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STACK EMISSIONS SURVEY
OF
LONE STAR INDUSTRIES, INC.
PORTLAND CEMENT PLANT
MARYNEAL, TEXAS

SEPTEMBER 1979

Reference 30:
(3) Coal-fired dry
process kilns w/
suspension preheaters
and bhouses.
Hi-vols in 3 sections
of positive pressure
bhouses!
Data Rating: C
Bad flow calibration [illegible]

FILE NUMBER EA 795-09

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INTRODUCTION

Ecology Audits, Inc., Austin, Texas, conducted a baghouse emissions survey at the Lone Star Industries portland cement plant located near Maryneal, Texas, on September 24 through 28, 1979. The purpose of this survey was to determine emissions of particulates from the baghouses of kiln numbers 1, 2, and 3, while being fired by bituminous coal; and, to compare these emissions to the emissions when kiln numbers 1, 2, and 3 were fired by natural gas.

The sampling followed the procedures set forth in the Texas Air Control Board notice for sampling procedures, March 15, 1979; the Compliance Sampling Manual, Texas Air Control Board, October, 1975; and the Appendix to the Code of Federal Regulations, Title 40, Part 60.

SUMMARY OF RESULTS

The principal conclusions are as follows:

Kiln Baghouse Number 1

1. The emissions of particulate matter from the baghouse were equal to 1.40 pounds per hour (0.00262 grains per dry standard cubic foot) based on averaging the three tests using Hi-Vol filters.

2. The allowable particulate emission rate as calculated from the Texas Air Control Board, Regulation I, Rule 131.03.05.001, May 6, 1979, is 61.5 pounds per hour. The actual emissions were 2.3 percent of the permitted emissions.

3. The initial emissions of particulate, when the kiln was fired by natural gas, were equal to 5.66 pounds per hour based on averaging the first and third tests. After conversion to coal, the emissions are 24.7 percent of the initial emissions.

Kiln Baghouse Number 2

1. The emissions of particulate matter from the baghouse were equal to 2.98 pounds per hour (0.00548 grains per dry standard cubic foot)

based on averaging the two tests using Hi-Vol filters.

2. The allowable particulate emission rate as calculated from the Texas Air Control Board, Regulation I, Rule 131.03.05.001, May 6, 1979, is 63.3 pounds per hour. The actual emissions were 4.7 percent of the permitted emissions.

3. The initial emissions of particulate, when the kiln was fired by natural gas, were equal to 15.7 pounds per hour based on averaging the three tests. After conversion to coal, the emissions are 19.0 percent of the initial emissions.

Kiln Baghouse Number 3

1. The emissions of particulate matter from the baghouse were equal to 3.45 pounds per hour (0.00815 grains per dry standard cubic foot) based on averaging the three tests using Hi-Vol filters.

2. The allowable particulate emission rate as calculated from the Texas Air Control Board, Regulation I, Rule 131.03.03.001, May 6, 1979, is 54.7 pounds per hour. The actual emissions were 6.3 percent of the permitted emissions.

3. The initial emissions of particulate, when the kiln was fired by natural gas, were equal to 6.26 pounds per hour based on averaging the four tests. After conversion to coal, the emissions are 55.1 percent of the initial emissions.

SUMMARY OF RESULTS

Baghouse Number 1

Run No.	Natural Gas Fired May 1979 (lbs/hr)	Coal Fired Sep 1979 (lbs/hr)	% of Initial Emissions
1	6.75	1.94	
2	-	1.02	
3	4.57	1.24	
Average	5.66	1.40	24.7

Baghouse Number 2

Run No.	Natural Gas Fired May 1979 (lbs/hr)	Coal Fired Sep 1979 (lbs/hr)	% of Initial Emissions
1	16.5	-	
2	13.2	2.67	
3	17.4	3.29	
Average	15.7	2.98	19.0

Baghouse Number 3

Run No.	Natural Gas Fired May 1979 (lbs/hr)	Coal Fired Sep 1979 (lbs/hr)	% of Initial Emissions
1	6.49	3.50	
2	5.07	3.37	
3	6.07	3.49	
4	7.39	-	
Average	6.26	3.45	55.1

SUMMARY OF RESULTS

Kiln Baghouse Number 1

Run Number	1	2	3
Date	27 Sep 79	27 Sep 79	27 Sep 79
Time	1255-1355	1455-1555	1650-1750
Preheater Flow Rate - ACFM	70300	69200	69200
Preheater Flow Rate - DSCFM*	25600	25700	23900
Baghouse Flow Rate - ACFM	128000	87100	95300
Baghouse Flow Rate -DSCFM*	80300	53100	51900
% Water Vapor - %Vol.	7.55	6.80	5.73
% CO_2 - %Vol. @ Preheater	23.8	19.0	17.6
% CO_2 - %Vol. @ Baghouse	7.6	9.2	8.1
Baghouse Particulate Concentration - gr/dscf	0.00281	0.00225	0.00280
Baghouse Particulate Emission - lbs/hr	1.94	1.02	1.24
Kiln Feed Rate - Ton/hr	36.5	39.0	40.4

SUMMARY OF RESULTS

Kiln Baghouse Number 2

Run Number	2	3	
Date	28 Sep 79	28 Sep 79	
Time	1550-1650	1735-1835	
Preheater Flow Rate - ACFM	71300	71000	
Preheater Flow Rate - DSCFM*	26500	26300	
Baghouse Flow Rate - ACFM	80300	138000	
Baghouse Flow Rate -DSCFM*	48600	84900	
% Water Vapor - %Vol.	6.65	6.56	
% CO_2 - %Vol. @ Preheater	19.6	25.2	
% CO_2 - %Vol. @ Baghouse	10.7	7.8	
Baghouse Particulate Concentration - gr/dscf	0.00642	0.00453	
Baghouse Particulate Emission - lbs/hr	2.67	3.29	
Kiln Feed Rate - Ton/hr	34.8	36.1	

SUMMARY OF RESULTS

Kiln Baghouse Number 3

Run Number	3	4	5
Date	26 Sep 79	26 Sep 79	26 Sep 79
Time	1041-1141	1255-1355	1510-1610
Preheater Flow Rate - ACFM	76200	72700	74500
Preheater Flow Rate - DSCFM*	28900	27200	27000
Baghouse Flow Rate - ACFM	82100	81600	91600
Baghouse Flow Rate -DSCFM*	48700	47700	52100
% Water Vapor - %Vol.	5.70	6.08	7.56
% CO_2 - %Vol. @ Preheater	19.2	18.8	21.0
% CO_2 - %Vol. @ Baghouse	11.4	10.7	10.9
Baghouse Particulate Concentration - gr/dscf	0.00840	0.00824	0.00782
Baghouse Particulate Emission - lbs/hr	3.50	3.37	3.49
Kiln Feed Rate - Ton/hr	40.1	40.7	41.0

DISCUSSION OF RESULTS

The tests performed on the baghouses of kiln numbers 1, 2, and 3 for particulate emissions appear to be valid representations of the actual emissions during the testing. The indicative parameters calculated from the field data of kiln number 1 were in agreement.

The measured preheater flow rates (Qs) for the three tests were within 4.7 percent of the mean value.

The calculated baghouse flow rates (Qb) for the three tests were within 30.0 percent of the mean value.

The calculated emissions (pounds per hour) have shown a range of -27.1 percent to +38.6 percent deviation from the mean value for the three tests.

Although the particulate collection for run number 1 was 71.7 percent above the mean value of runs 2 and 3, it may still be representative of the actual emissions. The increase in the carbon dioxide dilution ratio in run number 1 was the primary factor in the increased emission rate.

The indicative parameters calculated from the field data of kiln number 2 were in close agreement.

The measured preheater flow rates (Qs) for the two tests were within 0.4 percent of the mean value.

The calculated baghouse flow rates (Qb) for the two tests were within 27.2 percent of the mean value.

The calculated emissions (pounds per hour) have shown a range of ±10.4 percent deviation from the mean value for the two tests.

The indicative parameters calculated from the field data of kiln number 3 were in close agreement.

The measured preheater flow rates (Qs) for the three tests were within 4.3 percent of the mean value.

The calculated baghouse flow rates (Qb) for the three tests were within 5.3 percent of the mean value.

The calculated emissions (pounds per hour) have shown a range of -2.3 percent to +1.5 percent deviation from the mean value for the three tests.

Analysis of the accuracy and precision of the test results reveal two areas primarily responsible for error in the emissions: the Hi-vol flow rate measurements and the dilution air correction rates. Hi-vol flow rates were measured from the pressure drop across an orifice which is related to the flow rate in actual cubic feet per minute (Q2) via a calibration curve for a specific orifice. This flow rate (Q2) was then corrected for temperature, pressure and gas molecular weight variation from the time of calibration. The minimum calibration point on the calibrated orifice curve was about 30 acfm. An estimate of the actual flow rate between 20 and 30 acfm may be obtained by a straight line extrapolation of the two lower calibration points. In this lower range, lower orifice pressure drops which indicate a Hi-vol flow rate between 20 to 30 acfm tend to bias the emission rate slightly higher. The following shows a worst case comparison of emissions during initial testing, while firing by natural gas and using the run with the highest Hi-vol flow rate, versus the emissions during the final test, while firing by coal and using the run with the lowest Hi-vol flow rate:

NATURAL GAS FIRED				COAL FIRED			
Kiln No.	Run No.	Avg Q3 ACFM	Ep lbs/hr	Kiln No.	Run No.	Avg Q3 ACFM	Ep lbs/hr
1	1	34.0	6.75	1	1	42.1	1.94
2	2	24.1	13.2	2	2	44.8	2.67
3	1	37.8	6.49	3	3	36.1	3.50

The dilution air correction ratio was based upon the concentration of carbon dioxide at the preheater versus an integrated orsat concentration at the baghouse. The ratio, which was used to determine the baghouse gas flow rate, directly affects the calculated emissions. The greatest variation occurred in the test of kiln number 2 by 27.6 percent from the mean value of the two tests.

DESCRIPTION OF PROCESS OPERATION

Lone Star Industries, Inc. portland cement plant uses a dry process at Maryneal, Texas, in which limestone pulverized in a mill is fed into a suspension preheater followed by the elevated end of a rotary kiln. Bituminous coal burned at the lower end of the kiln heats the raw materials to between 2600°F and 3000°F. The flame front extends about two-thirds the way up the slightly tilted kiln. The combustion gases pass through the slowly rotating kiln and suspension preheater, counterflow to the raw materials and entrain some of the particulate raw material. The products of combustion include carbon dioxide, sulfur dioxide, nitrogen oxides, and water vapor from the fuel. The heated raw materials gives off carbon dioxide as the calcium carbonate is reduced to calcium oxide. The products of combustion and particulates pass through a baghouse and then are exhausted to the atmosphere through the top vents.

The Maryneal plant has three of these kilns each having a kiln feed rate between 35 and 45 tons per hour.

DESCRIPTION OF SAMPLING LOCATION

The sampling doors to the cells are located on the baghouses approximately 70 feet above the ground. The Baghouse Diagram, Figure 1, shows the location of the sampling doors for each of the six cells of the baghouse. The Baghouse Cells Diagram, Figure 2, shows the location of each cell sampled in each of the three baghouses sampled.

The velocity traverses and moisture samples were taken immediately after the preheater from ports located approximately 100 feet above the ground. The sampling was performed on preheater exhaust duct number 1 from two ports on the cylindrical duct located approximately 40 feet (9 duct diameters) downstream of a bend in the duct and approximately 6.5 feet (1.5 duct diameters) upstream of a contraction in the duct. The sampling was performed on preheater exhaust duct 2 and 3 from two ports on the cylindrical duct located approximately 40 feet (9 duct diameters) downstream of a bend in the duct and approximately 24.5 feet (5.55 duct diameters) upstream of a bend in the duct.

The inside duct diameter after the preheater of each kiln is 4 feet 5 inches.

FIGURE 1

Baghouse Diagram

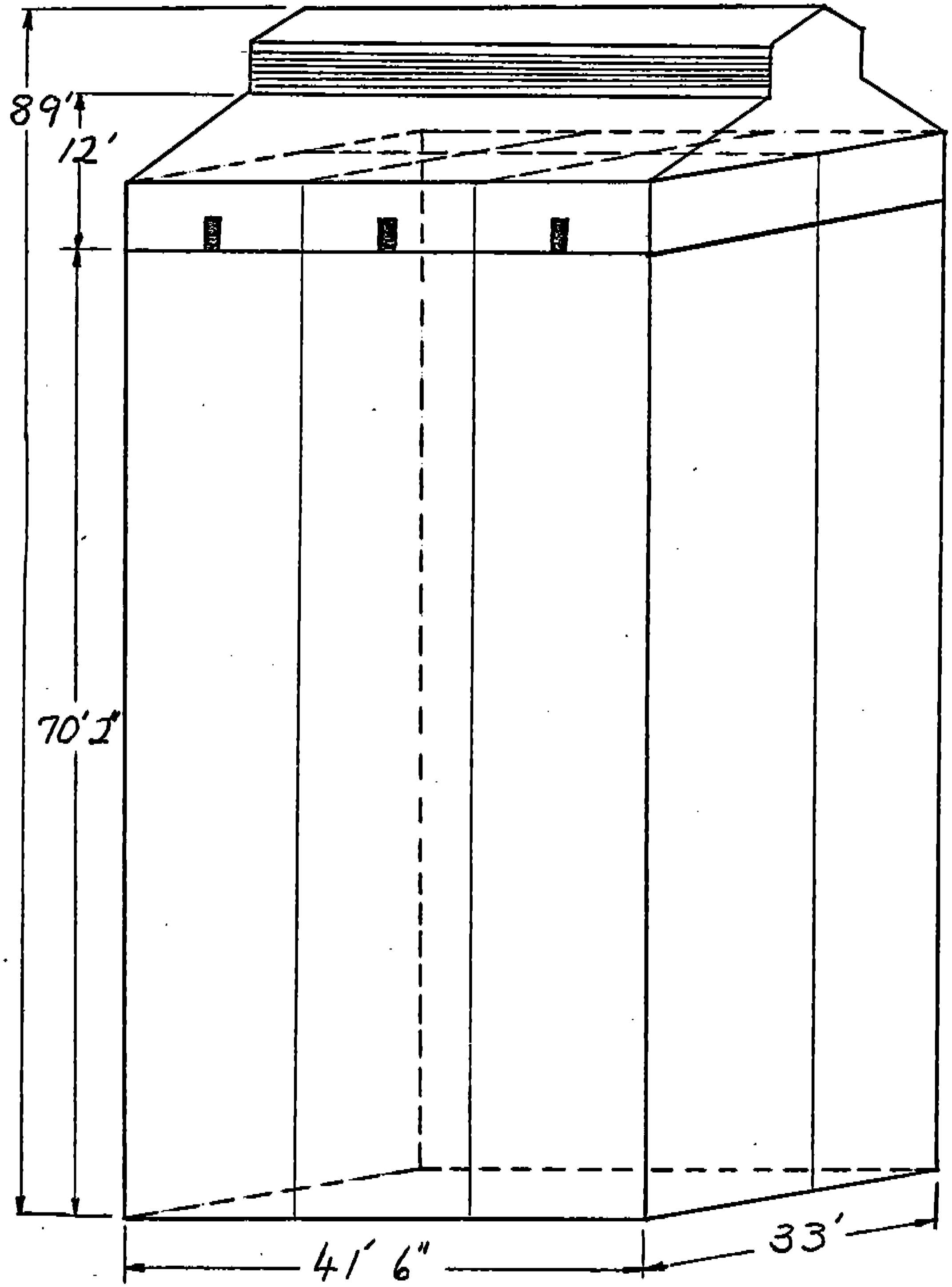
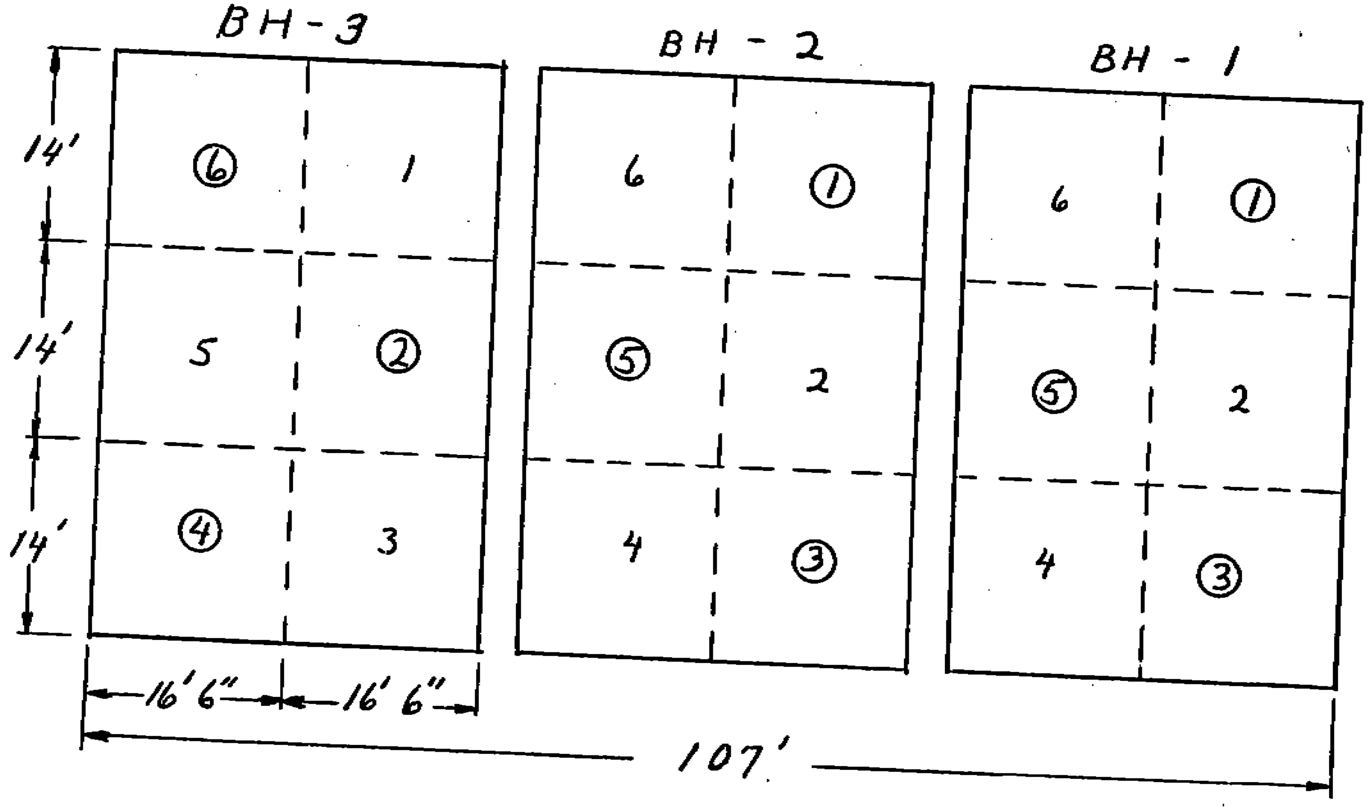


FIGURE 2

Baghouse Cells Diagram



○ Indicates cells sampled

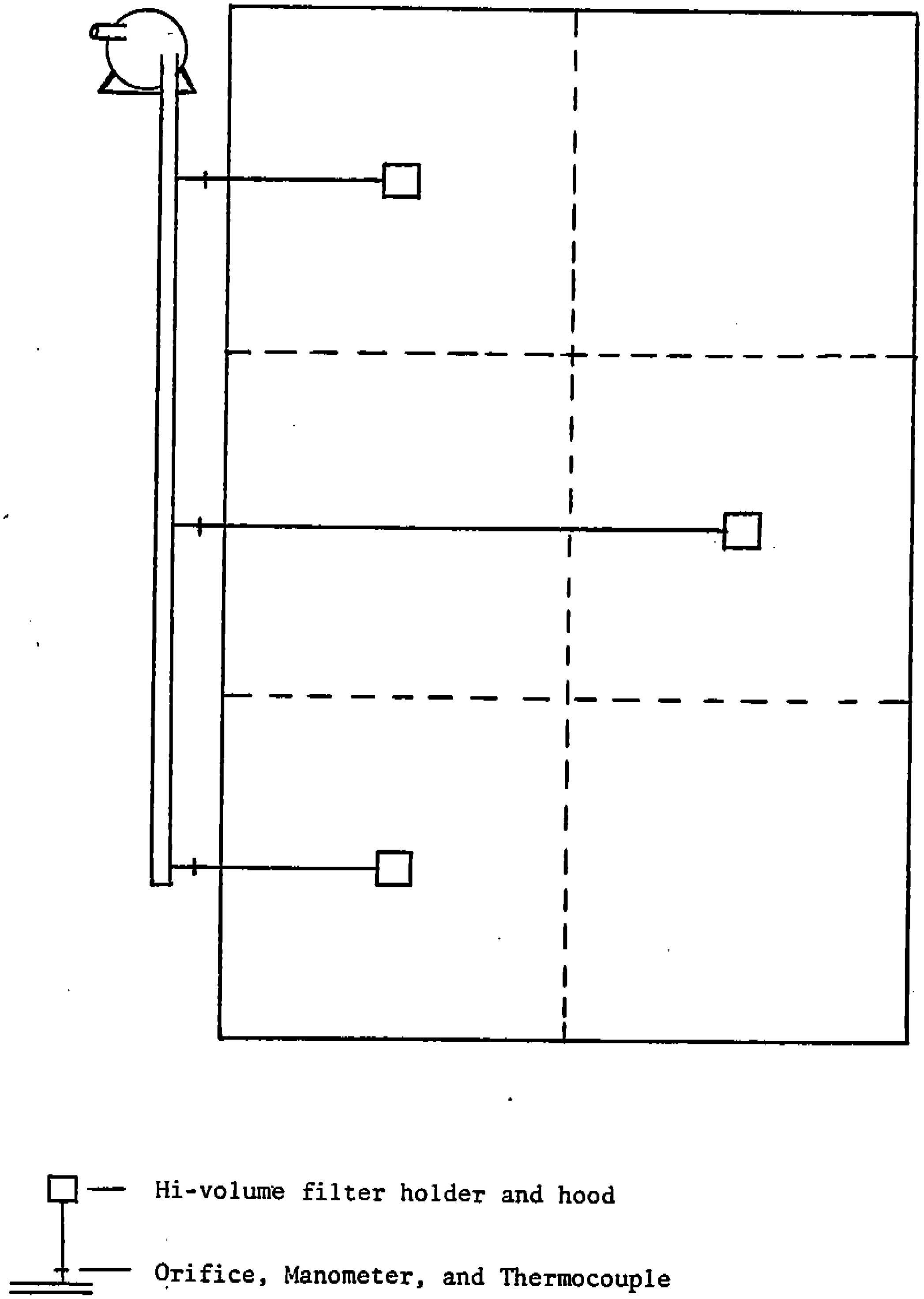
SAMPLING AND ANALYTICAL PROCEDURES

The sampling and analytical procedures used followed the procedures outlined in the Texas Air Control Board notice for sampling procedures, March 15, 1979; the Compliance Sampling Manual, Texas Air Control Board, October 1975; and the Appendix to the Code of Federal Regulations, Title 40, Part 60.

