of the total PCDD and total PCDF at the baghouse outlet were 1.4 ng/dscm and 1.3 ng/dscm, respectively. The hourly emission rates were 32 ug/hr for total PCDD and 29 ug/hr for total PCDF. Hexa, hepta- and octa- CDD were the most prevalent of the tetra- through octa-chlorinated dioxin homologues, while the furans were dominated by tetra-CDF.

At the spray cooler inlet, all targeted dioxin and furan species were detected. Average as-measured stack gas concentrations were 0.06 ng/dscm for 2378 TCDD, 21 ng/dscm for total PCDD and 50 ng/dscm for total PCDF. The hourly emissions rates were 0.96 ug/hr for 2378 TCDD, 310 ug/hr for total PCDD, and 750 ug/hr for total PCDF. For the dioxin homologues, hepta- and octa- TCDD were the most prevalent and for the furan homlogues tetra-CDD's other than 2378 TCDD were most prevalent. The spray cooler/baghouse emission control system positively controlled dioxin/furan emissions.

TABLE 2-1. SOURCE SAMPLING AND ANALYSIS OVERVIEW FOR SITE CRF-A

Item	Item Description
1. Number of test runs	- Three identical test runs. (Runs 1, 2, 3).
2. Gaseous sampling	- MM5 dioxin sampling at the baghouse outlet exhaust stack and the spray cooler inlet (afterburner outlet) location (Runs 1, 2, and 3). Dioxin/furan analysis.
	- MM5 HCl sampling at the baghouse outlet exhaust stack (Runs 1, 2, 3). Total chloride analysis.
	- Ambient air sampling near atomizing air intake point at spray cooler. (Two identical composites for Runs 1, 2, 3.) Dioxin/furan and precursor analysis.
	- EPA Reference Methods 2 and 4 at baghouse outlet exhaust stack and spray cooler inlet (Runs 1, 2, 3). Gas velocity and moisture.
	- Integrated bag sampling (EPA Reference Method 3) at baghouse outlet exhaust stack, spray cooler inlet and furnace outlet (Runs 1, 2, 3). CO_2, O_2, and N_2 analysis for molecular weight determination.
	- Continuous monitoring of CO, CO_2, O_2, SO_2, NO_x, and THC (total hydrocarbons) at baghouse outlet exhaust stack. (Runs 1, 2, 3).
4. Solid sampling	- Spent carbon feed sampling (Runs 1, 2, 3). Precursor analysis.
	- Baghouse dust sampling (Runs 1, 2, 3). Dioxin/furan analysis.