The first and third baghouses were tested with three samples per test, while baghouse number 2 was tested with two samples. Three cells in staggered configuration were sampled during each one hour test. The Hi-Vol sampling assembly is shown in Figure 3. A high volume type air sampler filter holder and hood was placed in the center of each cell sampled approximately 6 feet above the walkway. The Hi-Vol filter holder was connected to an air tight ducting in which the calibrated Hi-Vol orifice had been placed immediately outside the baghouse and before the gas entered a manifold. A manometer and thermocouple were placed at each orifice to record the pressure drop and temperature at 10 minute intervals. The manifold, connecting the duct of each of the three cells sampled, was joined to a large fan and motor assembly capable of withstanding gas temperatures up to 400°F.

FIGURE 3

Hi-Vol Sampling Assembly



Simultaneous with baghouse sampling, a velocity traverse was made at the preheater exhaust duct from each of the two ports in order to determine the gas flow rate from the kiln. A total of 24 points were sampled on preheater number 1 and 12 points were sampled on preheater numbers 2 and 3. A moisture sample was taken at the preheater during each baghouse sample. An orsat was taken at the preheater during each baghouse sample. An integrated sample was taken at the baghouse from each cell sampled at the start and end of each sample. The gas flow rate from the baghouse was corrected for dilution air based on the carbon dioxide concentrations. The bottom of each baghouse was to be sealed to minimize the entrance of dilution air.

Before each moisture sample, the sampling train was leak-checked at 15 inches of mercury at the nozzle. After each test, the train was again leak-checked at the nozzle at the highest recorded vacuum reading during the test. Final leak-checking was performed in order to predetermine the possibility of a diluted sample.

Also before and after each test, the pitot tube lines were checked for leaks under both a vacuum and pressure. The lines were also checked for clearance and the zero manometer reading verified before and after each test.

The particulate emissions were calculated from gravimetric analysis using the preweighed high volume filters.

DESCRIPTION OF TESTS

Personnel from Ecology Audits, Inc. arrived at the portland cement at 1540 hours on Monday, September 24, 1979. After a brief meeting with plant personnel, the equipment was moved onto the baghouse. Each of the Hi-Volume sampling assemblies were calibrated to produce a manometer pressure drop versus Hi-Vol flow rate curve for each orifice. The equipment was secured for the night by 1930 hours.

On Tuesday, September 25, work began at 0750 hours. The equipment was made ready for testing. A slight delay in testing was incurred while plant personnel replaced some of the fiberglass bags in the baghouse, and to obtain power at the electrical outlets of the preheater. The first run began at 1140 hours and continued until its completion at 1240 hours. The flow rates through each Hi-Vol unit were calculated and found to be at the lower limit of 20 acfm. It was decided to monitor the amperage drawn by the motor of the Hi-Vol fan. The second run began at 1530 hours and continued until its completion at 1630 hours. The flow rates through each Hi-Vol unit were calculated and found to have decreased to below 20 acfm. However, the amperage drawn by the motor revealed that it was not under strain. The Hi-Vol fan was inspected and found to be in good condition as well. Plans were made to place another fan and motor assembly in series with the existing assembly to increase the Hi-Vol units' flow rates. The equipment was secured for the night by 1810 hours.

On Wednesday, September 26, work began at 0920 hours. The equipment was made ready for testing while the plant personnel connected another Hi-Vol fan and motor assembly in series with the existing assembly. The Hi-Vol flow rates increased to about 35 acfm. Since the minimum calibration point of the Hi-Vol calibration set was about 30 acfm, the first two runs of baghouse number 3 were voided. The third run began at 1041 hours and continued until its completion at 1141 hours. The fourth run began at 1255 hours and continued until its completion at 1355 hours. The fifth run began at 1510 hours and continued until its completion at 1610 hours. The equipment was secured for the night by 1700 hours.

On Thursday, September 27, work began at 1120 hours. Plant personnel were completing the Hi-Vol manifold and fan assembly transfer to baghouse number 1. The first run on baghouse number 1 began at 1255 hours and continued until its completion at 1355 hours. The second run began at 1455 hours and continued until its completion at 1555 hours. The third run began at 1650 hours and continued until its completion at 1750 hours. The equipment was secured for the night by 1845 hours.

On Friday, September 28, work began at 0815 hours. The equipment was made ready for testing baghouse number 2. The first run began at 1010 hours and continued until its completion at 1110 hours. However, the Hi-Vol flow rate averaged about 20 acfm, below the range of the calibration curve. Therefore, the first run was voided. It was first thought the motor and fan assembly was over heating, as it had been placed on the catwalk between the baghouses. The fan assembly was moved to the outside catwalk for sufficient cooling; however, the Hi-Vol flow rate did not increase. At this time plant personnel discovered the second Hi-Vol fan motor had been wired incorrectly. The motor was wired correctly by 1530 hours. The second run began at 1550 hours and continued until its completion at 1650 hours. The third run began at 1735 hours and continued until its completion at 1835 hours. A fourth run could not be made on the baghouse because Ecology Audits' supply of tared Hi-Vol filters had been exhausted.

The equipment was moved off the baghouse and loaded into the mobile laboratory. The samples were recovered and taken to Ecology Audits' laboratory in Dallas, Texas, for further analysis and evaluation.

Operations at the Lone Star Industries portland cement plant located near Maryneal, Texas, were completed by 1955 hours on Friday, September 28, 1979.

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APPENDICES

APPENDIX A

Location of Velocity Traverse Points
Kiln Preheater Exhaust Duct

On kiln number 1 the sampling ports are located on the cylindrical duct approximately 40 feet (9 duct diameters) downstream of a bend in the duct and approximately 6.5 feet (1.5 duct diameters) upstream of a duct contraction. The location of the traverse points were calculated as follows:

Inside Duct Diameter = 4 feet 5 inches

Port Extension = 2 3/4 inches

Point Number	Percent From The Wall	Distance From the Wall (inches)
1	4.4	2 5/16"
2	14.7	7 13/16"
3	29.5	15 5/8 "
4	70.5	37 3/8 "
5	85.3	45 7/32"
6	95.6	50 11/16"

On kiln numbers 2 and 3 the sampling ports are located on the cylindrical duct approximately 40 feet (9 duct diameters) downstream of a bend in the duct and approximately 24.5 feet (5.55 duct diameters) upstream of a bend in the duct. The location of the traverse points were calculated as follows:

Inside Duct Diameter = 4 feet 5 inches

Port Extension = 2 3/4 inches

Point Number	Percent From The Wall	Distance the Wall (inches)
1	0.021	1 1/8 "
2	0.067	3 9/16"
3	0.118	6 1/4 "
4	0.177	9 5/16"
5	0.250	13 1/4 "
6	0.355	18 13/16"
7	0.645	34 7/32"
8	0.750	39 3/4 "
9	0.823	43 5/8 "
10	0.882	46 3/4 "
11	0.933	49 1/2 "
12	0.979	51 15/16"

APPENDIX B

Source Emissions Calculations

EA 795-09

EMISSION CALCULATIONS
SEPTEMBER 1979

Baghouse No. 1 Run No. 1

1. The flow rate of each Hi-Vol in the specified cell is as follows:

$$Q3 = Q2 \sqrt{\frac{T3\ P2\ 28.9}{T2\ P3\ MW3}} \quad ; V = 60 \text{ min.} (Q3)$$

orifice plate Calibration T & P. outlet temp Barometric molecular wt from orsat

Cell No.	Q2 (ACFM)	T2 (°R)	P2 (in.Hg)	T3 (°R)	P3 (in.Hg)	MW3 (lb/lb mole)	Q3 (ACFM)	V (CF)
1/1	33.06	561	27.94	709	27.84	28.97	41.8	2508
3/3	40.5	570	27.94	666	27.84	28.97	43.8	2628
5/4	36.2	579	27.94	726	27.84	28.97	40.56	2433

2. The particulate concentration in each cell is as follows:

$$Cp = 0.8712 \ \frac{WG\ T3\ DGF}{V\ \ P3}$$

Cell No.	WG (grams)	V (cuf)	P3 (in.Hg)	T3 (°R)	DGF	C_p (gr/dscf)
1	.3082	2508	27.84	709	.9245	.00252
3	.1597	2628	27.84	666	.9245	.00117
5	.5503	2433	27.84	726	.9245	.00475

3. Particulate emission rate from the baghouse is as follows:

Average C_p = 0.00281 grains/dscf

Qb - Baghouse Flow Rate = 80302 DSCFM

$E_p = 0.00857 \ (C_{P\ AVG}) \ (Q_b)$

E_p = 0.00857 (.00281) (80302) = 1.94 lbs/hr

FLOW RATE CALCULATION

Kiln Number 1 Run Number 1

1. Calculate the average corrected stack velocity (V).

   a. Average $\sqrt{\Delta P}$ = $\frac{\sum \sqrt{\Delta P}}{N}$ = .899 in.$^{1/2}$$H_2O$

   b. Average Stack Temperature, TS = 1205 °R

   c. Stack Pressure, PS = 26.91 in.Hg

$$V = 85.48\ (PTCF) \sqrt{\frac{TS}{(MW)(PS)}}\ \text{Avg}\ \sqrt{\Delta P}$$

$$V = 85.48\ (.829) \sqrt{\frac{(1205)}{(31.03)(26.91)}}\ (.899) = \underline{76.515}\ \text{ft/sec}$$

2. Calculate the stack gas flow rate at standard conditions.

   a. Crossectional Area of Stack, AS = 15.32 ft^2

   b. Dry Gas Fraction, DGF = .9245

Qa = 60 sec/min (V) (AS)

Qa = 60 (76.515) (15.32) = 70332 ACFM

$$Qs = Qa\ (DGF)\ \frac{PS}{29.92}\ \frac{528}{TS}$$

$$Qs = (70332)\ (.9245)\ \frac{(26.91)}{29.92}\ \frac{528}{(1205)}$$

Qs = 25625 DSCFM

FLOW RATE DILUTION CORRECTION

Kiln Number 1

Flow rate correction for dilution air based on carbon dioxide concentrations from integrated orsats taken at the preheater and the bag house.

$$Q_b = Q_p \frac{(CO2_p)}{(CO2_b)}$$

a. Volumetric flow rate at the preheater, Q_p = 25643 DSCFM

b. Volumetric flow rate at the bag house, Q_b , DSCFM.

c. CO2 gas fraction at the preheater, $CO2_p$ = .238

d. CO2 gas fraction at the bag house, $CO2_b$ = .076

RUN #1

$$Q_b = (\ 25643\ )\ \frac{(\ .238\ )}{(\ .076\ )} = 80306 \text{ DSCFM}$$

RUN #2

$$Q_b = (\ 25723\ )\ \frac{(\ .190\ )}{(\ .092\ )} = 53125 \text{ DSCFM}$$

RUN #3

$$Q_b = (\ 23875\ )\ \frac{(\ .176\ )}{(\ .081\ )} = 51877 \text{ DSCFM}$$

MAXIMUM ALLOWABLE PARTICULATE EMISSIONS
Kiln Number 1

Texas Air Control Board Rule 131.03.05.001

$E = 0.048\ q^{0.62}$

where E = allowable emission rate, lbs/hr
q = stack gas flow rate, acfm

Run Number	1	2	3
q - acfm	128000	87100	95300
E - lbs/hr	70.4	55.5	58.7
Stack Height Correction Factor*	> 1	> 1	> 1
Stack Height Corrected E - lbs/hr**	-	-	-
Average Allowable Emissions, lbs/hr	-------------- 61.5 ----------------		

$$* \quad SHCF = \left(\frac{\text{Effective Stack Height}}{\text{Standard Effective Stack Height}}\right)^2$$

$$** \quad SHCE = E\ (SHCF)$$

The allowable emissions is only corrected when SHCF is less than one.

MAXIMUM ALLOWABLE PARTICULATE EMISSIONS

Kiln Number 2

Texas Air Control Board Rule 131.03.05.001

$E = 0.048\ q^{0.62}$

where E = allowable emission rate, lbs/hr
q = stack gas flow rate, acfm

Run Number	2	3	
q - acfm	80300	138000	
E - lbs/hr	52.7	73.8	
Stack Height Correction Factor*	> 1	> 1	
Stack Height Corrected E - lbs/hr**	-	-	
Average Allowable Emissions, lbs/hr	-------------- 63.3 ----------------		

$$* \quad SHCF = \left(\frac{\text{Effective Stack Height}}{\text{Standard Effective Stack Height}}\right)^2$$

** SHCE = E (SHCF)

The allowable emissions is only corrected when SHCF is less than one.

MAXIMUM ALLOWABLE PARTICULATE EMISSIONS
Kiln Number 3

Texas Air Control Board Rule 131.03.05.001

$E = 0.048\ q^{0.62}$

where E = allowable emission rate, lbs/hr
q = stack gas flow rate, acfm

Run Number	3	4	5
q - acfm	82100	81600	91600
E - lbs/hr	53.5	53.3	57.2
Stack Height Correction Factor*	> 1	> 1	> 1
Stack Height Corrected E - lbs/hr**	-	-	-
Average Allowable Emissions, lbs/hr	54.7		

* $\text{SHCF} = \left(\frac{\text{Effective Stack Height}}{\text{Standard Effective Stack Height}}\right)^2$

** SHCE = E (SHCF)

The allowable emissions is only corrected when SHCF is less than one.

EMISSION CALCULATIONS

Sept 79

Baghouse No. 1 Run No. 1

1. The flow rate of each Hi-Vol in the specified cell is as follows:

$$Q3 = Q2 \sqrt{\frac{T3\ P2\ 28.9}{T2\ P3\ MW3}} \quad ; V = 60 \text{ min. } Q3$$

Cell No.	Q2 (ACFM)	T2 (°R)	P2 (in.Hg)	T3 (°R)	P3 (in.Hg)	MW (lb/lb mole)	Q3 (ACFM)	V (CF)
1 /1	33.06	561	27.94	709	27.84	28.97	37.2 41.8	2232 2508
3 /3	40.5	570	27.94	666	27.84	28.97	43.8	2628
5 /4	36.2	579	27.94	726	27.84	28.97	40.56	2433

2. The particulate concentration in each cell is as follows:

$$Cp = 0.8712 \ \frac{WG\ T3\ DGF}{V\ \ P3}$$

Cell No.	WG (grams)	V (cuf)	P3 (in.Hg)	T3 (°R)	DGF	C_p (gr/dscf)
1	.3082	2508	27.84	709	.9245	.00252
3	.1597	2628	27.84	666	.9245	.00117
5	.5503	2433	27.84	726	.9245	.00475

3. Particulate emission rate from the baghouse is as follows:

Average C_p = 0.00281 grains/dscf

Qb - Baghouse Flow Rate = 80302 DSCFM

$E_p = 0.00857\ (C_{p\ AVG})\ (Q_b)$

$E_p = 0.00857\ (.00281)\ (80302) =$ 1.94 lbs/hr

EMISSION CALCULATIONS

Sept 1979

Baghouse No. 1 Run No. 2

1. The flow rate of each Hi-Vol in the specified cell is as follows:

$$Q3 = Q2 \sqrt{\frac{T3\ P2\ 28.9}{T2\ P3\ MW3}} \quad ; V = 60 \text{ min. } Q3$$

Cell No.	Q2 (ACFM)	T2 (°R)	P2 (in.Hg)	T3 (°R)	P3 (in.Hg)	MW (lb/lb mole)	Q3 (ACFM)	V (CF)
1/1	33.6	561	27.94	734	27.79	29.67	38.02	2281
3/3	39.5	570	27.94	709	27.79	29.67	43.60	2615
5/4	49.7	579	27.94	733	27.79	29.67	55.34	3320

2. The particulate concentration in each cell is as follows:

$$Cp = 0.8712 \ \frac{WG\ T3\ DGF}{V\ \ P3}$$

Cell No.	WG (grams)	V (cuf)	P3 (in.Hg)	T3 (°R)	DGF	C_p (gr/dscf)
1	.2534	2280	27.79	734	.932	.00238
3	.2106	2615	27.79	709	.932	.00167
5	.4173	3320	27.79	733	.932	.00269

3. Particulate emission rate from the baghouse is as follows:

Average C_p = 0.00225 grains/dscf

Qb - Baghouse Flow Rate = 53125 DSCFM

$Ep = 0.00857 \ (C_{p\ AVG}) \ (Q_b)$

$Ep = 0.00857 \ (.00225) \ (53125) =$ 1.02 lbs/hr

EMISSION CALCULATIONS

Sept 1979

Baghouse No. 1　　　　Run No. 3

1. The flow rate of each Hi-Vol in the specified cell is as follows:

$$Q3 = Q2 \sqrt{\frac{T3\ P2\ 28.9}{T2\ P3\ MW3}} \quad ; V = 60 \text{ min. } Q3$$

Cell No.	Q2 (ACFM)	T2 (°R)	P2 (in.Hg)	T3 (°R)	P3 (in.Hg)	MW (lb/lb mole)	Q3 (ACFM)	V (CF)
1/1	37.9	561	27.94	756	27.765	29.26	43.86	2631
3/3	40.1	570	27.94	694	27.765	29.26	44.11	2646
5/4	35.6	579	27.94	753	27.765	29.26	4047	2428

2. The particulate concentration in each cell is as follows:

$$Cp = 0.8712 \ \frac{WG\ T3\ DGF}{V\ \ P3}$$

Cell No.	WG (grams)	V (cuf)	P3 (in.Hg)	T3 (°R)	DGF	C_p (gr/dscf)
1	.2408	2631	27.765	756	.9427	.00205
3	.4029	2646	27.765	694	.9427	.00313
5	.3519	2428	27.765	753	.9427	.00323

3. Particulate emission rate from the baghouse is as follows:

Average Cp = 0.00280 grains/dscf

Qb - Baghouse Flow Rate = 51877 DSCFM

$E_p = 0.00857 \ (C_{P\ AVG}) \ (Q_b)$

$E_p = 0.00857 \ (0.00280 \ (51877 \ ) =$ 1.24 lbs/hr

EMISSION CALCULATIONS

Sept 79

Baghouse No. 2 Run No. 2

1. The flow rate of each Hi-Vol in the specified cell is as follows:

$$Q3 = Q2 \sqrt{\frac{T3\ P2\ 28.9}{T2\ P3\ MW3}} \quad ; V = 60 \text{ min. } Q3$$

Cell No.	Q2 (ACFM)	T2 (°R)	P2 (in.Hg)	T3 (°R)	P3 (in.Hg)	MW (lb/lb mole)	Q3 (ACFM)	V (CF)
1/1	34.1	561	27.94	761	27.89	29.47	39.37	2362
3/3	44.4	570	27.94	683	27.89	29.47	48.17	2890
5/4	41.5	579	27.94	751	27.89	29.47	46.84	2810

2. The particulate concentration in each cell is as follows:

$$Cp = 0.8712 \ \frac{WG\ T3\ DGF}{V\ \ P3}$$

Cell No.	WG (grams)	V (cuf)	P3 (in.Hg)	T3 (°R)	DGF	Cp (gr/dscf)
1	.7839	2362	27.89	761	.9335	.00736
3	.7116	2890	27.89	683	.9335	.00490
5	.8977	2810	27.89	751	.9335	.00700

3. Particulate emission rate from the baghouse is as follows:

Average Cp = 0.00642 grains/dscf

Qb - Baghouse Flow Rate = 48563 DSCFM

$Ep = 0.00857\ (Cp_{AVG})\ (Q_b)$

Ep = 0.00857 (.00642) (48563) = 2.67 lbs/hr

EMISSION CALCULATIONS

Sept 79

Baghouse No. 2 Run No. 3

1. The flow rate of each Hi-Vol in the specified cell is as follows:

$$Q3 = Q2 \sqrt{\frac{T3\ P2\ 28.9}{T2\ P3\ MW3}} \quad ; V = 60 \text{ min. } Q3$$

Cell No.	Q2 (ACFM)	T2 (°R)	P2 (in.Hg)	T3 (°R)	P3 (in.Hg)	MW (lb/lb mole)	Q3 (ACFM)	V (CF)
1/1	36.8	561	27.94	755	27.89	29.12	42.57	2554
3/3	53.0	570	27.94	682	27.89	29.12	5780	3468
5/4	42.2	579	27.94	732	27.89	29.12	47.31	2839

2. The particulate concentration in each cell is as follows:

$$Cp = 0.8712 \ \frac{WG\ T3\ DGF}{V\ \ P3}$$

Cell No.	WG (grams)	V (cuf)	P3 (in.Hg)	T3 (°R)	DGF	C_p (gr/dscf)
1	.5408	2554	27.89	755	.9344	.00467
3	.5593	3468	27.89	682	.9344	.00321
5	.7596	2839	27.89	732	.9344	.00572

3. Particulate emission rate from the baghouse is as follows:

Average C_p = 0.00453 grains/dscf

Qb - Baghouse Flow Rate = 84864 DSCFM

$E_p = 0.00857\ (C_{p\ AVG})\ (Q_b)$

$E_p = 0.00857\ (.00453)\ (84864) =$ 3.29 lbs/hr

EMISSION CALCULATIONS
Sep '79

Baghouse No. 3 Run No. 3

1. The flow rate of each Hi-Vol in the specified cell is as follows:

$$Q3 = Q2 \sqrt{\frac{T3\ P2\ 28.9}{T2\ P3\ MW3}} \quad ; V = 60 \text{ min. } Q3$$

Cell No.	Q2 (ACFM)	T2 (°R)	P2 (in.Hg)	T3 (°R)	P3 (in.Hg)	MW (lb/lb mole)	Q3 (ACFM)	V (CF)
6/3	33.75	570	27.94	773	28.04	29.72	38.69	2321
4/1	35.05	560.5	27.94	744	28.04	29.72	39.75	2385
2/4	26.40	579	27.94	762	28.04	29.72	29.81	1789

2. The particulate concentration in each cell is as follows:

$$Cp = 0.8712 \frac{WG\ T3\ DGF}{V\ P3}$$

Cell No.	WG (grams)	V (cuf)	P3 (in.Hg)	T3 (°R)	DGF	C_p (gr/dscf)
6	.6047	2321	28.04	773	.943	.00590
4	.2083	2385	28.04	744	.943	.00190
2	1.3938	1789	2804	762	.943	.0174

3. Particulate emission rate from the baghouse is as follows:

Average C_p = 0.00840 grains/dscf

Qb - Baghouse Flow Rate = 48694 DSCFM

$E_p = 0.00857\ (C_{p\ AVG})\ (Q_b)$

$E_p = 0.00857\ (.00840)\ (48694) =$ 3.50 lbs/hr

EMISSION CALCULATIONS

Sept1979

Baghouse No. 3 Run No. 4

1. The flow rate of each Hi-Vol in the specified cell is as follows:

$$Q3 = Q2\sqrt{\frac{T3\ P2\ 28.9}{T2\ P3\ MW3}}\ ;\ V = 60\ \text{min.}\ Q3$$

Cell No.	Q2 (ACFM)	T2 (°R)	P2 (in.Hg)	T3 (°R)	P3 (in.Hg)	MW (lb/lb mole)	Q3 (ACFM)	V (CF)
6/3	36.8	570	27.94	775	27.98	29.55	42.41	2544
4/1	39.6	560.5	27.94	751	27.98	29.55	45.30	2718
2/4	30.2	579	27.94	768.4	27.98	29.55	34.38	2063

2. The particulate concentration in each cell is as follows:

$$Cp = 0.8712\ \frac{WG\ T3\ DGF}{V\ \ P3}$$

Cell No.	WG (grams)	V (cuf)	P3 (in.Hg)	T3 (°R)	DGF	C_p (gr/dscf)
6	.7559	2544	27.98	775	.9392	.00673
4	.2974	2718	27.98	751	.9392	.00240
2	1.4330	2068	27.98	768.4	.9392	.0156

3. Particulate emission rate from the baghouse is as follows:

Average C_p = 0.00824 grains/dscf

Qb - Baghouse Flow Rate = 47712 DSCFM

$E_p = 0.00857\ (C_{P\ AVG})\ (Q_b)$

$E_p = 0.00857$ (.00824) (47712) = 3.37 lbs/hr

EMISSION CALCULATIONS
Sept, 1979

Baghouse No. 3 Run No. 5

1. The flow rate of each Hi-Vol in the specified cell is as follows:

$$Q3 = Q2\sqrt{\frac{T3\ P2\ 28.9}{T2\ P3\ MW3}}\ ;\ V = 60\ \text{min.}\ Q3$$

Cell No.	Q2 (ACFM)	T2 (°R)	P2 (in.Hg)	T3 (°R)	P3 (in.Hg)	MW (lb/lb mole)	Q3 (ACFM)	V (CF)
6/3	37,2	570	27,94	777	27,88	29,40	43.11	2586
4/1	48.5	561	27,94	760	27.88	29,40	55,58	3335
2/4	29,8	579	27,94	775	27,88	29.40	34.22	2053

2. The particulate concentration in each cell is as follows:

$$Cp = 0.8712\ \frac{WG\ T3\ DGF}{V\ \ P3}$$

Cell No.	WG (grams)	V (cuf)	P3 (in.Hg)	T3 (°R)	DGF	C_p (gr/dscf)
6	.6476	2586	27.88	777	.9244	,00562
4	.2710	3335	27.88	760	.9244	,00178
2	1.4732	2053	27.88	775	.9244	,0161

3. Particulate emission rate from the baghouse is as follows:

Average C_p = 0,00782 grains/dscf

Q_b - Baghouse Flow Rate = 52,07 DSCFM

$E_p = 0.00857\ (C_{P\ AVG})\ (Q_b)$

$E_p = 0.00857\ (.00782)\ (52,07) =$ 3.49 lbs/hr

FLOW RATE CALCULATION

Kiln 1, Run 1

1. Calculate the average corrected stack velocity (V).

   a. Average $\sqrt{\Delta P} = \frac{\sum \sqrt{\Delta P}}{N}$ = .899 in.$^{1/2}H_2O$

   b. Average Stack Temperature, TS = 1205 °R

   c. Stack Pressure, PS = 26.91 in.Hg

$$V = 85.48\ (PTCF) \sqrt{\frac{TS}{(MW)(PS)}}\ \text{Avg}\ \sqrt{\Delta P}$$

$$V = 85.48\ (.329) \sqrt{\frac{(1205)}{(31.03)\ (26.91)}}\ (.899) = 76.515\ \text{ft/sec}$$

2. Calculate the stack gas flow rate at standard conditions.

   a. Crossectional Area of Stack, AS = 15.32 ft^2

   b. Dry Gas Fraction, DGF = .9245

$$Qa = 60\ \text{sec/min}\ (V)\ (AS)$$

$$Qa = 60\ (76.515)\ (15.32) = 70332\ \text{ACFM}$$

$$Qs = Qa\ (DGF)\ \frac{PS}{29.92}\ \frac{528}{TS}$$

$$Qs = (70332)\ (.9245)\ \frac{(26.91)}{29.92}\ \frac{528}{(1205)}$$

$$Qs = 25625\ \text{DSCFM}$$

FLOW RATE CALCULATION

Kiln 1, Run 2

1. Calculate the average corrected stack velocity (V).

   a. Average $\sqrt{\Delta P} = \frac{\sum \sqrt{\Delta P}}{N} =$ .882 in.$^{1/2}H_2O$

   b. Average Stack Temperature, TS = 1190 °R

   c. Stack Pressure, PS = 26.89 in.Hg

$$V = 85.48\ (PTCF) \sqrt{\frac{TS}{(MW)(PS)}}\ Avg\ \sqrt{\Delta P}$$

$$V = 85.48\ (.829) \sqrt{\frac{(1190)}{(30.49)(26.89)}}\ (.882) = 75.299 \text{ ft/sec}$$

2. Calculate the stack gas flow rate at standard conditions.

   a. Crossectional Area of Stack, AS = 15.32 ft^2

   b. Dry Gas Fraction, DGF = 0.9320

$$Qa = 60 \text{ sec/min } (V)\ (AS)$$

$$Qa = 60\ (75.299)\ (15.32) = 69214.488 \text{ ACFM}$$

$$Qs = Qa\ (DGF)\ \frac{PS}{29.92}\ \frac{528}{TS}$$

$$Qs = (69214.488)\ (.932)\ \frac{(26.89)}{29.92}\ \frac{528}{(1190)}$$

$$Qs = 25723.443 \text{ DSCFM}$$

FLOW RATE CALCULATION

Kiln 1, Run 3

1. Calculate the average corrected stack velocity (V).

   a. Average $\sqrt{\Delta P} = \frac{\sum \sqrt{\Delta P}}{N} =$ .893 in.$^{1/2}H_2O$

   b. Average Stack Temperature, TS = 1158 °R

   c. Stack Pressure, PS = 26.88 in.Hg

$$V = 85.48\ (PTCF) \sqrt{\frac{TS}{(MW)(PS)}}\ \text{Avg}\ \sqrt{\Delta P}$$

$$V = 85.48\ (.829) \sqrt{\frac{(1158)}{(30.47)(26.88)}}\ (.893) = \underline{75.2444}\ \text{ft/sec}$$

2. Calculate the stack gas flow rate at standard conditions.

   a. Crossectional Area of Stack, AS = 15.32 ft^2

   b. Dry Gas Fraction, DGF = .9427

$$Qa = 60\ \text{sec/min}\ (V)\ (AS)$$

$$Qa = 60\ (75.2444)\ (15.32) = \underline{69164.285}\ \text{ACFM}$$

$$Qs = Qa\ (DGF)\ \frac{PS}{29.92}\ \frac{528}{TS}$$

$$Qs = (69164.285)\ (.9427)\ \frac{(26.88)}{29.92}\ \frac{528}{(1158)}$$

$$Qs = \underline{23875.25}\ \text{DSCFM}$$

FLOW RATE CALCULATION
Kiln 2, Run 2

1. Calculate the average corrected stack velocity (V).
   a. Average $\sqrt{\Delta P} = \frac{\sum \sqrt{\Delta P}}{N} = \underline{.909}$ in.$^{1/2}H_2O$
   b. Average Stack Temperature, TS = $\underline{1191}$ °R
   c. Stack Pressure, PS = $\underline{26.88}$ in.Hg

$$V = 85.48\ (PTCF) \sqrt{\frac{TS}{(MW)(PS)}}\ Avg \sqrt{\Delta P}$$

$$V = 85.48\ (.829) \sqrt{\frac{(1191)}{(30.59)(26.88)}}\ (.909) = \underline{77.574}\ \text{ft/sec}$$

2. Calculate the stack gas flow rate at standard conditions.
   a. Crossectional Area of Stack, AS = $\underline{15.32}$ ft^2
   b. Dry Gas Fraction, DGF = $\underline{.9335}$

$$Qa = 60\ \text{sec/min}\ (V)\ (AS)$$

$$Qa = 60\ (77.574)\ (15.32) = \underline{71306.412}\ \text{ACFM}$$

$$Qs = Qa\ (DGF)\ \frac{PS}{29.92}\ \frac{528}{TS}$$

$$Qs = (71306.412)\ (.9335)\ \frac{(26.88)}{29.92}\ \frac{528}{(1191)}$$

$$Qs = \underline{26511.405}\ \text{DSCFM}$$

FLOW RATE CALCULATION

Kiln #2, Run 3

1. Calculate the average corrected stack velocity (V).

   a. Average $\sqrt{\Delta P}$ = $\frac{\sum \sqrt{\Delta P}}{N}$ = .914 in.$^{1/2}H_2O$

   b. Average Stack Temperature, TS = 1198 °R

   c. Stack Pressure, PS = 26.88 in.Hg

$$V = 85.48\ (PTCF) \sqrt{\frac{TS}{(MW)(PS)}}\ \text{Avg}\ \sqrt{\Delta P}$$

$$V = 85.48\ (.829) \sqrt{\frac{(1198)}{(31.34)(26.88)}}\ (.914) = 77.238\ \text{ft/sec}$$

2. Calculate the stack gas flow rate at standard conditions.

   a. Crossectional Area of Stack, AS = 15.32 ft^2

   b. Dry Gas Fraction, DGF = .9344

$$Qa = 60\ \text{sec/min}\ (V)\ (AS)$$

$$Qa = 60\ (77.238)\ (15.32) = 70996.925\ \text{ACFM}$$

$$Qs = Qa\ (DGF)\ \frac{PS}{29.92}\ \frac{528}{TS}$$

$$Qs = (70996.925\ (.9344)\ \frac{(26.88)}{29.92}\ \frac{528}{(1198)}$$

$$Qs = 26267.404\ \text{DSCFM}$$

FLOW RATE CALCULATION
Kiln 3, Run 3

1. Calculate the average corrected stack velocity (V).

   a. Average $\sqrt{\Delta P}$ = $\frac{\sum \sqrt{\Delta P}}{N}$ = .9778 in.$^{1/2}$ H_2O

   b. Average Stack Temperature, TS = 1187 °R

   c. Stack Pressure, PS = 27.08 in.Hg

$$V = 85.48\ (PTCF)\ \sqrt{\frac{TS}{(MW)(PS)}}\ \text{Avg}\ \sqrt{\Delta P}$$

$$V = 85.48\ (.829)\ \sqrt{\frac{(1187)}{(27.08)(30.60)}}\ (.9778) = 82.8484\ \text{ft/sec}$$

2. Calculate the stack gas flow rate at standard conditions.

   a. Crossectional Area of Stack, AS = 15.32 ft^2

   b. Dry Gas Fraction, DGF = .943

Qa = 60 sec/min (V) (AS)

Qa = 60 (82.8484) (15.32) = 76154.233 ACFM

$$Qs = Qa\ (DGF)\ \frac{PS}{29.92}\ \frac{528}{TS}$$

$$Qs = (76154233)\ (.943)\ \frac{(27.08)}{29.92}\ \frac{528}{(1187)}$$

Qs = 28911.859 DSCFM

FLOW RATE CALCULATION

Kiln 3 , Run 4

1. Calculate the average corrected stack velocity (V).

   a. Average $\sqrt{\Delta P} = \frac{\sum \sqrt{\Delta P}}{N} =$ .9264 in.$^{1/2}H_2O$

   b. Average Stack Temperature, TS = 1196.4 °R

   c. Stack Pressure, PS = 26.98 in.Hg

$$V = 85.48\ (PTCF) \sqrt{\frac{TS}{(MW)(PS)}}\ \text{Avg}\ \sqrt{\Delta P}$$

$$V = 85.48\ (.829) \sqrt{\frac{(1196.4)}{(30.59)(26.98)}}\ (.9264) = \underline{79.04}\ \text{ft/sec}$$

2. Calculate the stack gas flow rate at standard conditions.

   a. Crossectional Area of Stack, AS = 15.32 ft^2

   b. Dry Gas Fraction, DGF = .9392

Qa = 60 sec/min (V) (AS)

Qa = 60 (79.04) (15.32) = 72653.258 ACFM

$$Qs = Qa\ (DGF)\ \frac{PS}{29.92}\ \frac{528}{TS}$$

$$Qs = (76253.258)\ (.9392)\ \frac{(26.98)}{29.92}\ \frac{528}{(1196.4)}$$

Qs = 27155.078 DSCFM

FLOW RATE CALCULATION

Kiln 3, Run 5

1. Calculate the average corrected stack velocity (V).

   a. Average $\sqrt{\Delta P}$ = $\frac{\sum \sqrt{\Delta P}}{N}$ = .945 in.$^{1/2}H_2O$

   b. Average Stack Temperature, TS = 1208 °R

   c. Stack Pressure, PS = 26.88 in.Hg

$$V = 85.48\ (PTCF) \sqrt{\frac{TS}{(MW)(PS)}}\ \text{Avg}\ \sqrt{\Delta P}$$

$$V = 85.48\ (.829) \sqrt{\frac{(1208)}{(30.65)(26.88)}}\ (.945) = \underline{81.059}\ \text{ft/sec}$$

2. Calculate the stack gas flow rate at standard conditions.

   a. Crossectional Area of Stack, AS = 15.32 ft^2

   b. Dry Gas Fraction, DGF = .9244

$$Qa = 60\ \text{sec/min}\ (V)\ (AS)$$

$$Qa = 60\ (81.059)\ (15.32) = \underline{74509.433}\ \text{ACFM}$$

$$Qs = Qa\ (DGF)\ \frac{PS}{29.92}\ \frac{528}{TS}$$

$$Qs = (74509.433)\ (.9244)\ \frac{(26.88)}{29.92}\ \frac{528}{(1208)}$$

$$Qs = \underline{27046.175}\ \text{DSCFM}$$

FLOW RATE DILUTION CORRECTION

Kiln No. 1

Flow rate correction for dilution air based on carbon dioxide concentrations from integrated orsats taken at the preheater and the bag house.

$$Q_b = Q_p \frac{(CO2_p)}{(CO2_b)}$$

a. Volumetric flow rate at the preheater, Q_p = 25643 DSCFM

b. Volumetric flow rate at the bag house, Q_b , DSCFM.

c. CO2 gas fraction at the preheater, $CO2_p$ = .238

d. CO2 gas fraction at the bag house, $CO2_b$ = .076

RUN #1

$$Q_b = (25643) \frac{(.238)}{(.076)} = 80302 \text{ DSCFM}$$

RUN #2

$$Q_b = (25723) \frac{(.190)}{(.092)} = 53125 \text{ DSCFM}$$

RUN #3

$$Q_b = (23875) \frac{(.176)}{(.081)} = 51877 \text{ DSCFM}$$

FLOW RATE DILUTION CORRECTION

Kiln No. 2

Flow rate correction for dilution air based on carbon dioxide concentrations from integrated orsats taken at the preheater and the bag house.

$$Q_b = Q_p \frac{(CO2_p)}{(CO2_b)}$$

a. Volumetric flow rate at the preheater, Q_p = 26511 DSCFM

b. Volumetric flow rate at the bag house, Q_b , DSCFM.

c. CO2 gas fraction at the preheater, $CO2_p$ = .196

d. CO2 gas fraction at the bag house, $CO2_b$ = .107

RUN #1

$$Q_b = (\qquad) \frac{(\qquad)}{(\qquad)} = \underline{\qquad} \text{ DSCFM}$$

RUN #2

$$Q_b = (26511) \frac{(.196)}{(.107)} = 48565 \text{ DSCFM}$$

RUN #3

$$Q_b = (26267) \frac{(.252)}{(.078)} = 84864 \text{ DSCFM}$$

FLOW RATE DILUTION CORRECTION

Kiln No. 3

Flow rate correction for dilution air based on carbon dioxide concentrations from integrated orsats taken at the preheater and the bag house.

$$Q_b = Q_p \frac{(CO2_p)}{(CO2_b)}$$

a. Volumetric flow rate at the preheater, Q_p = 28912 DSCFM

b. Volumetric flow rate at the bag house, Q_b , DSCFM.

c. CO2 gas fraction at the preheater, $CO2_p$ = .192

d. CO2 gas fraction at the bag house, $CO2_b$ = .114

RUN #3

$Q_b = (28912) \frac{(.192)}{(.114)}$ = 48694 DSCFM

RUN #4

$Q_b = (27155) \frac{(.188)}{(.107)}$ = 47712 DSCFM

RUN #5

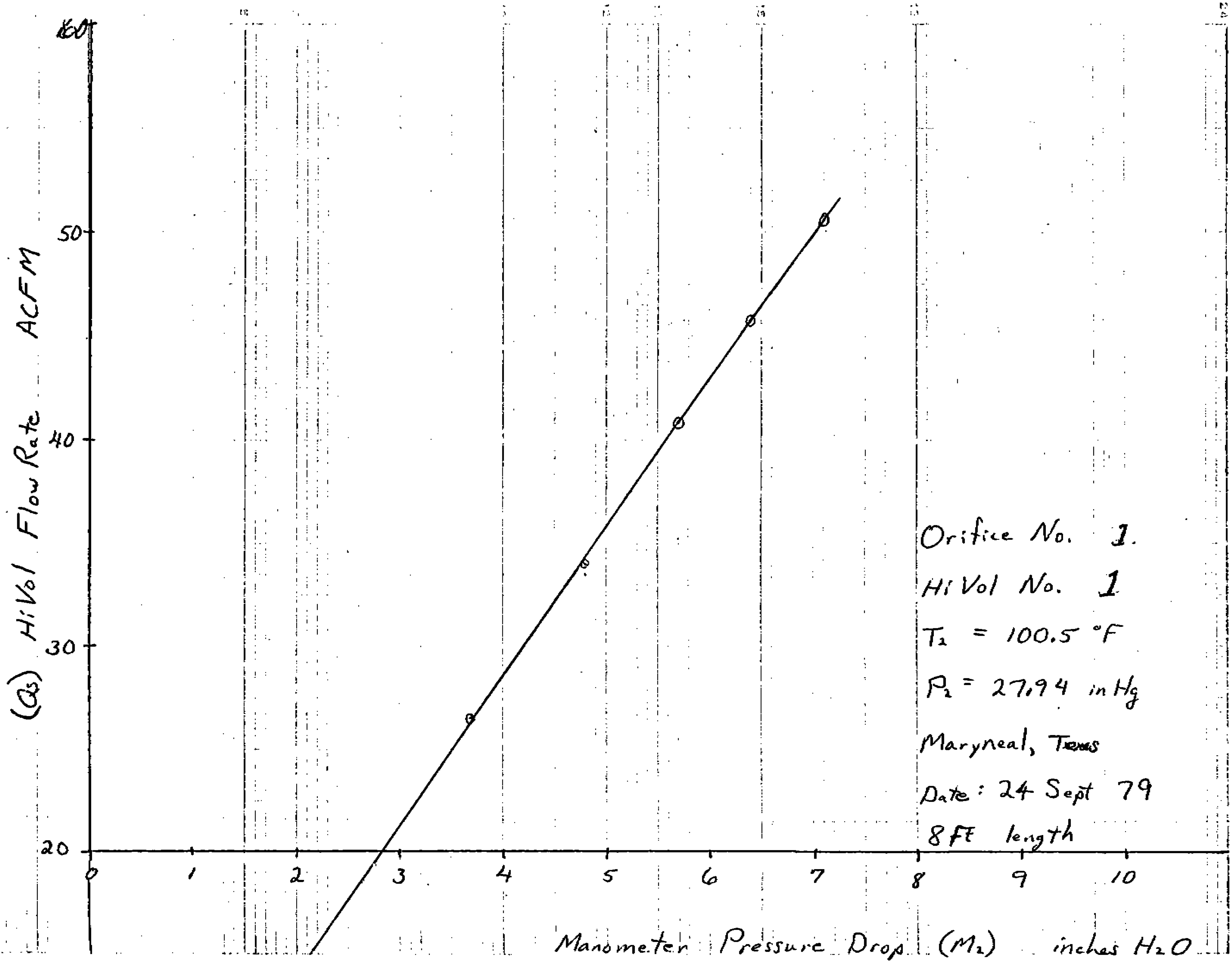
$Q_b = (27046) \frac{(.210)}{(.109)}$ = 52107 DSCFM