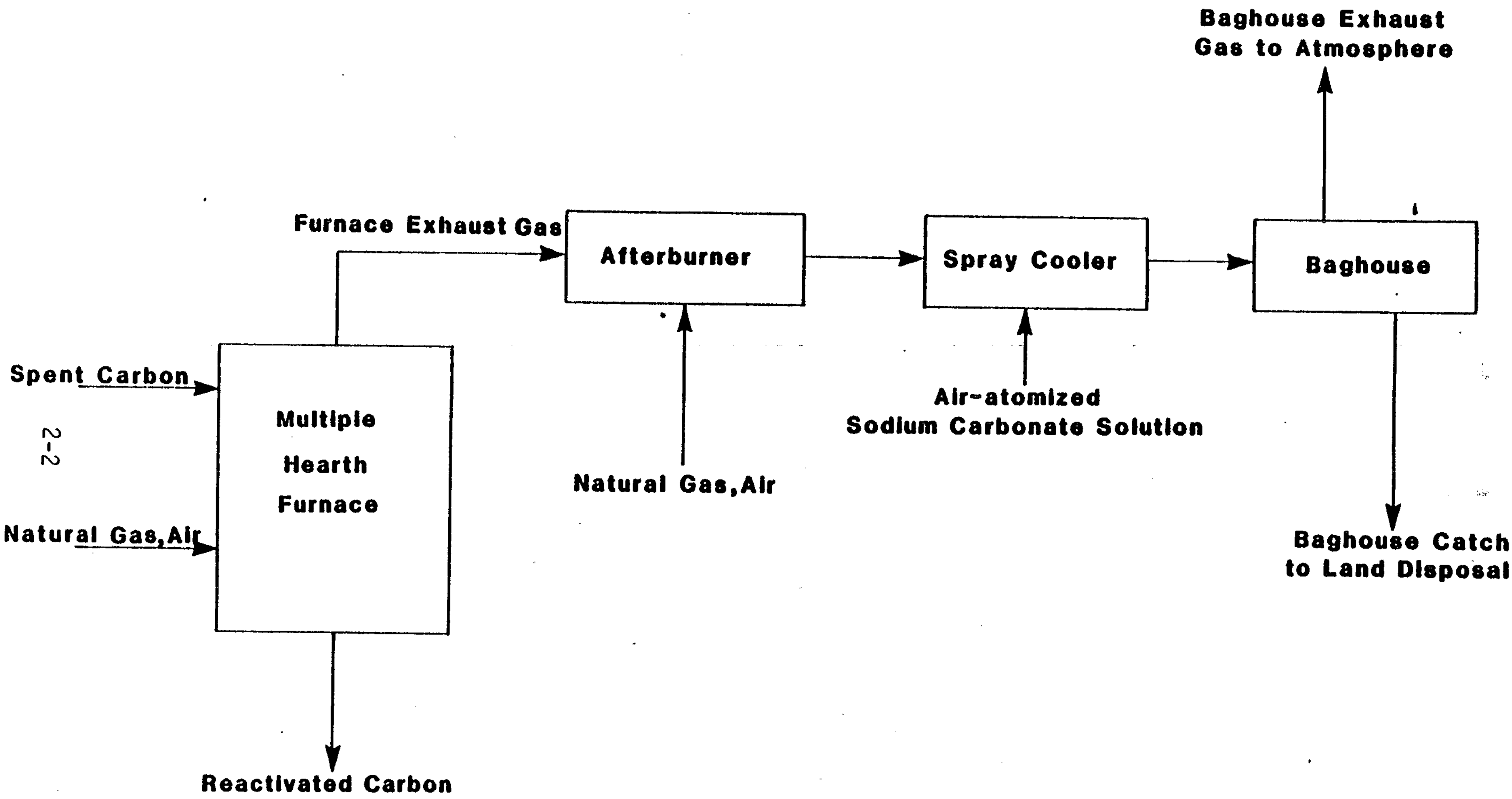


Figure 2-1. Simplified Process Flow Diagram of Carbon Regeneration Process.

2.0 SUMMARY

2.1 SOURCE SAMPLING AND ANALYSIS OVERVIEW

The host plant (Site CRF-A) is an activated carbon regeneration plant. A carbon regeneration furnace processing spent activated carbon that may contain adsorbed chlorinated organic compounds was tested for dioxin/furan emissions. Emissions in the exhaust gas from the carbon regeneration furnace are controlled by an afterburner, a sodium carbonate spray cooler and a baghouse. A process flow diagram of the carbon regeneration furnace and emissions control system is shown in Figure 2-1.

The gaseous and solid sampling conducted in this test program are summarized in Table 2-1. Sampling for dioxin/furan emissions was performed at the spray cooler inlet location and the baghouse outlet exhaust stack. The dioxin/furan sampling generally followed the October 1984 draft of the Modified Method 5 (MM5) procedure developed by the American Society of Mechanical Engineers (ASME) for measuring emissions of chlorinated organic compounds with minor changes. The two changes in the method are described in Section 5 of this report. The MM5 sample train components (probe rinses, filter, sorbent trap, etc.) were analyzed for dioxin/furan by one of the three EPA laboratories referred to collectively in the National Dioxin Study as Troika. The analysis quantified the 2378-tetrachlorodibenzo-p-dioxin isomer (2378-TCDD), the tetra- through octa-polychlorinated dioxin homologues (PCDD), and the tetra- through octa-polychlorinated dibenzo furan homologues (PCDF).

Sampling for HCl emissions was performed at the baghouse outlet exhaust stack using an HCl train, which is a modified version of the Method 5 train. Ambient air sampling was performed near the atomizing air intake point at the spray cooler. The ambient air sampling train contained an adsorbent resin to capture organic compounds. The resin samples were analyzed to determine the dioxin/furan and dioxin precursor concentrations in the ambient air. Integrated bag samples were collected at the furnace exhaust using EPA Method 3 for fixed gas (CO_2, CO, O_2, N_2) analysis. The samples were analyzed on-site using gas chromatography with thermal conductivity detection.

1.0 Introduction

The Environmental Protection Agency is assessing the potential for the emissions of dioxin/furans[a] from combustion sources under Tier 4 of the National Dioxin Study. If any of the combustion sources are found to emit dioxins, the secondary purpose of the Tier 4 study is to quantify these emissions and, if possible, relate the emissions to combustion parameters.

Carbon regeneration furnaces are one of eight source categories that have been included in the field test program. Carbon regeneration furnaces reactivate spent carbon from industrial or municipal water treatment facilities. The spent carbon may contain adsorbed chlorinated compounds.

This report presents the results of an emission test program conducted by Radian during May 28-31, 1985 at an industrial carbon regeneration furnace designated as Site CRF-A. The furnace was selected after an initial information screening and a pretest survey visit. This facility is considered representative of other carbon regeneration furnaces in the United States. Furnace CRF-A regenerates spent carbon from more than 20 plants that use activated carbon for industrial wastewater treatment.

An overview of the test program and the results and conclusions are presented in Section 2.0. The carbon regeneration furnace and the emission control system are described in Section 3.0. The process variables recorded during the tests and the detailed test results are presented in Section 4.0. Sections 5.0 through 7.0 present the various testing details. These include descriptions of the sampling locations and procedures (Section 5.0), descriptions of the analytical procedures (Section 6.0), and a summary of the quality control results (Section 7.0). The appendices contain complete calculations, field data, and other supporting material generated during the field test and analytical activities.

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[a]The term dioxin/furan as used in this report refers to the polychlorinated dibenzo-p-dioxin and dibenzofuran isomers with four or more chlorine atoms.

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FOREWORD

This report is the result of a cooperative effort between the Office of Research and Development's Hazardous Waste Engineering Research Laboratory (HWERL) and the Office of Air Quality Planning and Standard's Monitoring and Data Analysis Division (MDAD). The overall management of Tier 4 of the National Dioxin Study was the responsibility of MDAD. In addition, MDAD provided technical guidance for the source test covered by this report. HWERL was directly responsible for the management and technical direction of the source test.

This report has been reviewed by the Office Of Air Quality Planning And Standards, U.S. Environmental Protection Agency, and approved for publication as received from the contractor. Approval does not signify that the contents necessarily reflect the views and policies of the Agency, neither does mention of trade names or commercial products constitute endorsement or recommendation for use.

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NATIONAL DIOXIN STUDY
TIER 4 — COMBUSTION SOURCES

Final Test Report — Site 9
Carbon Regeneration Furnace CRF —A

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