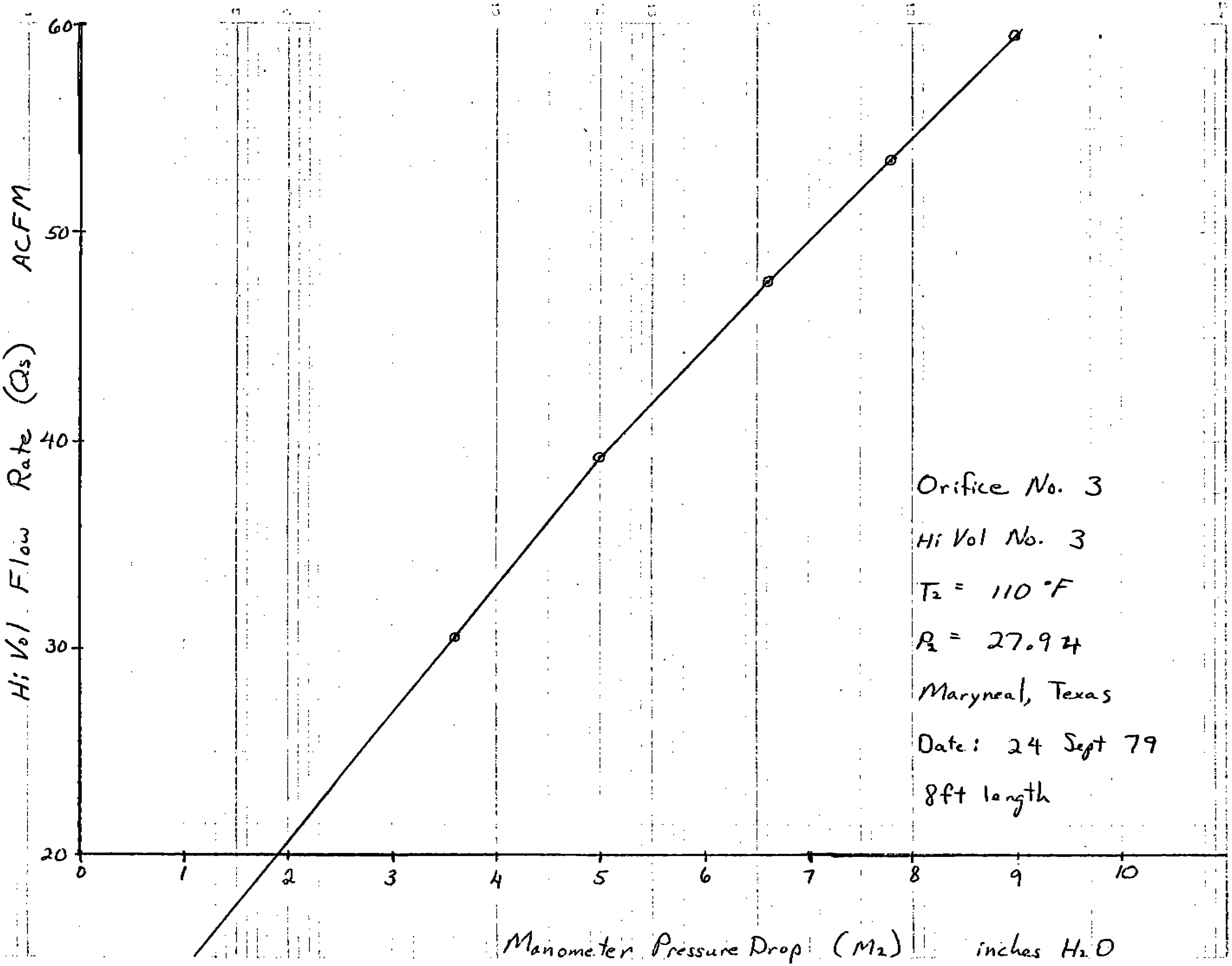
APPENDIX C

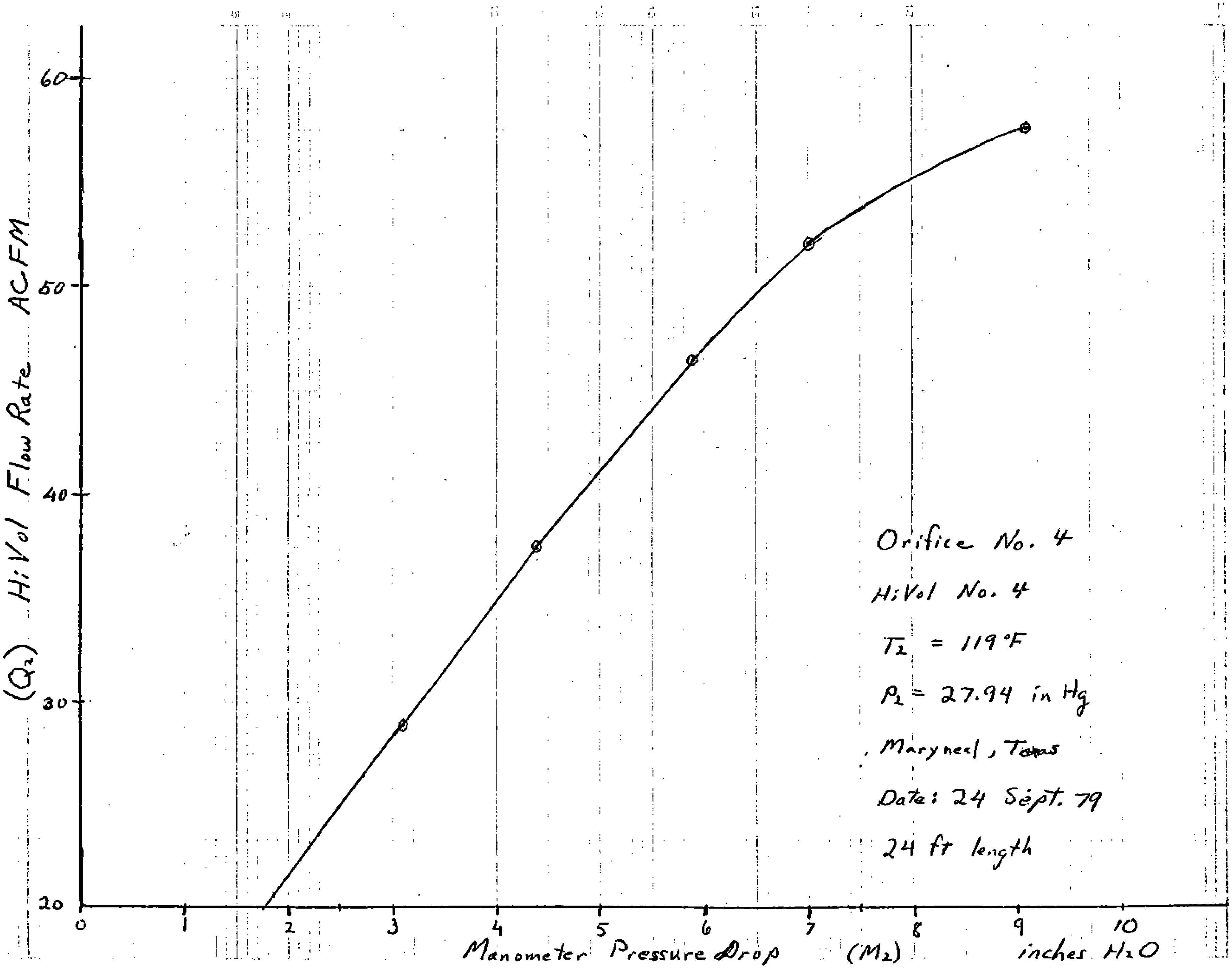
Calibration of Equipment

Equipment	Calibration Factor	Date of Calibration
Pitot Tube LS	0.829	14 May 1979
Dry Gas Meter #4	1.018	24 Jul 1979
*Hi-Vol Unit #1		24 Sep 1979
*Hi-Vol Unit #3		24 Sep 1979
*Hi-Vol Unit #4		24 Sep 1979

* Calibration of Hi-Volume air samplers was in accordance with the procedures as stated in Appendix C of the Compliance Sampling Manual, Texas Air Control Board, October 1975.

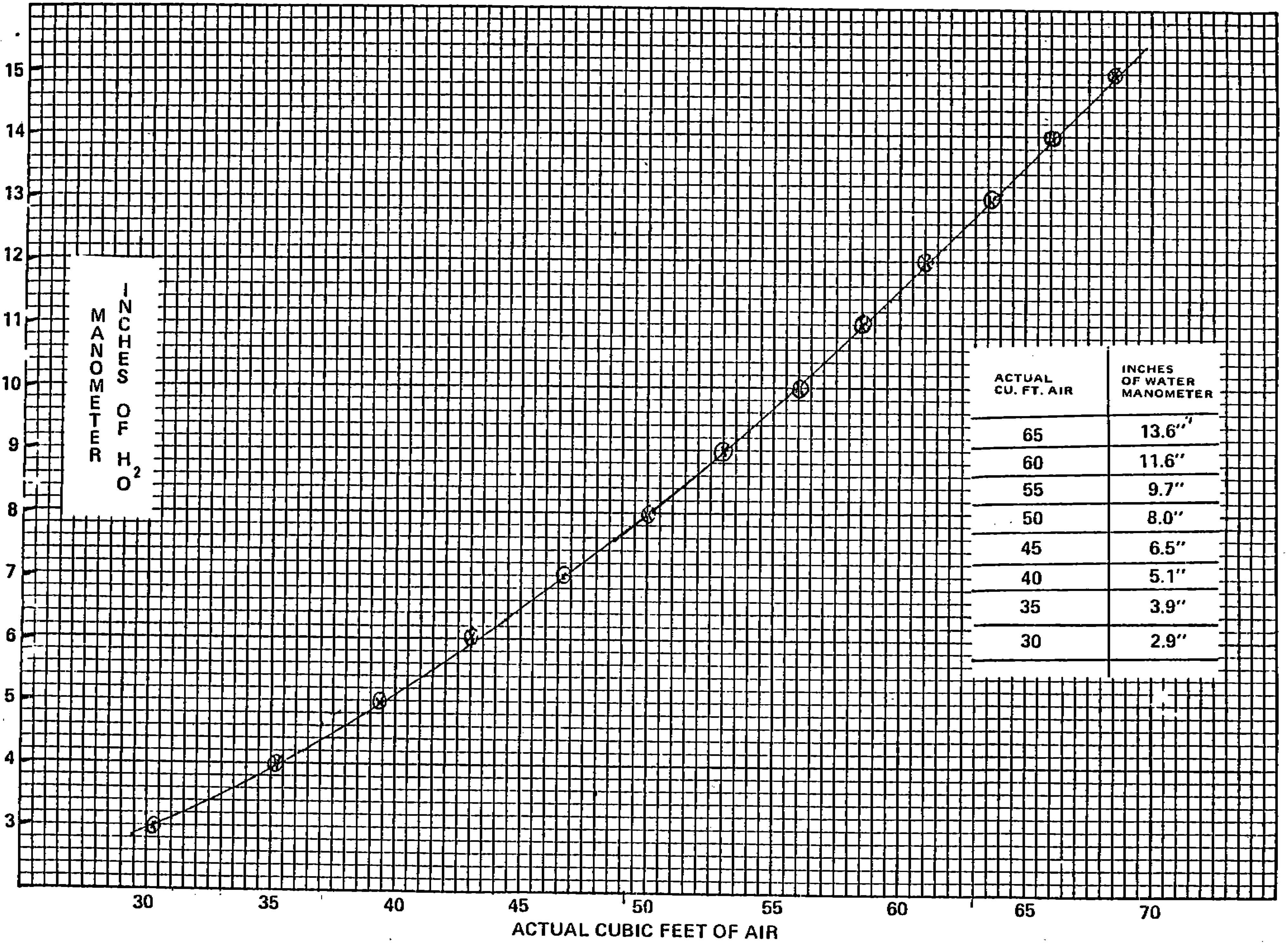

Orifice No. 1.
Hi Vol No. 1
T₁ = 100.5 °F
P₁ = 27.94 in Hg
Maryneal, Texas
Date: 24 Sept 79
8 Ft length
(Qs) HiVol Flow Rate ACFM
60
50
40
30
20
0
1
2
3
4
5
6
7
8
9
10
Manometer Pressure Drop (M₁) inches H₂O


Orifice No. 3
Hi Vol No. 3
T_2 = 110 °F
P_2 = 27.94
Maryneal, Texas
Date: 24 Sept 79
8ft length
Hi Vol Flow Rate (Q_s) ACFM
60
50
40
30
20
0
1
2
3
4
5
6
7
8
9
10
Manometer Pressure Drop (M_2) inches H_2O


(Q₂) HiVol Flow Rate ACFM
60
50
40
30
20
0
1
2
3
4
5
6
7
8
9
10
Manometer Pressure Drop (M₂) inches H₂O
Orifice No. 4
HiVol No. 4
T₂ = 119°F
P₂ = 27.94 in Hg
Maryneal, Texas
Date: 24 Sept. 79
24 ft length

GUR

AVERAGE CALIBRATION CURVE FOR GMW CALIBRATION ORIFICE ± 1.0% ACCURACY



ACTUAL CU. FT. AIR	INCHES OF WATER MANOMETER
65	13.6"
60	11.6"
55	9.7"
50	8.0"
45	6.5"
40	5.1"
35	3.9"
30	2.9"

DATE 14 May 79

Pitol Tube Calibration

BY T. Roe

Lone Star Industries Pitot tube

Average Range

Pitot No.	ΔP Std.	ΔP	ΔP Range (±)	Cp = $\sqrt{\frac{(.99)^2 \times \Delta P Std.}{\Delta P}}$
LS	.10	.165		0.7707
	.20	.295		0.8152
	.30	.44		0.8175
	.40	.585		0.8186
	✓.50	.725		0.8221
	.60	.865		0.8245
	.70	1.02		0.820
	✓.80	1.13		0.8330
	.90	1.27		0.8334
	1.00	1.40		0.8367
	1.25	1.75		0.8367
	✓1.50	2.10		0.8367
	2.00	2.78		0.8397
	2.50	2.48		0.839
	3.00	4.15		0.8417
	~~4.00~~			
	~~5.00~~			

Average Range during test Cp = 0.829

Total AVE. .8291

APPENDIX D

Field Testing Data

BAGHOUSE SAMPLING DATA

Date 27 Sept 79 Baghouse No. 1 Sample No. 1

Operator T. Roe Bar. Pressure 27.84 "Hg

Cell No. 1 Filter No. 21 Orifice No. 1

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1255	4.9	115
10	1305	5.2	213
20	1315	4.8	276
30	1325	4.6	264
40	1335	4.4	287
50	1345	4.2	298
60	1355	4.2	289

P_{AV} = 46.1 T_{AV} = 249

Q_2 = 33.06 ACFM

Cel No. 3 Filter No. 22 Orifice No. 3

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1255	5.4	108
10	1305	5.7	203
20	1315	5.4	214
30	1325	5.4	248
40	1335	5.6	218
50	1345	5.0	206
60	1355	4.9	244

P_{AV} = 5.26 T_{AV} = 206

Q_2 = 40.5 ACFM

BAGHOUSE SAMPLING DATA (continued)

Cell No. 5 Filter No. 10 Orifice No. 4

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1255	4.8	128
10	1305	4.7	276
20	1315	4.1	285
30	1325	4.1	298
40	1335	4.0	277
50	1345	3.9	300
60	1355	3.7	299

$P_{AV} = 4.19$ $T_{AV} = 266$

$Q_2 = \underline{36.2}$ ACFM

Integrated Orsat Analysis Results

(Gas Fractional Part)

Initial		**Final**		**Average**	
CO_2	.072	CO_2	.080	CO_2	.076
O_2	.162	O_2	.160	O_2	.161

BH 1
Run 1
Kiln 1

PRELIMINARY
ORSAT ANALYSIS RESULTS

Date 27 Sept 79
Time
Signature JJ
Gas Fractional Part

CO_2	0.076
O_2	0.161
CO	0
N_2	0.763

Orsat fractional parts must sum to 1.00.

At least one preliminary Orsat analysis must be taken unless reliable preliminary information is available from other sources. If a preliminary Orsat is not taken, state how this preliminary information was obtained: ______________________________.

PRELIMINARY
MOLECULAR WEIGHT CALCULATIONS

This calculation of molecular weight is not required for gaseous sampling.

	Molecular Weights	Orsat Fraction	Moisture Fraction / Dry Gas Fraction		Partial Mol. Wt.
H_2O	(18).		[.0755 x]	=	1.36
CO_2	(44)	(.076)	[.9245]	=	3092
O_2	(32)	(.161)			4.76
CO	(28)	(0)			0
N_2	(28)	(.763)			19.75

Molecular Weight of Stack Gas 28.97
(Sum of partial molecular weights)

Date 10 Oct
Signature JJ

Prehatr #1
Kiln #1
Run #1

PRELIMINARY
ORSAT ANALYSIS RESULTS

Date 27 Sept 79

Time 1300

Signature

Gas Fractional Part

CO_2 .238

O_2 .072

CO .000

N_2 .690

Orsat fractional parts must sum to 1.00.

At least one preliminary Orsat analysis must be taken unless reliable preliminary information is available from other sources. If a preliminary Orsat is not taken, state how this preliminary information was obtained:

PRELIMINARY
MOLECULAR WEIGHT CALCULATIONS

This calculation of molecular weight is not required for gaseous sampling.

	Molecular Weights	Orsat Fraction	Moisture Fraction / Dry Gas Fraction	Partial Mol. Wt.
H_2O	(18)		.0755	1.36
CO_2	(44)	.238	.9245	9.68
O_2	(32)	.072		2.13
CO	(28)	0		0
N_2	(28)	.690		17.86

Molecular Weight of Stack Gas 31.03
(Sum of partial molecular weights)

Date 10 Oct

Signature

Kiln #1
Run #1

PRELIMINARY MOISTURE DETERMINATION

If preliminary moisture is not determined by the following procedure please state how preliminary moisture was determined:

____

____

CONDENSER METHOD

Initial Meter Temp. Inlet 88 Outlet 86

Final Meter Temp. Inlet 91 Outlet 89

Average Tmp. 88.5 °F TM = Average temp. + 460 = 548.5 °R

FIRST IMPINGER		SILICA GEL IMPINGER	
Final Wt.	685.5	Final Wt.	873.4
Initial Wt.	676.10	Initial Wt.	867.00
	9.4		6.4

Total Gain, MWC 15.8 grams H_2O

(Add the gains from both impingers to obtain total gain)

Pressure at Meter, PM, 27.84 inches Hg. (For purposes of this test, PM is equal to atmospheric pressure since ΔH is very small.)

Dry Gas Meter Reading, Final 582.002
Initial 572.002
Net Volume 10.000 ft^3

Corrected Volume (V)
Dry Gas Meter Calibration Factor, DGMCF 1.018
V = (Net Vol) (DGMCF) = (10.000) (1.018) = 10.180 ft^3

$$\text{Moisture Fraction} = \frac{(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}}{\left[(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}\right] + \left[\frac{(\text{V})\quad(\text{PM})}{(\text{TM})}\ (501.7)\ \frac{\text{liters } ^\circ\text{R}}{\text{ft}^3 \text{ in. Hg}}\right]}$$

$$\text{Moisture Fraction} = \frac{(15.8)\ (1.339)}{\left[(15.8)\ (1.339)\right] + \left[\frac{(10.180)\ (27.84)}{548.5}\ (501.7)\right]}$$

$$= \underline{\underline{0.0755}}$$

Dry Gas Fraction = 1 - (moisture fraction) = 1 - (.0755) = 0.9245

When the moisture determination experiment is repeated, use copies of this page for collecting data and recording results. If this is done, calculate the averages:

Average Moisture Fraction ________

Average Dry Gas Fraction ________

Date ________
Signature

PRELIMINARY VELOCITY DETERMINATION

If preliminary velocity is not determined by the following procedure please state how preliminary velocity was determined.

Kiln # 1 Run # 1

Traverse Pt.	Δp (inches H_2O) I	II	III
Date	West 27 Sept		
Time	Port 1300	North	Port
1	.62/748	.69/	727
2	.78/750	.83/	746
3	.88/758	.89/	748
4	.88/758	.91/	753
5	.91/760	.95/	752
6	.92/762	.97/	757
7	.89/765	.95/	758
8	.87/761	.93/	760
9	.80/751	.92/	751
10	.71/738	.82/	745
11	.65/735	.64/	741
12	.55/650	.57/	705
13			
14		T_s = 745	
15		= 1205 °R	
16			
17			
18			
19			
20			
21			
22			
23			
24			

For Preliminary Velocity Calculation, Isokinetic Sampling:

1. Use calculator to sum the square roots of all Δp's and divide this by N, the number of Δp's.

$$\text{Aver. } \sqrt{\Delta p} = \frac{\Sigma\sqrt{\Delta p}}{N}$$

$$\text{Aver. } \sqrt{\Delta p} = \frac{(\quad)}{(\quad)} = .899$$

(units are inches H_2O to the one half power)

2. Obtain the pitot tube calibration factor for the probe used. Probe No. L5 Pitot Tube Calibration Factor .829 (Shown in the equation below as PTCF)

3. Calculate Absolute Stack Pressure:

5.9
6.7
12.6

Measured Stk. Press. (gage) -12.6 "H_2O

(Measured stack press. may be (+) or (−))

Preliminary Atmo. Press. 27.84 "Hg

Stack pressure in inches of water (gage), times 0.07355, plus the barometric pressure in inches mercury equal to the absolute stack pressure in inches of mercury:

(   ) in.H_2O (.07355) + (   ) in. Hg = Stack Press. 26.91 in. Hg

4. Calculate average preliminary velocity, V, in feet per second as shown below.

$$V = (85.48)\,(\text{PTCF})\sqrt{\frac{(\text{Stack Temp. }^\circ\text{R})}{\begin{bmatrix}\text{Mole.}\\ \text{Wt.}\end{bmatrix}\begin{bmatrix}\text{Stk. Press.}\\ \text{inches Hg}\end{bmatrix}}}\,(\text{Average}\sqrt{\Delta p})$$

$$V = (85.48)\,(\quad)\sqrt{\frac{(\quad)}{(\quad)(\quad)}}\,(\quad) = \underline{\qquad}\ \text{ft/sec}$$

Date ______

Time ______

Signature ______

BAGHOUSE SAMPLING DATA

Date 22 Sept 89 Baghouse No. 1 Sample No. 2

Operator T Roe Bar. Pressure 27.79 "Hg

Cell No. 1 Filter No. 23 Orifice No. 1

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1455	6.1	119
10	1505	4.9	285
20	1515	4.5	310
30	1525	4.4	308
40	1535	4.9	299
50	1545	4.0	299
60	1555	4.0	297

$P_{AV} = 4.69$ $T_{AV} = 274$

$Q_2 = \underline{33.6}$ ACFM

Cel No. 3 Filter No. 24 Orifice No. 3

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1455	5.4	120
10	1505	5.2	233
20	1515	5.2	282
30	1525	4.9	287
40	1535	4.9	272
50	1545	4.9	271
60	1555	4.8	275

$P_{AV} = 5.04$ $T_{AV} = 249$

$Q_2 = \underline{39.5}$ ACFM

BAGHOUSE SAMPLING DATA (continued)

Cell No. 5 Filter No. 25 Orifice No. 4

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1455	7.9	140
10	1505	6.9	281
20	1515	6.7	306
30	1525	6.3	303
40	1535	6.2	297
50	1545	6.0	290
60	1555	5.8	295

$P_{AV} = 6.54$ $T_{AV} = 273$

$Q_2 = 49.7$ ACFM

Integrated Orsat Analysis Results

(Gas Fractional Part)

Initial		Final		Average	
CO_2	.090	CO_2	.094	CO_2	.092
O_2	.157	O_2	.152	O_2	.1545

BH-1
Run-1
Kiln-1

PRELIMINARY
ORSAT ANALYSIS RESULTS

Date 27 Sept 79

Time

Signature JJ

Gas Fractional Part

CO_2 .092

O_2 .1545

CO 0

N_2 .7535

Orsat fractional parts must sum to 1.00.

At least one preliminary Orsat analysis must be taken unless reliable preliminary information is available from other sources. If a preliminary Orsat is not taken, state how this preliminary information was obtained:

PRELIMINARY
MOLECULAR WEIGHT CALCULATIONS

This calculation of molecular weight is not required for gaseous sampling.

	Molecular Weights	Orsat Fraction	Moisture Fraction / Dry Gas Fraction	Partial Mol. Wt.
H_2O	(18)		[.0680 x] =	1.224
CO_2	(44)	(.092)	[.9320] =	3.77
O_2	(32)	(.1545)		4.61
CO	(28)	(0 ~~.1545~~)		0
N_2	(28)	(.7535)		19.66

Molecular Weight of Stack Gas 29.67
(Sum of partial molecular weights)

Date 10 Oct

Signature JJ

Preheater #1
Kiln #1
Run #2

PRELIMINARY
ORSAT ANALYSIS RESULTS

Date 27 Sept 79

Time 1515

Signature

Gas Fractional Part

CO_2 .190

O_2 .090

CO .000

N_2 .720

Orsat fractional parts must sum to 1.00.

At least one preliminary Orsat analysis must be taken unless reliable preliminary information is available from other sources. If a preliminary Orsat is not taken, state how this preliminary information was obtained: ______

PRELIMINARY
MOLECULAR WEIGHT CALCULATIONS

This calculation of molecular weight is not required for gaseous sampling.

	Molecular Weights	Moisture Fraction	Partial Mol. Wt.
H_2O	(18)	.0680	1.224

	Molecular Weights	Orsat Fraction	Dry Gas Fraction	Partial Mol. Wt.
CO_2	(44)	.190	.9320	7.79
O_2	(32)	.090		2.68
CO	(28)	0		0
N_2	(28)	.720		18.79

Molecular Weight of Stack Gas 30.49
(Sum of partial molecular weights)

Date 10 Oct

Signature

Kiln #1
Run #2

PRELIMINARY MOISTURE DETERMINATION

If preliminary moisture is not determined by the following procedure please state how preliminary moisture was determined:

____

____

CONDENSER METHOD

Initial Meter Temp. Inlet 96 Outlet 95

Final Meter Temp. Inlet 97 Outlet 96

Average Tmp. 96 °F TM = Average temp. + 460 = 556 °R

FIRST IMPINGER		SILICA GEL IMPINGER	
Final Wt.	687.4	Final Wt.	878.5
Initial Wt.	678.8	Initial Wt.	873.4
	8.6		5.1

Total Gain, MWC 13.7 grams H_2O

(Add the gains from both impingers to obtain total gain)

Pressure at Meter, PM, 27.79 inches Hg. (For purposes of this test, PM is equal to atmospheric pressure since ΔH is very small.)

Dry Gas Meter Reading, Final 592.101
Initial 582.255
Net Volume 9.846 ft^3

Corrected Volume (V)
Dry Gas Meter Calibration Factor, DGMCF 1.018

V = (Net Vol) (DGMCF) = (9.846) (1.018) = 10.023 ft^3

$$\text{Moisture Fraction} = \frac{(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}}{\left[(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}\right] + \left[\frac{(\text{V})\ (\text{PM})}{(\text{TM})}\ (501.7)\ \frac{\text{liters } ^\circ\text{R}}{\text{ft}^3 \text{ in. Hg}}\right]}$$

$$\text{Moisture Fraction} = \frac{(13.7)\ (1.339)}{\left[(13.7)\ (1.339)\right] + \left[\frac{(10.023)(27.79)}{556}\ (501.7)\right]}$$

$$= \underline{\underline{0.0680}}$$

Dry Gas Fraction = 1 - (moisture fraction) = 1 - (.0680) = 0.9320

When the moisture determination experiment is repeated, use copies of this page for collecting data and recording results. If this is done, calculate the averages:

Average Moisture Fraction ________

Average Dry Gas Fraction ________

Date 27 Sept

PRELIMINARY VELOCITY DETERMINATION

If preliminary velocity is not determined by the following procedure please state how preliminary velocity was determined.

Kiln #1 Run #2

Traverse Pt.	Δp (inches H_2O) I	II	III
Date			
Time	1450		North Port
1	.63/720		.66/718
2	.80/729		.72/725
3	.90/741		.81/728
4	.90/746		.81/728
5	.87/729		.89/733
6	.92/738		.88/729
7	.92/745		.88/731
8	.88/736		.90/735
9	.84/735		.85/731
10	.78/732		79/730
11	.60/722		.63/730
12	.50/700		.45/730
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

Ts = 730
=1190

For Preliminary Velocity Calculation, Isokinetic Sampling:

1. Use calculator to sum the square roots of all Δp's and divide this by N, the number of Δp's.

$$\text{Aver. } \sqrt{\Delta p} = \frac{\Sigma\sqrt{\Delta p}}{N}$$

$$\text{Aver. } \sqrt{\Delta p} = \frac{(\quad)}{(\quad)} = .882$$

(units are inches H_2O to the one half power)

2. Obtain the pitot tube calibration factor for the probe used. Probe No. L8 Pitot Tube Calibration Factor 0.829 (Shown in the equation below as PTCF)

3. Calculate Absolute Stack Pressure:
Measured Stk. Press. (gage) -12.2 "H_2O
(Measured stack press. may be (+) or (-))

5.8
6.4
12.2

Preliminary Atmo. Press. 27.79 "Hg

Stack pressure in inches of water (gage), times 0.07355, plus the barometric pressure in inches mercury equal to the absolute stack pressure in inches of mercury:

( ) in.H_2O (.07355) + ( ) in. Hg
= Stack Press. 26.89 in. Hg

4. Calculate average preliminary velocity, V, in feet per second as shown below.

$$V = (85.48)\,(\text{PTCF})\,\sqrt{\frac{(\text{Stack Temp. } ^\circ R)}{\left[\begin{matrix}\text{Mole.}\\ \text{Wt.}\end{matrix}\right]\left[\begin{matrix}\text{Stk. Press.}\\ \text{inches Hg}\end{matrix}\right]}}\;(\text{Average}\sqrt{\Delta p})$$

$$V = (85.48)\,(\quad)\,\sqrt{\frac{(\quad)}{(\quad)(\quad)}}\;(\quad) = \underline{\qquad\qquad} \text{ ft/sec}$$

Date

Time

Signature

BAGHOUSE SAMPLING DATA

Date 27 Sept 79 Baghouse No. 1 Sample No. 3

Operator T. Roe Bar. Pressure 27.765 "Hg

Cell No. 1 Filter No. 12 Orifice No. 1

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1650 ~~435~~	4.7	290
10	1700	4.8	299
20	10	4.6	300
30	20	4.6	291
40	30	4.4	298
50	40	4.4	296
60	50	4.2	298

$P_{AV} = 4.53$ $T_{AV} = 296$

$Q_2 = 37.9$ ACFM

Cel No. 3 Filter No. 13 Orifice No. 3

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1650	6.8	241
10	1700	5.9	240
20	10	4.8	246
30	20	4.9	223
40	30	4.6	239
50	40	4.6	226
60	50	4.6	230

$P_{AV} = 5.17$. $T_{AV} = 234$

$Q_2 = 40.1$ ACFM

BAGHOUSE SAMPLING DATA (continued)

Cell No. 5 Filter No. 14 Orifice No. 4

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1650	4.4	288
10	1700	4.4	296
20	10	4.3	298
30	20	4.1	284
40	30	4.0	296
50	40	3.8	292
60	50	3.8	295

$P_{AV} = 4.11$ $T_{AV} = 293$

$Q_2 = 35.6$ ACFM

Integrated Orsat Analysis Results

(Gas Fractional Part)

Initial		Final		Average	
CO_2	.082	CO_2	.080	CO_2	0.081
O_2	.164	O_2	.162	O_2	.163

BH-1
Run-3
Kiln-1

PRELIMINARY
ORSAT ANALYSIS RESULTS

Date 27 Sept 79

Time

Signature

Gas Fractional Part

CO_2	.081
O_2	.163
CO	0
N_2	.756

Orsat fractional parts must sum to 1.00.

At least one preliminary Orsat analysis must be taken unless reliable preliminary information is available from other sources. If a preliminary Orsat is not taken, state how this preliminary information was obtained: ______________________________.

PRELIMINARY
MOLECULAR WEIGHT CALCULATIONS

This calculation of molecular weight is not required for gaseous sampling.

	Molecular Weights	Orsat Fraction	Moisture Fraction / Dry Gas Fraction	Partial Mol. Wt.
H_2O	(18)		.0573	1.031
CO_2	(44)	.081	.9427	3.36
O_2	(32)	.163		4.92
CO	(28)	0		0
N_2	(28)	.756		19.96

Molecular Weight of Stack Gas 29.26
(Sum of partial molecular weights)

Date 10 Oct

Signature

Preheater #1
Kiln #1
Run #3

PRELIMINARY
ORSAT ANALYSIS RESULTS

Date 27 Sept 79
Time 1730
Signature

Gas Fractional Part

CO_2	.176
O_2	.104
CO	.000
N_2	.720

Orsat fractional parts must sum to 1.00.

At least one preliminary Orsat analysis must be taken unless reliable preliminary information is available from other sources. If a preliminary Orsat is not taken, state how this preliminary information was obtained: ______________________________

PRELIMINARY
MOLECULAR WEIGHT CALCULATIONS

This calculation of molecular weight is not required for gaseous sampling.

	Molecular Weights		Moisture Fraction		Partial Mol. Wt.
H_2O	(18)		[.0573 x / Dry]	=	1.031
		Orsat Fraction	Gas Fraction		
CO_2	(44)	(.176)	[.9427]	=	7.30
O_2	(32)	(.104)			3.14
CO	(28)	(0)			0
N_2	(28)	(.720)			19.01

Molecular Weight of Stack Gas 30.47
(Sum of partial molecular weights)

Date 10 Oct
Signature

Kiln #1
Run #3

PRELIMINARY MOISTURE DETERMINATION

If preliminary moisture is not determined by the following procedure please state how preliminary moisture was determined:

____

____

CONDENSER METHOD

Initial Meter Temp. Inlet 107 Outlet 102

Final Meter Temp. Inlet 108 Outlet 106

Average Tmp. 104.5 °F TM = Average temp. + 460 = 564.5 °R

FIRST IMPINGER		SILICA GEL IMPINGER	
Final Wt.	671.3	Final Wt.	815.3
Initial Wt.	663.45 7.85	Initial Wt.	809.12 6.18

Total Gain, MWC 14.03 grams H_2O

(Add the gains from both impingers to obtain total gain)

Pressure at Meter, PM, 27.76 inches Hg. (For purposes of this test, PM is equal to atmospheric pressure since ΔH is very small.)

Dry Gas Meter Reading, Final 604.811
Initial 592.501
Net Volume 12.310 ft^3

Corrected Volume (V)
Dry Gas Meter Calibration Factor, DGMCF 1.018

V = (Net Vol) (DGMCF) = (12.310) (1.018) = 12.532 ft^3

$$\text{Moisture Fraction} = \frac{(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}}{\left[(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}\right] + \left[\frac{(\text{V})\ \ (\text{PM})}{(\text{TM})}\ (501.7)\ \frac{\text{liters } ^\circ\text{R}}{\text{ft}^3 \text{ in. Hg}}\right]}$$

$$\text{Moisture Fraction} = \frac{(14.03)\ (1.339)}{\left[(14.03)\ (1.339)\right] + \left[\frac{(12.532)(27.76)}{564.5}\ (501.7)\right]}$$

$$= \underline{\underline{0.0573}}$$

Dry Gas Fraction = 1 - (moisture fraction) = 1 - (.0573) = .9427

When the moisture determination experiment is repeated, use copies of this page for collecting data and recording results. If this is done, calculate the averages:

Average Moisture Fraction ________

Average Dry Gas Fraction ________

Date ____________

PRELIMINARY VELOCITY DETERMINATION

If preliminary velocity is not determined by the following procedure please state how preliminary velocity was determined.

Kiln #1 Run #3

Traverse Pt.	Δp (inches H_2O) I	II	III
Date	27 Sept 79		
Time	West Port 1645		North Port
1	.64/685		.70/683
2	.83/684		.85/692
3	.88/692		.90/704
4	.85/688		.95/709
5	.88/690		.88/705
6	.92/700		.89/705
7	.91/712		.94/704
8	.90/713		.83/711
9	.87/714		.83/710
10	.81/710		.78/705
11	.62/700		.67/703
12	.55/660		.40/665
13			
14		$T_s = 698$	
15		= 1158 °R	
16			
17			
18			
19			
20			
21			
22			
23			
24			

For Preliminary Velocity Calculation, Isokinetic Sampling:

1. Use calculator to sum the square roots of all Δp's and divide this by N, the number of Δp's.

$$\text{Aver.}\sqrt{\Delta p} = \frac{\Sigma\sqrt{\Delta p}}{N}$$

$$\text{Aver.}\sqrt{\Delta p} = \frac{(\quad)}{(\quad)} = .893$$

(units are inches H_2O to the one half power)

2. Obtain the pitot tube calibration factor for the probe used. Probe No. 25 Pitot Tube Calibration Factor 0.829 (Shown in the equation below as PTCF)

5.8
6.3
12.1

3. Calculate Absolute Stack Pressure:
Measured Stk. Press. (gage) -12.1 "H_2O
(Measured stack press. may be (+) or (-))
Preliminary Atmo. Press. 27.77 "Hg
Stack pressure in inches of water (gage), times 0.07355, plus the barometric pressure in inches mercury equal to the absolute stack pressure in inches of mercury:

( ) in.H_2O (.07355) + ( ) in. Hg
= Stack Press. 26.88 in. Hg

4. Calculate average preliminary velocity, V, in feet per second as shown below.

$$V = (85.48)\ (\text{PTCF})\sqrt{\frac{(\text{Stack Temp. }^\circ\text{R})}{\begin{bmatrix}\text{Mole.}\\ \text{Wt.}\end{bmatrix}\begin{bmatrix}\text{Stk. Press.}\\ \text{inches Hg}\end{bmatrix}}}\ (\text{Average}\sqrt{\Delta p})$$

$$V = (85.48)\ (\quad)\sqrt{\frac{(\quad)}{(\quad)(\quad)}}\ (\quad) = \_\_\_\_\_\_ \text{ ft/sec}$$

Date ______
Time ______
Signature ______

Test was Voided due to the average pressure drop falling below the calibration curve of ΔP versus Q_2 ACFM.

BAGHOUSE SAMPLING DATA

Date 28 Sept 79 Baghouse No. 2 Sample No. 1

Operator D Bushaet Bar. Pressure 27.98 "Hg

Cell No. 1 Filter No. ______ Orifice No. 1

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1010	2.3	~~177~~ 300
10	1020	2.1	~~156~~ 300
20	1030	1.9	~~149~~ 300
30	1040	1.8	~~187~~ ~~215~~ 300
40	1050	1.8	~~215~~ 300
50	1100	1.6	300
60	1110	1.8	328

$P_{Av} = 1.90$

Q_2 = Below curve, 13.4 ACFM indicated

Cel No. 3 Filter No. ______ Orifice No. 3

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1010	3.4	270
10	1020	3.1	271
20	1030	3.1	235
30	1040	2.9	260
40	1050	2.9	289
50	1100	2.2	~~397~~ 330
60	1110	2.8	305

$P_{Av} = 2.91$

Q_2 = 26.5 ACFM

BAGHOUSE SAMPLING DATA (continued)

Cell No. 5 Filter No. ______ Orifice No. 4

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1010	2.4	~~165~~ 297
10	1020	2.0	~~132~~ 297
20	1030	2.0	~~172~~ 297
30	1040	1.8	297
40	1050	1.6	297
50	1100	1.6	297
60	1110	1.4	301

$P_{AV} = 1.83$

$Q_2 = 20.3$ ACFM (extrapolated below calib. point)

Integrated Orsat Analysis Results

(Gas Fractional Part)

Initial		**Final**		**Average**	
CO_2		CO_2		CO_2	
O_2		O_2		O_2	

PRELIMINARY VELOCITY DETERMINATION

If preliminary velocity is not determined by the following procedure please state how preliminary velocity was determined.

Kiln #2 Run #1

Traverse Pt.		Δp (inches H_2O) I	II	III
Date	West	28 Sept 79		South Port
Time	Port	0950		
1		.57/707		.50/683
2		1.2/728		.95/713
3		1.7/745		1.4/725
4		1.2/744		1.17/736
5		.71/730		.64/722
6		.45/590		.39/650
7				
8				
9	1052			
10		.68/683		.46/734
11		1.0/726		1.1/747
12		1.1/745		1.5/748
13		1.1/747		1.1/753
14		.74/749		~~[illegible]~~
15		.64/688		.79/743
16		~~[illegible]~~		.48/737
17				
18				
19				
20				
21				
22				
23				
24				

For Preliminary Velocity Calculation, Isokinetic Sampling:

1. Use calculator to sum the square roots of all Δp's and divide this by N, the number of Δp's.

$$\text{Aver. } \sqrt{\Delta p} = \frac{\Sigma \sqrt{\Delta p}}{N}$$

$$\text{Aver. } \sqrt{\Delta p} = \frac{(\quad)}{(\quad)} = \_\_\_\_$$

(units are inches H_2O to the one half power)

2. Obtain the pitot tube calibration factor for the probe used. Probe No. 25 Pitot Tube Calibration Factor 0.829 (Shown in the equation below as PTCF)

6.2
6.9
13.1

3. Calculate Absolute Stack Pressure:
Measured Stk. Press. (gage) -13.1 "H_2O
(Measured stack press. may be (+) or (-))
Preliminary Atmo. Press. 27.98 "Hg

Stack pressure in inches of water (gage), times 0.07355, plus the barometric pressure in inches mercury equal to the absolute stack pressure in inches of mercury:

( ) in.H_2O (.07355) + ( ) in. Hg
= Stack Press. ____ in. Hg

4. Calculate average preliminary velocity, V, in feet per second as shown below.

$$V = (85.48)\ (\text{PTCF}) \sqrt{\frac{(\text{Stack Temp. } ^\circ R)}{\left[\begin{array}{l}\text{Mole.}\\ \text{Wt.}\end{array}\right]\left[\begin{array}{l}\text{Stk. Press.}\\ \text{inches Hg}\end{array}\right]}}\ (\text{Average} \sqrt{\Delta p})$$

$$V = (85.48)\ (\quad) \sqrt{\frac{(\quad)}{(\quad)(\quad)}}\ (\quad) = \_\_\_\_ \text{ ft/sec}$$

Date ____

Time ____

Signature ____

Preheater #2
Kiln #2
Run #1

PRELIMINARY
ORSAT ANALYSIS RESULTS

Date 28 sept 79

Time 0930

Signature

Gas Fractional Part

CO_2 .214

O_2 .076

CO .000

N_2 .710

Orsat fractional parts must sum to 1.00.

At least one preliminary Orsat analysis must be taken unless reliable preliminary information is available from other sources. If a preliminary Orsat is not taken, state how this preliminary information was obtained: ______________________

PRELIMINARY
MOLECULAR WEIGHT CALCULATIONS

This calculation of molecular weight is not required for gaseous sampling.

	Molecular Weights	Orsat Fraction	Moisture Fraction ÷ Dry Gas Fraction		Partial Mol. Wt.
H_2O	(18)		[______ ÷]	=	______
CO_2	(44)	(______)	[______]	=	______
O_2	(32)	(______)			______
CO	(28)	(______)			______
N_2	(28)	(______)			______

Molecular Weight of Stack Gas . . . . ______
(Sum of partial molecular weights)

Date ______

Signature ______

PRELIMINARY MOISTURE DETERMINATION

If preliminary moisture is not determined by the following procedure please state how preliminary moisture was determined:

Kiln #2 Run 1

CONDENSER METHOD

Initial Meter Temp. Inlet 78 Outlet 78

Final Meter Temp. Inlet 80 Outlet 79

Average Tmp. 78.75 °F TM = Average temp. + 460 = ______ °R

FIRST IMPINGER	SILICA GEL IMPINGER
Final Wt. 660.68	Final Wt. 805.54
Initial Wt. 651.75	Initial Wt. 799.55

Total Gain, MWC ______ grams H_2O

(Add the gains from both impingers to obtain total gain)

Pressure at Meter, PM, 27.98 inches Hg. (For purposes of this test, PM is equal to atmospheric pressure since ΔH is very small.)

Dry Gas Meter Reading, Final 616.315
Initial 605.059
Net Volume ______ ft^3

Corrected Volume (V)
Dry Gas Meter Calibration Factor, DGMCF 1.018
V = (Net Vol) (DGMCF) = ( ) ( ) = ______ ft^3

$$\text{Moisture Fraction} = \frac{(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}}{\left[(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}\right] + \left[\frac{(\text{V})\ \ (\text{PM})}{(\text{TM})}\ (501.7)\ \frac{\text{liters }^\circ\text{R}}{\text{ft}^3\text{ in. Hg}}\right]}$$

$$\text{Moisture Fraction} = \frac{(\quad\ )\ (1.339)}{\left[(\quad\ )\ (1.339)\right] + \left[\frac{(\quad\ )(\quad\ )}{}\ (501.7)\right]}$$

= ______

Dry Gas Fraction = 1 - (moisture fraction) = 1 - ( ) = ______

When the moisture determination experiment is repeated, use copies of this page for collecting data and recording results. If this is done, calculate the averages:

Average Moisture Fraction ______

Average Dry Gas Fraction ______

Date ______

BAGHOUSE SAMPLING DATA

Date 28 Sept 79 Baghouse No. 2 Sample No. 2

Operator D Bushart Bar. Pressure 27.89 "Hg

Cell No. 1 Filter No. 29 Orifice No. 1

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1550	6.5	165
10	1600	5.4	315
20	1610	4.7	322
30	1620	4.5	324
40	1630	4.2	320
50	1640	4.1	329
60	1650	3.9	329

P_{AV} = 4.76 T_{AV} = 301

Q_2 = 34.1 ACFM

Cel No. 3 Filter No. 30 Orifice No. 3

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1550	7.5	133
10	1600	6.5	206
20	1610	6.1	247
30	1620	5.6	235
40	1630	5.7	225
50	1640	5.4	247
60	1650	5.2	269

P_{AV} = 6.00 T_{AV} = 223

Q_2 = 44.4 ACFM

BAGHOUSE SAMPLING DATA (continued)

Cell No. 5 Filter No. 31 Orifice No. 4

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1550	6.9	258
10	1600	5.8	287
20	1610	5.2	298
30	1620	5.0	299
40	1630	4.4	296
50	1640	4.2	296
60	1650	4.0	303

$P_{AV} = 5.07$ $T_{AV} = 291$

Q_2 41.5 ACFM

Integrated Orsat Analysis Results

(Gas Fractional Part)

Initial		Final		Average	
CO_2	.100	CO_2	.114	CO_2	.107
O_2	.144	O_2	.144	O_2	.144

BH-2
Run-2
Kiln-2

PRELIMINARY
ORSAT ANALYSIS RESULTS

Date 28 Sept 79

Time

Signature

Gas Fractional Part

CO_2 .107

O_2 .144

CO 0

N_2 .749

Orsat fractional parts must sum to 1.00.

At least one preliminary Orsat analysis must be taken unless reliable preliminary information is available from other sources. If a preliminary Orsat is not taken, state how this preliminary information was obtained:

PRELIMINARY
MOLECULAR WEIGHT CALCULATIONS

This calculation of molecular weight is not required for gaseous sampling.

	Molecular Weights	Moisture Fraction		Partial Mol. Wt.
H_2O	(18)	[.0665 ✓] =		1.196
		Orsat Fraction	Dry Gas Fraction	
CO_2	(44)	(.107)	.9335	4.395
O_2	(32)	(.144)		4.302
CO	(28)	(0)		0
N_2	(28)	(.749)		19.58

Molecular Weight of Stack Gas 29.47
(Sum of partial molecular weights)

Date 10 Oct

Preheater - 2
Kiln #2
Run #2

PRELIMINARY
ORSAT ANALYSIS RESULTS

Date 28 sept 79

Time 1615

Signature

Gas Fractional Part

CO_2 .196

O_2 .078

CO .000

N_2 .726

Orsat fractional parts must sum to 1.00.

At least one preliminary Orsat analysis must be taken unless reliable preliminary information is available from other sources. If a preliminary Orsat is not taken, state how this preliminary information was obtained: ________________

PRELIMINARY
MOLECULAR WEIGHT CALCULATIONS

This calculation of molecular weight is not required for gaseous sampling.

	Molecular Weights	Moisture Fraction		Partial Mol. Wt.
H_2O	(18)	[.0665]		= 1.196
		Orsat Fraction	**Dry Gas Fraction**	
CO_2	(44)	(.196)	.9335	= 8.05
O_2	(32)	(.078)		2.33
CO	(28)	(0)		0
N_2	(28)	(.726)		18.98

Molecular Weight of Stack Gas 30.55
(Sum of partial molecular weights)

Date 10 Oct

Signature FJ

PRELIMINARY MOISTURE DETERMINATION

Kiln #2 Run #2

If preliminary moisture is not determined by the following procedure please state how preliminary moisture was determined:

____

____

CONDENSER METHOD

Initial Meter Temp. Inlet 91 Outlet 93

Final Meter Temp. Inlet 93 Outlet 92

Average Tmp. 92.25 °F TM = Average temp. + 460 = 552.25 °R

FIRST IMPINGER
Final Wt. 684.2
Initial Wt. 674.7
9.5

SILICA GEL IMPINGER
Final Wt. 877.0
Initial Wt. 872.8
4.2

Total Gain, MWC 13.7 grams H_2O

(Add the gains from both impingers to obtain total gain)

Pressure at Meter, PM, 27.89 inches Hg. (For purposes of this test, PM is equal to atmospheric pressure since ΔH is very small.)

Dry Gas Meter Reading, Final 627250
Initial 617265
Net Volume 9985 ft³

Corrected Volume (V)
Dry Gas Meter Calibration Factor, DGMCF 1.018

V = (Net Vol) (DGMCF) = (9.985) (1.018) = 10.165 ft³

$$\text{Moisture Fraction} = \frac{(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}}{\left[(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}\right] + \left[\frac{(V)\quad(PM)}{(TM)}\ (501.7)\ \frac{\text{liters } ^\circ R}{ft^3 \text{ in. Hg}}\right]}$$

$$\text{Moisture Fraction} = \frac{(13.7)\ (1.339)}{\left[(13.7)\ (1.339)\right] + \left[\frac{(10.165)(27.89)}{552}\ (501.7)\right]}$$

$$= \underline{\underline{0.0665}}$$

Dry Gas Fraction = 1 - (moisture fraction) = 1 - (.0665) = 0.9335

When the moisture determination experiment is repeated, use copies of this page for collecting data and recording results. If this is done, calculate the averages:

Average Moisture Fraction ________

Average Dry Gas Fraction ________

Date 28 Sept

preheat-#2
Kiln # 2
Run # 2

PRELIMINARY VELOCITY DETERMINATION

If preliminary velocity is not determined by the following procedure please state how preliminary velocity was determined.

Kiln #2 Run #2

Traverse Pt.	Δp (inches H_2O) I	II	III
Date	28 sept 79		
Time	1550		.45/724
1	.58/728		.94/721
2	1.1/745		~~#6~~ 1.6/729
3	1.5/750		1.1/745
4	1.0/752		.65/740
5	.63/692		.44/714
6	.43/732		
7			
8		T_s = 731	
9		= 1191°R	
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

For Preliminary Velocity Calculation, Isokinetic Sampling:

1. Use calculator to sum the square roots of all Δp's and divide this by N, the number of Δp's.

   $$\text{Aver. } \sqrt{\Delta p} = \frac{\Sigma\sqrt{\Delta P}}{N}$$

   $$\text{Aver. } \sqrt{\Delta p} = \frac{(\quad)}{(\quad)} = .909$$

   (units are inches H_2O to the one half power)

2. Obtain the pitot tube calibration factor for the probe used. Probe No. L.S. Pitot Tube Calibration Factor .829 (Shown in the equation below as PTCF)

3. Calculate Absolute Stack Pressure:
   Measured Stk. Press. (gage) -13.8 "H_2O
   (Measured stack press. may be (+) or (-))
   Preliminary Atmo. Press. 27.89 "Hg
   Stack pressure in inches of water (gage), times 0.07355, plus the barometric pressure in inches mercury equal to the absolute stack pressure in inches of mercury:

   ( ) in.H_2O (.07355) + ( ) in. Hg = Stack Press. 26.88 in. Hg

4. Calculate average preliminary velocity, V, in feet per second as shown below.

$$V = (85.48)\ (\text{PTCF}) \sqrt{\frac{(\text{Stack Temp. } ^\circ\text{R})}{\begin{bmatrix}\text{Mole.}\\ \text{Wt.}\end{bmatrix}\begin{bmatrix}\text{Stk. Press.}\\ \text{inches Hg}\end{bmatrix}}}\ (\text{Average}\sqrt{\Delta p})$$

$$V = (85.48)\ (\quad) \sqrt{\frac{(\quad)}{(\quad)(\quad)}}\ (\quad) = \underline{\qquad}\ \text{ft/sec}$$

Date ______

Time ______

Signature ______

.5
7.3/a

BAGHOUSE SAMPLING DATA

Date 28 Sept 79 Baghouse No. 2 Sample No. 3

Operator D Bushart Bar. Pressure 27.89 "Hg

Cell No. 1 Filter No. 33 Orifice No. 1

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1735	6.1	156
10	1745	5.5	311
20	1755	5.2	324
30	1805	5.1	317
40	1815	4.9	318
50	1825	4.7	319
60	1835	4.4	318

$P_{AV} = 5.13$ $T_{AV} = 295$

$Q_2 = $ 36.8 ACFM

Cel No. 3 Filter No. 32 Orifice No. 3

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1735	8.7	123
10	1745	7.9	234
20	1755	7.9	260
30	1805	7.5	220
40	1815	7.7	229
50	1825	7.1	244
60	1835	7.1	246

$P_{AV} = 7.7$ $T_{AV} = 222$

$Q_2 = $ 53.0ACFM

BAGHOUSE SAMPLING DATA (continued)

Cell No. 5 Filter No. 34 Orifice No. #4

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1735	6.8	131
10	1745	5.8	290
20	1755	5.3	302
30	1805	5.0	296
40	1815	4.7	296
50	1825	4.4	295
60	1835	4.2	295

$P_{Av} = 5.17$ $T_{Av} = 272$

$Q_2 =$ 42.2 ACFM

Integrated Orsat Analysis Results

(Gas Fractional Part)

Initial		Final		Average	
CO_2	.080	CO_2	.076	CO_2	0.078
O_2	.160	O_2	.164	O_2	.162

BH 2
Run 3
Kiln 2

PRELIMINARY
ORSAT ANALYSIS RESULTS

Date 28 Sept 79

Time

Signature

Gas Fractional Part

CO_2 .078

O_2 .162

CO 0

N_2 .760

Orsat fractional parts must sum to 1.00.

At least one preliminary Orsat analysis must be taken unless reliable preliminary information is available from other sources. If a preliminary Orsat is not taken, state how this preliminary information was obtained: ______________________________.

PRELIMINARY
MOLECULAR WEIGHT CALCULATIONS

This calculation of molecular weight is not required for gaseous sampling.

	Molecular Weights		Moisture Fraction	Partial Mol. Wt.
H_2O	(18)		[.0656 x] =	1.181

		Orsat Fraction	Dry Gas Fraction	Partial Mol. Wt.
CO_2	(44)	.078	.9344	3.21
O_2	(32)	.162		= 4.84
CO	(28)	0		0
N_2	(28)	.760		19.88

Molecular Weight of Stack Gas 29.12
(Sum of partial molecular weights)

Date 10 Oct

Signature

Preheater #2
Kiln #2
Run #3

PRELIMINARY
ORSAT ANALYSIS RESULTS

Date 28 Sept 79

Time 1800

Signature

Gas Fractional Part

CO_2 .252

O_2 .062

CO .000

N_2 .686

Orsat fractional parts must sum to 1.00.

At least one preliminary Orsat analysis must be taken unless reliable preliminary information is available from other sources. If a preliminary Orsat is not taken, state how this preliminary information was obtained: ______

PRELIMINARY
MOLECULAR WEIGHT CALCULATIONS

This calculation of molecular weight is not required for gaseous sampling.

	Molecular Weights		Moisture Fraction / Dry	Partial Mol. Wt.
H_2O	(18)		[.0656 / Dry] =	1.181
		Orsat Fraction	Gas Fraction	
CO_2	(44)	(.252)	.9344	10.36
O_2	(32)	(.062)		= 1.85
CO	(28)	(0)		0
N_2	(28)	(.686)		17.95

Molecular Weight of Stack Gas 31.34
(Sum of partial molecular weights)

Date 10 Oct

Signature

Kiln #2 Run #3

PRELIMINARY MOISTURE DETERMINATION

If preliminary moisture is not determined by the following procedure please state how preliminary moisture was determined:

CONDENSER METHOD

Initial Meter Temp. Inlet 93 Outlet 94

Final Meter Temp. Inlet 94 Outlet 95

Average Tmp. 94 °F TM = Average temp. + 460 = 554 °R

FIRST IMPINGER		SILICA GEL IMPINGER	
Final Wt.	682.9	Final Wt.	821.2
Initial Wt.	671.3	Initial Wt.	815.3
	11.6		5.9

Total Gain, MWC 17.5 grams H_2O

(Add the gains from both impingers to obtain total gain)

Pressure at Meter, PM, 27.89 inches Hg. (For purposes of this test, PM is equal to atmospheric pressure since ΔH is very small.)

Dry Gas Meter Reading, Final 640.935
Initial 627.957
Net Volume 12.978 ft^3

Corrected Volume (V)
Dry Gas Meter Calibration Factor, DGMCF 1.018

V = (Net Vol) (DGMCF) = (12.978) (1.018) = 13.211 ft^3

$$\text{Moisture Fraction} = \frac{(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}}{\left[(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}\right] + \left[\frac{(\text{V})\ \ (\text{PM})}{(\text{TM})}\ (501.7)\ \frac{\text{liters } ^\circ\text{R}}{\text{ft}^3 \text{ in. Hg}}\right]}$$

$$\text{Moisture Fraction} = \frac{(17.5)\ (1.339)}{\left[(17.5)\ (1.339)\right] + \left[\frac{(13.211)(27.89)}{554}\ (501.7)\right]}$$

$$= \underline{\underline{.0656}}$$

Dry Gas Fraction = 1 - (moisture fraction) = 1 - (.0656) = .9344

When the moisture determination experiment is repeated, use copies of this page for collecting data and recording results. If this is done, calculate the averages:

Average Moisture Fraction ________

Average Dry Gas Fraction ________

Date 28 Sept
Signature

Kiln #2
Run #3

PRELIMINARY VELOCITY DETERMINATION

If preliminary velocity is not determined by the following procedure please state how preliminary velocity was determined.

Traverse Pt.	Δp (inches H_2O) I	II	III
Date	1730		
Time	28 sept 79		
1	.60/714		.45/716
2	.96/729		.93/739
3	1.5/746		1.5/751
4	1.1/742		1.1/757
5	.70/739		.72/755
6	.46/730		.44/736
7			
8			
9		T_s = 738	
10		= 1198 °R	
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

For Preliminary Velocity Calculation, Isokinetic Sampling:

1. Use calculator to sum the square roots of all Δp's and divide this by N, the number of Δp's.

$$\text{Aver. } \sqrt{\Delta p} = \frac{\Sigma \sqrt{\Delta p}}{N}$$

$$\text{Aver. } \sqrt{\Delta p} = \frac{(\quad)}{(\quad)} = .94$$

(units are inches H_2O to the one half power)

2. Obtain the pitot tube calibration factor for the probe used. Probe No. 2.5. Pitot Tube Calibration Factor .829 (Shown in the equation below as PTCF)

3. Calculate Absolute Stack Pressure:
Measured Stk. Press. (gage) -13.7 "H_2O
(Measured stack press. may be (+) or (-))
Preliminary Atmo. Press. 27.89 "Hg

Stack pressure in inches of water (gage), times 0.07355, plus the barometric pressure in inches mercury equal to the absolute stack pressure in inches of mercury:

( ) in.H_2O (.07355) + ( ) in. Hg
= Stack Press. 26.88 in. Hg

4. Calculate average preliminary velocity, V, in feet per second as shown below.

$$V = (85.48)\ (\text{PTCF}) \sqrt{\frac{(\text{Stack Temp. } ^\circ\text{R})}{\begin{bmatrix}\text{Mole.}\\ \text{Wt.}\end{bmatrix} \begin{bmatrix}\text{Stk. Press.}\\ \text{inches Hg}\end{bmatrix}}}\ (\text{Average} \sqrt{\Delta p})$$

$$V = (85.48)\ (\quad) \sqrt{\frac{(\quad)}{(\quad)(\quad)}}\ (\quad) = \underline{\qquad} \text{ ft/sec}$$

Date ______________

Time ______________

Signature ______________

6.3
7.4
/7
.3.

Void

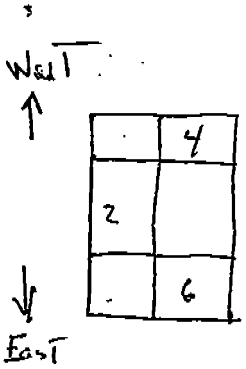
BAGHOUSE SAMPLING DATA

Date 25 Sept 77 Baghouse No. 3 Sample No. 1

Operator D Bushaet Bar. Pressure 28.075 "Hg

Cell No. 6 Filter No. 20 Orifice No. 3

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1140	3.2	184
10	1150	2.7	241
20	1200	2.7	245
30	1210	2.3	258
40	1220	2.1	255
50	1230	1.9	270
60	1240	1.5	268



$P_{AV} = 2.343$ $T_{AV} = 245.9$°F

Q_2 = 22.7 ACFM

Cel No. 4 Filter No. 19 Orifice No. 1

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1140	3.3	143
10	1150	2.9	171
20	1200	2.8	170
30	1210	2.7	246
40	1220	2.6	210
50	1230	2.5	238
60	1240	2.5	202

$P_{AV} = 2.76$, $T_{AV} = 197.1$

Q_2 = 19.65 ACFM

BAGHOUSE SAMPLING DATA (continued)

Cell No. 2 Filter No. 18 Orifice No. 4

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1140	2.6	229
10	1150	2.3	300
20	1200	2.0	304
30	1210	1.8	305
40	1220	1.6	305
50	1230	1.5	303
60	1240	1.4	307

P=Av 1.886 $T_{Avg} = 293.3$

Q_2 = 20.8 ACFM

Integrated Orsat Analysis Results

(Gas Fractional Part)

Initial	Final	Average
CO_2 .106	CO_2	CO_2 .106
O_2 .090	O_2	O_2 .090

PRELIMINARY VELOCITY DETERMINATION

If preliminary velocity is not determined by the following procedure please state how preliminary velocity was determined.

Run #1 Kiln #3

Traverse Pt.	Δp (inches H_2O) I	II	III
Date			
Time	1140		South Port
1 West Port	.88/745		.85/760
2	1.02/775		1.15/756
3	1.2/758		1.10/752
4	1.15/755		1.05/748
5	0.90/730		1.0 749
6	0.65/420		0.62/702
7			
8		T_s =	720.8°F
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

For Preliminary Velocity Calculation, Isokinetic Sampling:

1. Use calculator to sum the square roots of all Δp's and divide this by N, the number of Δp's.

$$\text{Aver. } \sqrt{\Delta p} = \frac{\Sigma \sqrt{\Delta p}}{N}$$

$$\text{Aver. } \sqrt{\Delta p} = \frac{(\quad)}{(\quad)} = 0.9772$$

(units are inches H_2O to the one half power)

2. Obtain the pitot tube calibration factor for the probe used. Probe No. L5 Pitot Tube Calibration Factor 0.829 (Shown in the equation below as PTCF)

3. Calculate Absolute Stack Pressure:
Measured Stk. Press. (gage) -13.6 "H_2O
(Measured stack press. may be (+) or (-))
Preliminary Atmo. Press. 28.08 "Hg
Stack pressure in inches of water (gage), times 0.07355, plus the barometric pressure in inches mercury equal to the absolute stack pressure in inches of mercury:

( ) in.H_2O (.07355) + ( ) in. Hg
= Stack Press. ______ in. Hg

4. Calculate average preliminary velocity, V, in feet per second as shown below.

$$V = (85.48)\ (\text{PTCF}) \sqrt{\frac{(\text{Stack Temp. } ^\circ R)}{\left[\begin{matrix}\text{Mole.}\\ \text{Wt.}\end{matrix}\right]\left[\begin{matrix}\text{Stk. Press.}\\ \text{inches Hg}\end{matrix}\right]}}\ (\text{Average} \sqrt{\Delta p})$$

$$V = (85.48)\ (\quad) \sqrt{\frac{(\quad)}{(\quad)(\quad)}}\ (\quad) = 82.61 \text{ ft/sec}$$

Date 25 Sept 79
Time 1140
Signature

Kiln # 3
Run # 1

PRELIMINARY MOISTURE DETERMINATION

If preliminary moisture is not determined by the following procedure please state how preliminary moisture was determined:

6.4
7.2
13.6

CONDENSER METHOD

Initial Meter Temp. Inlet 98 Outlet 101

Final Meter Temp. Inlet 98 Outlet 102

Average Tmp. 99.7 °F TM = Average temp. + 460 = 559.7 °R

FIRST IMPINGER Sec. SILICA GEL IMPINGER

Final Wt. 673.4 680.1 Final Wt. 809.1

Initial Wt. 668.20 679.60 Initial Wt. 805.50

5.2 .5 3.6

Total Gain, MWC 11.3 grams H_2O

(Add the gains from both impingers to obtain total gain)

Pressure at Meter, PM, 28.07 inches Hg. (For purposes of this test, PM is equal to atmospheric pressure since ΔH is very small.)

Dry Gas Meter Reading, Final 547.878
Initial 542.168
Net Volume 5.710 ft^3

Corrected Volume (V)
Dry Gas Meter Calibration Factor, DGMCF 1.018

V = (Net Vol) (DGMCF) = (5.710) (1.018) = 5.813 ft^3

$$\text{Moisture Fraction} = \frac{(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}}{\left[(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}\right] + \left[\frac{(\text{V})\ (\text{PM})}{(\text{TM})}\ (501.7)\ \frac{\text{liters } ^\circ\text{R}}{\text{ft}^3 \text{ in. Hg}}\right]}$$

$$\text{Moisture Fraction} = \frac{(11.3)\ (1.339)}{\left[(11.3)\ (1.339)\right] + \left[\frac{(5.813)(28.07)}{559.7}\ (501.7)\right]}$$

$$= \underline{\underline{0.0937}}$$

Dry Gas Fraction = 1 - (moisture fraction) = 1 - (.0937) = .9063

When the moisture determination experiment is repeated, use copies of this page for collecting data and recording results. If this is done, calculate the averages:

Average Moisture Fraction ______

Average Dry Gas Fraction ______

Date 25 Sept 79

Signature

Kiln #3
Run #1
Preheater

PRELIMINARY
ORSAT ANALYSIS RESULTS

Date 25 Sept 79

Time 1230

Signature

Gas Fractional Part

CO_2 .140

O_2 .126

CO 0.00

N_2 0.736

Orsat fractional parts must sum to 1.00.

At least one preliminary Orsat analysis must be taken unless reliable preliminary information is available from other sources. If a preliminary Orsat is not taken, state how this preliminary information was obtained: ______________________________

PRELIMINARY
MOLECULAR WEIGHT CALCULATIONS

This calculation of molecular weight is not required for gaseous sampling.

	Molecular Weights	Orsat Fraction	Moisture Fraction / Dry Gas Fraction		Partial Mol. Wt.
H_2O	(18)		[0.0937]	=	
CO_2	(44)	(.140)	[.9063]	=	
O_2	(32)	(.126)			
CO	(28)	(0.0)			
N_2	(28)	(.736)			

Molecular Weight of Stack Gas 29.55
(Sum of partial molecular weights)

Date 25 Sept 79

Signature

Kiln #3 Baghouse Run #1

PRELIMINARY
ORSAT ANALYSIS RESULTS

Date 25 Sept 79

Time ______

Signature ______

Gas Fractional Part

CO_2 .106

O_2 .09

CO .00

N_2 .804

Orsat fractional parts must sum to 1.00.

At least one preliminary Orsat analysis must be taken unless reliable preliminary information is available from other sources. If a preliminary Orsat is not taken, state how this preliminary information was obtained: ______

PRELIMINARY
MOLECULAR WEIGHT CALCULATIONS

This calculation of molecular weight is not required for gaseous sampling.

	Molecular Weights		Moisture Fraction / Dry		Partial Mol. Wt.
H_2O	(18)		[______ / Dry]	=	______

		Orsat Fraction	Dry Gas Fraction		
CO_2	(44)	(______)			______
O_2	(32)	(______)	[______]	=	______
CO	(28)	(______)			______
N_2	(28)	(______)			______

Molecular Weight of Stack Gas 28.93
(Sum of partial molecular weights)

Date 25 Sept 79

Signature

Void

BAGHOUSE SAMPLING DATA

Date 25 Sept 75 Baghouse No. 3 Sample No. 2

Operator D Bushart Bar. Pressure 28.075 "Hg

Cell No. 6 Filter No. 16 Orifice No. 3

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1530	3.2	272
10	1540	2.7	314
20	1550	2.3	284
30	1600	2.2	315
40	1610	2.0	324
50	1620	1.9	324
60	1630	1.7	324

$P_{Av} = 2.286$ $T_{Av} = 308.1$

$Q_2 = 22.4$ ACFM

Cel No. 4 Filter No. 17 Orifice No. 1

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1530	3.2	272
10	1540	2.8	302
20	1550	2.7	310
30	1600	2.5	318
40	1610	2.4	314
50	1620	2.4	323
60	1630	2.4	315

$P_{Av} = 2.63$, $T_{Av} = 307.7$

$Q_2 = 18.7$ ACFM

BAGHOUSE SAMPLING DATA (continued)

Cell No. 2 Filter No. 11 Orifice No. 4

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1530	2.7	261
10	1540	2.1	311
20	1550	1.7	260
30	1600	1.8	315
40	1610	1.4	319
50	1620	1.3	314
60	1630	1.2	315

P_{Av} = 1.743 T_{Av} = 299.3

Q_2 = 19.8 ACFM

Integrated Orsat Analysis Results

(Gas Fractional Part)

Initial	Final	Average
CO_2 0.116	CO_2 0.120	CO_2 0.118
O_2 0.141	O_2 0.140	O_2 0.1405

PRELIMINARY VELOCITY DETERMINATION

If preliminary velocity is not determined by the following procedure please state how preliminary velocity was determined.

Kiln #3 Preheater Run #2

66
5.7
12.5

South Port

Traverse Pt.	Δp (inches H_2O) I	II	III
Date			
Time			West Port
1	0.75/726		0.78/735
2	0.94/734		.98/745
3	1.10/743		1.10/754
4	1.17/751		1.02/743
5	.93/730		.91/738
6	0.70/644		.72/550
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

For Preliminary Velccity Calculation, Isokinetic Sampling:

1. Use calculator to sum the square roots of all Δp's and divide this by N, the number of Δp's.

$$\text{Aver. } \sqrt{\Delta p} = \frac{\Sigma \sqrt{\Delta P}}{N}$$

$$\text{Aver. } \sqrt{\Delta p} = \frac{(\qquad)}{(\qquad)} = \underline{\qquad}$$

(units are inches H_2O to the one half power)

2. Obtain the pitot tube calibration factor for the probe used. Probe No. L5 Pitot Tube Calibration Factor .829 (Shown in the equation below as PTCF)

3. Calculate Absolute Stack Pressure: Measured Stk. Press. (gage) -12.5 "H_2O (Measured stack press. may be (+) or (-))

Preliminary Atmo. Press. 27.98 "Hg

Stack pressure in inches of water (gage), times 0.07355, plus the barometric pressure in inches mercury equal to the absolute stack pressure in inches of mercury:

( ) in.H_2O (.07355) + ( )in. Hg = Stack Press. ______ in. Hg

4. Calculate average preliminary velocity, V, in feet per second as shown below.

$$V = (85.48)\,(\text{PTCF})\sqrt{\frac{(\text{Stack Temp. }^\circ\text{R})}{\left[\begin{matrix}\text{Mole.}\\ \text{Wt.}\end{matrix}\right]\left[\begin{matrix}\text{Stk. Press.}\\ \text{inches Hg}\end{matrix}\right]}}\,(\text{Average}\sqrt{\Delta p})$$

$$V = (85.48)\,(\qquad)\sqrt{\frac{(\qquad)}{(\qquad)(\qquad)}}\,(\qquad) = \underline{\qquad}\ \text{ft/sec}$$

Date ______

Time ______

Signature ______

Run # 2
Kiln # 3

PRELIMINARY MOISTURE DETERMINATION

If preliminary moisture is not determined by the following procedure please state how preliminary moisture was determined:

____

____

CONDENSER METHOD

Initial Meter Temp. Inlet 107 Outlet 107

Final Meter Temp. Inlet 105 Outlet 108

Average Tmp. 106.75 °F TM = Average temp. + 460 = 566.75 °R

		Sec.		
FIRST IMPINGER			**SILICA GEL IMPINGER**	
Final Wt.	668.6	678.9	Final Wt.	867.5
Initial Wt.	659.30	681.86	Initial Wt.	864.01
	9.3	-3.0		3.5

Total Gain, MWC 9.8 grams H_2O

(Add the gains from both impingers to obtain total gain)

Pressure at Meter, PM, 27.99 inches Hg. (For purposes of this test, PM is equal to atmospheric pressure since ΔH is very small.)

Dry Gas Meter Reading, Final 554.000
Initial 548.925
Net Volume 5.075 ft^3

Corrected Volume (V)
Dry Gas Meter Calibration Factor, DGMCF 1.018
V = (Net Vol) (DGMCF) = (5.075) (1.018) = 5.166 ft^3

$$\text{Moisture Fraction} = \frac{(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}}{\left[(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}\right] + \left[\frac{(\text{V})\ (\text{PM})}{(\text{TM})}\ (501.7)\ \frac{\text{liters } ^\circ\text{R}}{\text{ft}^3 \text{ in. Hg}}\right]}$$

$$\text{Moisture Fraction} = \frac{(9.8)\cdot(1.339)}{\left[(9.8)\ (1.339)\right] + \left[\frac{(5.166)(27.99)}{566.75}\ (501.7)\right]}$$

= ________

Dry Gas Fraction = 1 - (moisture fraction) = 1 - (   ) = ________

When the moisture determination experiment is repeated, use copies of this page for collecting data and recording results. If this is done, calculate the averages:

Average Moisture Fraction ________

Average Dry Gas Fraction ________

Preheater
Kiln #3
Run #2

PRELIMINARY
ORSAT ANALYSIS RESULTS

Date 25 Sept 79

Time 1530

Signature

Gas Fractional Part

CO_2 .194

O_2 .092

CO .000

N_2 .714

Orsat fractional parts must sum to 1.00.

At least one preliminary Orsat analysis must be taken unless reliable preliminary information is available from other sources. If a preliminary Orsat is not taken, state how this preliminary information was obtained: ______________________________

PRELIMINARY
MOLECULAR WEIGHT CALCULATIONS

This calculation of molecular weight is not required for gaseous sampling.

	Molecular Weights	Orsat Fraction	Moisture Fraction / Dry Gas Fraction		Partial Mol. Wt.
H_2O	(18).		[______ / Dry]	=	______
CO_2	(44)	(______)			______
O_2	(32)	(______)	[______]	=	______
CO	(28)	(______)			______
N_2	(28)	(______)			______

Molecular Weight of Stack Gas . . . . ______
(Sum of partial molecular weights)

Date ______________

Signature

BAGHOUSE SAMPLING DATA

Date 26 Sept 79 Baghouse No. 3 Sample No. 3

Operator Bushart Bar. Pressure 28.035 "Hg

Cell No. 6 Filter No. 1 Orifice No. 3

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1041	4.4	257
10	1051	4.7	318
20	1101	4.3	322
30	1111	4.2	319
40	1121	3.9	326
50	1131	3.8	322
60	1141	3.5	325

P_{Av} = 4.11 T_{Av} = 312.7

Q_2 = 33.75 AcFM

Cel No. 4 Filter No. 2 Orifice No. 1

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1041	4.7	273
10	1051	5.2	278
20	1101	5.0	280
30	1111	5.0	268
40	1121	4.8	289
50	1131	4.8	302
60	1141	4.7	297

P_{Av} = 4.89 T_{Av} = 283.9

Q_2 = 35.05 AcFM

BAGHOUSE SAMPLING DATA (continued)

Cell No. 2 Filter No. 3 Orifice No. 4

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1041	3.6	252
10	1051	3.5	309
20	1101	2.9	313
30	1111	2.6	310
40	1121	2.3	310
50	1131	2.1	309
60	1141	2.0	309

P_{AV} = 2.714 T_{Av} = 301.7

Q_2 = 26.4 ACFM

Integrated Orsat Analysis Results

(Gas Fractional Part)

Initial		Final		Average	
CO_2	.110	CO_2	.118	CO_2	.114
O_2	.140	O_2	.162	O_2	.151

BH #3
Run 3
Kiln 3

PRELIMINARY
ORSAT ANALYSIS RESULTS

Date 26 Sept 79

Time

Signature

Gas Fractional Part

CO_2 .114

O_2 .151

CO 0

N_2 .735

Orsat fractional parts must sum to 1.00.

At least one preliminary Orsat analysis must be taken unless reliable preliminary information is available from other sources. If a preliminary Orsat is not taken, state how this preliminary information was obtained:

PRELIMINARY
MOLECULAR WEIGHT CALCULATIONS

This calculation of molecular weight is not required for gaseous sampling.

	Molecular Weights	Orsat Fraction	Dry Gas Fraction	Partial Mol. Wt.
H_2O	(18)		Moisture Fraction .057	1.03
CO_2	(44)	.114	.943	4.73
O_2	(32)	.151		4.56
CO	(28)	0		0
N_2	(28)	.735		19.40

Molecular Weight of Stack Gas 29.72
(Sum of partial molecular weights)

Date 26 Sept 79

Preheater #3
Run #3
Kiln #3

PRELIMINARY
ORSAT ANALYSIS RESULTS

Date 26 sept 79'

Time 11 00

Signature

Gas Fractional Part

CO_2 .192

O_2 .088

CO .000

N_2 .720

Orsat fractional parts must sum to 1.00.

At least one preliminary Orsat analysis must be taken unless reliable preliminary information is available from other sources. If a preliminary Orsat is not taken, state how this preliminary information was obtained:

PRELIMINARY
MOLECULAR WEIGHT CALCULATIONS

This calculation of molecular weight is not required for gaseous sampling.

	Molecular Weights		Moisture Fraction		Partial Mol. Wt.
H_2O	(18)		[.057]	=	1.030
		Orsat Fraction	**Dry Gas Fraction**		
CO_2	(44)	(.192)	[.943]	=	7.965
O_2	(32)	(.088)			2.655
CO	(28)	(0)			0
N_2	(28)	(.720)			19.01

Molecular Weight of Stack Gas 30.66
(Sum of partial molecular weights)

Date 10 Oct

Signature

PRELIMINARY MOISTURE DETERMINATION Kiln #3 Run 3

If preliminary moisture is not determined by the following procedure please state how preliminary moisture was determined:

____

____

CONDENSER METHOD

Initial Meter Temp. Inlet 76 Outlet 76

Final Meter Temp. Inlet 77 Outlet 78

Average Tmp. 76.75 °F TM = Average temp. + 460 = 536.75 °R

FIRST IMPINGER	Second Imp	SILICA GEL IMPINGER
Final Wt. 678.0	680.4	Final Wt. 810.6
Initial Wt. ~~668~~ 673.4	680.1	Initial Wt. 809.1
4.6	.3	1.5

Total Gain, MWC 6.4 grams H_2O

(Add the gains from both impingers to obtain total gain)

Pressure at Meter, PM, 28.03 inches Hg. (For purposes of this test, PM is equal to atmospheric pressure since ΔH is very small.)

Dry Gas Meter Reading, Final 559.624
Initial 554.513
Net Volume 5.111 ft^3

Corrected Volume (V)
Dry Gas Meter Calibration Factor, DGMCF 1.018

V = (Net Vol) (DGMCF) = (5.111) (1.018) = 5.203 ft^3

$$\text{Moisture Fraction} = \frac{(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}}{\left[(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}\right] + \left[\frac{(V)\ \ (PM)}{(TM)}\ (501.7)\ \frac{\text{liters } ^\circ R}{ft^3 \text{ in. Hg}}\right]}$$

$$\text{Moisture Fraction} = \frac{(6.4)\ (1.339)}{\left[(6.4)\ (1.339)\right] + \left[\frac{(5.203)(29.03)}{536.7}\ (501.7)\right]}$$

= .0591

Dry Gas Fraction = 1 - (moisture fraction) = 1 - (.0591) = .9409

When the moisture determination experiment is repeated, use copies of this page for collecting data and recording results. If this is done, calculate the averages:

Average Moisture Fraction __________

Average Dry Gas Fraction __________

Date ________________

PRELIMINARY VELOCITY DETERMINATION

If preliminary velocity is not determined by the following procedure please state how preliminary velocity was determined.

Kiln #3 Run #3

Traverse Pt.	Δp (inches H_2O) I	II	III
Date	26 Sept		South Port
Time West Port	1040	.81/	753
1	0.82/732	1.00/	755
2	1.00/745	1.10/	749
3	1.15/740	1.10/	745
4	1.16/730	1.02	/736
5	1.02/728	0.68	664
6	.70/650		
7	~~753~~		
8		T_s = 727.25	
9		466	
10		1187	
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

For Preliminary Velocity Calculation, Isokinetic Sampling:

1. Use calculator to sum the square roots of all Δp's and divide this by N, the number of Δp's.

$$\text{Aver. } \sqrt{\Delta p} = \frac{\Sigma\sqrt{\Delta P}}{N}$$

$$\text{Aver. } \sqrt{\Delta p} = \frac{(\quad)}{(\quad)} = .9778$$

(units are inches H_2O to the one half power)

2. Obtain the pitot tube calibration factor for the probe used. Probe No. LS Pitot Tube Calibration Factor .829 (Shown in the equation below as PTCF)

3. Calculate Absolute Stack Pressure: Measured Stk. Press. (gage) -13.1 "H_2O (Measured stack press. may be (+) or (-))

Preliminary Atmo. Press. 28.04 "Hg

Stack pressure in inches of water (gage), times 0.07355, plus the barometric pressure in inches mercury equal to the absolute stack pressure in inches of mercury:

( ) in.H_2O (.07355) + ( ) in. Hg = Stack Press. 27.08 in. Hg

4. Calculate average preliminary velocity, V, in feet per second as shown below.

$$V = (85.48)\ (\text{PTCF}) \sqrt{\frac{(\text{Stack Temp. } ^\circ\text{R})}{\left[\begin{array}{l}\text{Mole.}\\ \text{Wt.}\end{array}\right]\left[\begin{array}{l}\text{Stk. Press.}\\ \text{inches Hg}\end{array}\right]}}\ (\text{Average}\sqrt{\Delta p})$$

$$V = (85.48)\ (.829) \sqrt{\frac{(1187)}{(\quad)(\quad)}}\ (\quad) = \underline{\qquad}\ \text{ft/sec}$$

Date ____________

Time ____________

Signature ____________

BAGHOUSE SAMPLING DATA

Date 26 Sept 79 Baghouse No. 3 Sample No. 4

Operator Bushart Bar. Pressure 27.98 "Hg

Cell No. 6 Filter No. 4 Orifice No. 3

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1255	6.4	283
10	1305	5.1	313
20	1315	4.7	323
30	1325	4.3	319
40	1335	4.1	326
50	1345	3.8	318
60	1355	3.8	322

P_{AV} = 4.6 T_{AV} = 314.9

Q_2 = 36.8 ACFM

Cel No. 4 Filter No. 6 Orifice No. 1

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1255	6.8	291
10	1305	6.0	281
20	1315	5.6	316
30	1325	5.4	295
40	1335	4.2	310
50	1345	5.1	311
60	1355	5.0	252

P_{AV} = 5.52 T_{AV} = 290.9

Q_2 = 39.6 ACFM

BAGHOUSE SAMPLING DATA (continued)

Cell No. 2 Filter No. 5 ~~6~~ Orifice No. 4

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1255	5.3	264
10	1305	4.0	311
20	1315	3.5	316
30	1325	3.0	318
40	1335	2.9	317
50	1345	2.3	317
60	1355	2.2	316

$P_{AV} = 3.29$ $T_{AV} = 308.4$

$Q_2 = 30.2$ ACFM

Integrated Orsat Analysis Results

(Gas Fractional Part)

Initial		Final		Average	
CO_2	.114	CO_2	.100	CO_2	.107
O_2	.142	O_2	.152	O_2	.147

BH 3
Run 4
Kiln 3

PRELIMINARY
ORSAT ANALYSIS RESULTS

Date 26 Sept 79

Time

Signature

Gas Fractional Part

CO_2 .107

O_2 .147

CO 0

N_2 .746

Orsat fractional parts must sum to 1.00.

At least one preliminary Orsat analysis must be taken unless reliable preliminary information is available from other sources. If a preliminary Orsat is not taken, state how this preliminary information was obtained:

PRELIMINARY
MOLECULAR WEIGHT CALCULATIONS

This calculation of molecular weight is not required for gaseous sampling.

	Molecular Weights	Orsat Fraction	Moisture Fraction / Dry Gas Fraction	Partial Mol. Wt.
H_2O	(18)		.0608	1.094
CO_2	(44)	.107	.9392	4.42
O_2	(32)	.147		4.42
CO	(28)	0		0
N_2	(28)	.746		19.62

Molecular Weight of Stack Gas 29.55
(Sum of partial molecular weights)

Date 10 Oct

Signature

Preheater #3
Run #4
Kiln #3

PRELIMINARY
ORSAT ANALYSIS RESULTS

Date 26 SEPT 79

Time 1330

Signature

Gas Fractional Part

CO_2 .188

O_2 .098

CO .000

N_2 ~~.614~~ .714

Orsat fractional parts must sum to 1.00.

At least one preliminary Orsat analysis must be taken unless reliable preliminary information is available from other sources. If a preliminary Orsat is not taken, state how this preliminary information was obtained: __________

PRELIMINARY
MOLECULAR WEIGHT CALCULATIONS

This calculation of molecular weight is not required for gaseous sampling.

	Molecular Weights	Orsat Fraction	Moisture Fraction / Dry Gas Fraction	Partial Mol. Wt.
H_2O	(18)		[.0608 ×] =	1.094
CO_2	(44)	(.188)	.9392	7.77
O_2	(32)	(.098)		2.95
CO	(28)	(0)		0
N_2	(28)	(.714)		18.78

Molecular Weight of Stack Gas 30.59
(Sum of partial molecular weights)

Date 10 Oct

Signature

PRELIMINARY MOISTURE DETERMINATION

Run 4
Kiln #3

If preliminary moisture is not determined by the following procedure please state how preliminary moisture was determined:

____

____

CONDENSER METHOD

Initial Meter Temp. Inlet 89 Outlet 88

Final Meter Temp. Inlet 89 Outlet 90

Average Tmp. 89 °F TM = Average temp. + 460 = 549 °R

FIRST IMPINGER			SILICA GEL IMPINGER
Final Wt.	678.0	667.3	Final Wt. 869.0
Initial Wt.	673.0	666.6	Initial Wt. 867.5
	5.0	0.7	1.5

Total Gain, MWC 7.2 grams H_2O

(Add the gains from both impingers to obtain total gain)

Pressure at Meter, PM, 27.98 inches Hg. (For purposes of this test, PM is equal to atmospheric pressure since ΔH is very small.)

Dry Gas Meter Reading, Final 565.701
Initial 559.979
Net Volume 5.722 ft^3

Corrected Volume (V)
Dry Gas Meter Calibration Factor, DGMCF 1.018

V = (Net Vol) (DGMCF) = (5.722) (1.018) = 5.825 ft^3

$$\text{Moisture Fraction} = \frac{(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}}{\left[(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}\right] + \left[\frac{(V)\ \ (PM)}{(TM)}\ (501.7)\ \frac{\text{liters } ^\circ R}{ft^3 \text{ in. Hg}}\right]}$$

$$\text{Moisture Fraction} = \frac{(7.2)\ (1.339)}{\left[(7.2)\ (1.339)\right] + \left[\frac{(5.825)(27.98)}{549}\ (501.7)\right]}$$

$$= .0608$$

Dry Gas Fraction = 1 - (moisture fraction) = 1 - (.0608) = .9392

When the moisture determination experiment is repeated, use copies of this page for collecting data and recording results. If this is done, calculate the averages:

Average Moisture Fraction ________

Average Dry Gas Fraction ________

Date ____________

PRELIMINARY VELOCITY DETERMINATION

If preliminary velocity is not determined by the following procedure please state how preliminary velocity was determined.

Kiln #3 Run 4

Traverse Pt.		Δp (inches H_2O)		
		I	II	III
Date		26 Sep		
Time	West Port	1300	South Port	
1		.72/730	.77	/735
2		.81/732	1.00	/746
3		.95/733	1.00	/748
4		.96/735	1.00	/746
5		.93/738	.96	/746
6		.59/715	.68	/733
7				
8				
9			Ts = 736.4	
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				

For Preliminary Velocity Calculation, Isokinetic Sampling:

1. Use calculator to sum the square roots of all Δp's and divide this by N, the number of Δp's.

   $$\text{Aver. } \sqrt{\Delta p} = \frac{\Sigma\sqrt{\Delta P}}{N}$$

   $$\text{Aver. } \sqrt{\Delta p} = \frac{(\quad)}{(\quad)} = .9264$$

   (units are inches H_2O to the one half power)

2. Obtain the pitot tube calibration factor for the probe used. Probe No. LS Pitot Tube Calibration Factor .829 (Shown in the equation below as PTCF)

3. Calculate Absolute Stack Pressure:
   Measured Stk. Press.
   (gage) -13.6 "H_2O
   (Measured stack press. may be (+) or (–))

   Preliminary Atmo. Press. 27.98 "Hg

   Stack pressure in inches of water (gage), times 0.07355, plus the barometric pressure in inches mercury equal to the absolute stack pressure in inches of mercury:

   $(\quad)$ in.H_2O (.07355) + $(\quad)$ in. Hg
   = Stack Press. 26.98 in. Hg

4. Calculate average preliminary velocity, V, in feet per second as shown below.

$$V = (85.48)\,(\text{PTCF})\sqrt{\frac{(\text{Stack Temp. }^\circ\text{R})}{\begin{bmatrix}\text{Mole.}\\ \text{Wt.}\end{bmatrix}\begin{bmatrix}\text{Stk. Press.}\\ \text{inches Hg}\end{bmatrix}}}\,(\text{Average}\sqrt{\Delta p})$$

$$V = (85.48)\,(.829)\sqrt{\frac{(1196.4)}{(30.59)(26.98)}}\,(.9264) = 79.04 \text{ ft/sec}$$

Date 26 Sept

Time

Signature

BAGHOUSE SAMPLING DATA

Date 26 Sept 79 Baghouse No. 3 Sample No. 5

Operator Bushart Bar. Pressure 27.88 "Hg

Cell No. 6 Filter No. 7 Orifice No. 3

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1510	6.1	286
10	1520	5.2	313
20	1530	4.7	324
30	1540	4.5	321
40	1550	4.2	323
50	1600	4.0	324
60	1610	3.8	326

P_{AV} = 4.64 T_{AV} = 316.7

Q_2 = 37.2 ACFM

Cel No. 4 Filter No. 8 Orifice No. 2

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1510	7.8	276
10	1520	6.9	270
20	1530	6.9	314
30	1540	7.0	305
40	1550	6.4	301
50	1600	6.3	313
60	1610	6.2	318

P_{AV} = 6.79 T_{AV} = 299.6

Q_2 = 48.5 ACFM

BAGHOUSE SAMPLING DATA (continued)

Cell No. 2 Filter No. 9 Orifice No. 4

Elapsed Time (min)	Time	P inch H_2O	Orifice Temp. °F
0	1510	5.0	298
10	1520	4.1	317
20	1530	3.4	323
30	1540	3.0	317
40	1550	2.7	317
50	1600	2.4	318
60	1610	2.1	318

P_{AV} = 3.243 T_{AV} = 315.4

Q_2 = 29.8 ACFM

Integrated Orsat Analysis Results

(Gas Fractional Part)

Initial		Final		Average	
CO_2	.106	CO_2	.112	CO_2	.109
O_2	.148	O_2	.144	O_2	.146

BH 3
Run 5
Kiln 3

PRELIMINARY
ORSAT ANALYSIS RESULTS

Date 26 Sept 79

Time

Signature JJ

Gas Fractional Part

CO_2 .109

O_2 .146

CO 0

N_2 .745

Orsat fractional parts must sum to 1.00.

At least one preliminary Orsat analysis must be taken unless reliable preliminary information is available from other sources. If a preliminary Orsat is not taken, state how this preliminary information was obtained: ______________________________.

PRELIMINARY
MOLECULAR WEIGHT CALCULATIONS

This calculation of molecular weight is not required for gaseous sampling.

	Molecular Weights	Orsat Fraction	Moisture Fraction / Dry Gas Fraction		Partial Mol. Wt.
H_2O	(18)		[.0756]	=	1.361
CO_2	(44)	(.109)	[.9244]	=	4.43
O_2	(32)	(.146)			4.32
CO	(28)	(0)			0
N_2	(28)	(.745)			19.28

Molecular Weight of Stack Gas 29.40
(Sum of partial molecular weights)

Date 10 Oct

Signature

Preheater #3
Run #5
Kiln #3

PRELIMINARY
ORSAT ANALYSIS RESULTS

Date 26 Sept 79

Time ~~3~~ 1530

Signature

Gas Fractional Part

CO_2 .210

O_2 .082

CO .000

N_2 .708

Orsat fractional parts must sum to 1.00.

At least one preliminary Orsat analysis must be taken unless reliable preliminary information is available from other sources. If a preliminary Orsat is not taken, state how this preliminary information was obtained: ______________________________

PRELIMINARY
MOLECULAR WEIGHT CALCULATIONS

This calculation of molecular weight is not required for gaseous sampling.

	Molecular Weights		Moisture Fraction		Partial Mol. Wt.
H_2O	(18)		[.0756 / Dry]	=	1.361
		Orsat Fraction	Gas Fraction		
CO_2	(44)	(.210)	.9244	=	8.541
O_2	(32)	(.082)			2.426
CO	(28)	( )			0
N_2	(28)	(.708)			18.325

Molecular Weight of Stack Gas 30.65
(Sum of partial molecular weights)

Date 10 Oct 79

Signature

PRELIMINARY VELOCITY DETERMINATION

If preliminary velocity is not determined by the following procedure please state how preliminary velocity was determined.

Kiln #3 Run #5

Traverse Pt.	Δp (inches H_2O) I	II	III
Date	26 Sept		
Time	1515		South Port
1 West Port	.77/744		.81/744
2	1.04/760		.84/746
3	1.05/771		.95/748
4	1.05/762		1.03/753
5	1.06/761		.93/748
6	.63/740		.68/700
7			
8		T_s = 748.1	
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

For Preliminary Velocity Calculation, Isokinetic Sampling:

1. Use calculator to sum the square roots of all Δp's and divide this by N, the number of Δp's.

$$\text{Aver. } \sqrt{\Delta p} = \frac{\Sigma \sqrt{\Delta p}}{N}$$

$$\text{Aver. } \sqrt{\Delta p} = \frac{(\quad)}{(\quad)} = \underline{\underline{.945}}$$

(units are inches H_2O to the one half power)

2. Obtain the pitot tube calibration factor for the probe used. Probe No. LS Pitot Tube Calibration Factor .829 (Shown in the equation below as PTCF)

3. Calculate Absolute Stack Pressure:
64
73
13.7

Measured Stk. Press. (gage) -13.7 "H_2O

(Measured stack press. may be (+) or (-))

Preliminary Atmo. Press. 27.88 "Hg

Stack pressure in inches of water (gage), times 0.07355, plus the barometric pressure in inches mercury equal to the absolute stack pressure in inches of mercury:

( ) in.H_2O (.07355) + ( ) in. Hg

= Stack Press. 26.88 in. Hg

4. Calculate average preliminary velocity, V, in feet per second as shown below.

$$V = (85.48)\,(\text{PTCF})\,\sqrt{\frac{(\text{Stack Temp. } ^\circ\text{R})}{\left[\begin{matrix}\text{Mole.}\\ \text{Wt.}\end{matrix}\right]\left[\begin{matrix}\text{Stk. Press.}\\ \text{inches Hg}\end{matrix}\right]}}\;(\text{Average}\sqrt{\Delta p})$$

$$V = (85.48)\,(.829)\,\sqrt{\frac{(1208.1)}{(\quad)(\quad)}}\;(.945) = \underline{\underline{\qquad}}\ \text{ft/sec}$$

Date ______

Time ______

Signature ______

PRELIMINARY MOISTURE DETERMINATION

Run #5 Kiln #3

If preliminary moisture is not determined by the following procedure please state how preliminary moisture was determined:

____

____

CONDENSER METHOD

Initial Meter Temp. Inlet 104 Outlet 103

Final Meter Temp. Inlet 103 Outlet 102

Average Tmp. 103 °F TM = Average temp. + 460 = 563 °R

FIRST IMPINGER		SILICA GEL IMPINGER	
Final Wt.	673.7	Final Wt.	570.4
Initial Wt.	667.3	Initial Wt.	869.0
	6.4		1.4

Total Gain, MWC 7.8 grams H_2O

(Add the gains from both impingers to obtain total gain)

Pressure at Meter, PM, 27.88 inches Hg. (For purposes of this test, PM is equal to atmospheric pressure since ΔH is very small.)

Dry Gas Meter Reading, Final 571.601
Initial 566.552
Net Volume 5.049 ft^3

Corrected Volume (V)
Dry Gas Meter Calibration Factor, DGMCF 1.018

V = (Net Vol) (DGMCF) = (5.049) (1.018) = 5.140 ft^3

$$\text{Moisture Fraction} = \frac{(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}}{\left[(\text{MWC})\ (1.339)\ \frac{\text{liters}}{\text{gm } H_2O}\right] + \left[\frac{(\text{V})\ \ (\text{PM})}{(\text{TM})}\ (501.7)\ \frac{\text{liters } {}^\circ\text{R}}{\text{ft}^3 \text{ in. Hg}}\right]}$$

$$\text{Moisture Fraction} = \frac{(\ 7.8\ )\ (1.339)}{\left[(\ 7.8\ )\ (1.339)\right] + \left[\frac{(\ 5.140\ )(\ 27.88\ )}{563.}\ (501.7)\right]}$$

$$= \underline{\underline{0.0756}}$$

Dry Gas Fraction = 1 - (moisture fraction) = 1 - (.0756) = .9244

When the moisture determination experiment is repeated, use copies of this page for collecting data and recording results. If this is done, calculate the averages:

Average Moisture Fraction ________

Average Dry Gas Fraction ________

Date 26 Sept 79

Signature

APPENDIX E

Plant Operational Data

KILN NO. Kiln #3 9-25

RECORD EVERY 30 MINUTES DURING TEST

	11:00 AM	11:30	12:00	12:30	2:00	2:30
	SAMPLE NO. 1		SAMPLE NO. 2		SAMPLE NO. 3	
	A	B	A	B	A	B
KILN FEED RATE	40.5	40.6	40.5	40.5	41.0	41.0
FUEL FEED RATE	3.8	4.0	4.0	3.95	3.9	3.9
KF (.54) CLKR. PRODUCTION (CALC.)	21.9	21.9	21.9	21.9	22.1	22.1
SAMPLE MOISTURE % (1)	.43%	.50%	.41%	.13%	.00	.00%
BAGHOUSE FAN AMPS	48.0	49.0	49.0	48.0	49.0	49.0
BAGHOUSE FAN R.P.M. (1)	920	940	930	940	920	930
Oxygen	2.2	1.4	1.4	1.3	1.6	1.8
Kiln Temp	1260	1270	1270	1230	1270	1220

KILN NO.____

RECORD EVERY 30 MINUTES DURING TEST

	3:30	4:00	4:30		10:45 AM	11:15
	SAMPLE Nº 1		SAMPLE	Nº 2	SAMPLE	Nº 3
	A	B	A	B	A	B
KILN FEED RATE 40.4	41.5	40.5	41.5	'	39.0	40.5
FUEL FEED RATE 3.5	3.9	3.9	3.9		4.0	3.9
CLKR. PRODUCTION (CALC.)	22.4	21.9	22.4		21.1	21.9
SAMPLE MOISTURE % (1)	.01%	.27%	.23%		.22%	.17%
BAGHOUSE FAN AMPS	49.0	48.5	48.5		48.5	48.0
BAGHOUSE FAN R.P.M. (1)	930	930	940		910	910
Oxygen	1.6	1.4	1.3		1.6	1.7
Kiln Temp	1210	1210	1210		1290	1290

9-25 | 9-26

KILN N

9-26 9-26

RECORD EVERY 30 MINUTES DURING TEST

1145 12:50 1:20 1:50

	SAMPLE № 1		SAMPLE № 2		SAMPLE № 3	
	A	B	A	B	A	B
KILN FEED RATE	40.7	41.0	40.8	40.5	41.0	41.0
FUEL FEED RATE	3.88	3.90	3.80	3.90	3.80	3.80
CLKR. PRODUCTION (CALC.)	22.0	22.1	22.0	21.9	22.1	22.1
SAMPLE MOISTURE % (1)	.30%	.17%	.20%	.28%	.26%	13,3700 2 .18%
BAGHOUSE FAN AMPS	49.5	50.5	49.8	50.0	49.0	49.5
BAGHOUSE FAN R.P.M. (1)	920	910	920	910	920	920
Oxygen	1.3	1.4	2.1	1.6	1.6	1.9
Kiln Temp	1290	1310	1290	1290	1300	1280

KILN N-

RECORD EVERY 30 MINUTES DURING TEST

#3 Kiln 4:00 | #1 Kiln 12:00 12:30 1:00 1:30

	SAMPLE Nº 1		SAMPLE Nº 2		SAMPLE Nº 3	
	A	B	A	B	A	B
KILN FEED RATE	46.7		32.0	36.0	37.0	
FUEL FEED RATE	3.9		3.9	3.9	3.9	
CLKR. PRODUCTION (CALC.)	22.1		17.3	19.4	20.0	
SAMPLE MOISTURE % (1)	12:30 .16%		.25%	.16%	.19%	
BAGHOUSE FAN AMPS	50.0		49.0	49.0	48.5	
BAGHOUSE FAN R.P.M. (1)	920		900	890	900	
Oxygen	1.5		1.3	1.8	1.2	
Kilin Temp	1300		1390	1390	1400	

9-26 | 9-27

KILN N

9-27 RECORD EVERY 30 MINUTES DURING TEST

	2:40	3:10	3:40	4:30	5:00	5:30
	SAMPLE Nº 1		SAMPLE Nº 2		SAMPLE Nº 3	
	A	B	A	B	A	B
KILN FEED RATE 39.0	38.0	39.0	39.0	39.0	40.0	40.0
FUEL FEED RATE 3.9	3.85	3.9	3.9	3.9	3.9	3.9
CLKR. PRODUCTION (CALC.)	20.5	21.1	21.1	21.1	21.6	21.6
SAMPLE MOISTURE % (1)	.16%	.20%	.35%	.30%	.27%	.30%
BAGHOUSE FAN AMPS	49.0	50.0	50.0	50.5	50.5	49.5
BAGHOUSE FAN R.P.M. (1)	900	900	900	900	900	900
Oxygen	1.4	2.3	1.5	1.3	1.4	1.2
Kiln Temp	1290	1300	1290	1380	1400	1420

9-28:

RECORD EVERY 30 MINUTES DURING TEST

	9:30	10:00	10:30	11:00		
	SAMPLE Nº 1		SAMPLE Nº 2		SAMPLE Nº 3	
	A	B	A	B	A	B
KILN FEED RATE	36.5	37.5	37.0	37.0		
FUEL FEED RATE	3.8	3.7	3.7	3.7		
CLKR. PRODUCTION (CALC.)	19.7	20.3	20.0	20.0		
SAMPLE MOISTURE % (1)	.24%	.19%	.23%	.19%		
BAGHOUSE FAN AMPS	50.0	50.0	48.5	49.5		
BAGHOUSE FAN R.P.M. (1)	930	920	910	920		

Oxygen .5 .6 .5 .5

Kiln Temp 1360 1330 1360 1350

9-26 RECORD EVERY 30 MINUTES DURING TEST

	SAMPLE № 1		SAMPLE № 2		SAMPLE № 3	
	A	B	A	B	A	B
	3:40	4:10	4:40	5:30	6:00	6:30
KILN FEED RATE	35.0	34.5	35.0	35.5	36.0	36.7
FUEL FEED RATE	3.7	3.7	3.7	3.7	3.8	3.7
CLKR. PRODUCTION (CALC.)	18.9	18.6	18.9	19.2	19.4	19.8
SAMPLE MOISTURE % (1)	.27%	.24%	.22%	.28%	.28%	.26%
BAGHOUSE FAN AMPS	48.0	48.5	49.5	49.0	50.5	49.5
BAGHOUSE FAN R.P.M. (1)	920	910	920	930	920	
Oxygen	.5	.4	.2	.6	.2	.5
Kiln Temp	1330	1290	1380	1320	1380	1330

[illegible]-AIR CORPORATION

DATE FEBRUARY 1, 1970

PREPARED FOR: LONE STAR CEMENT CORPORATION

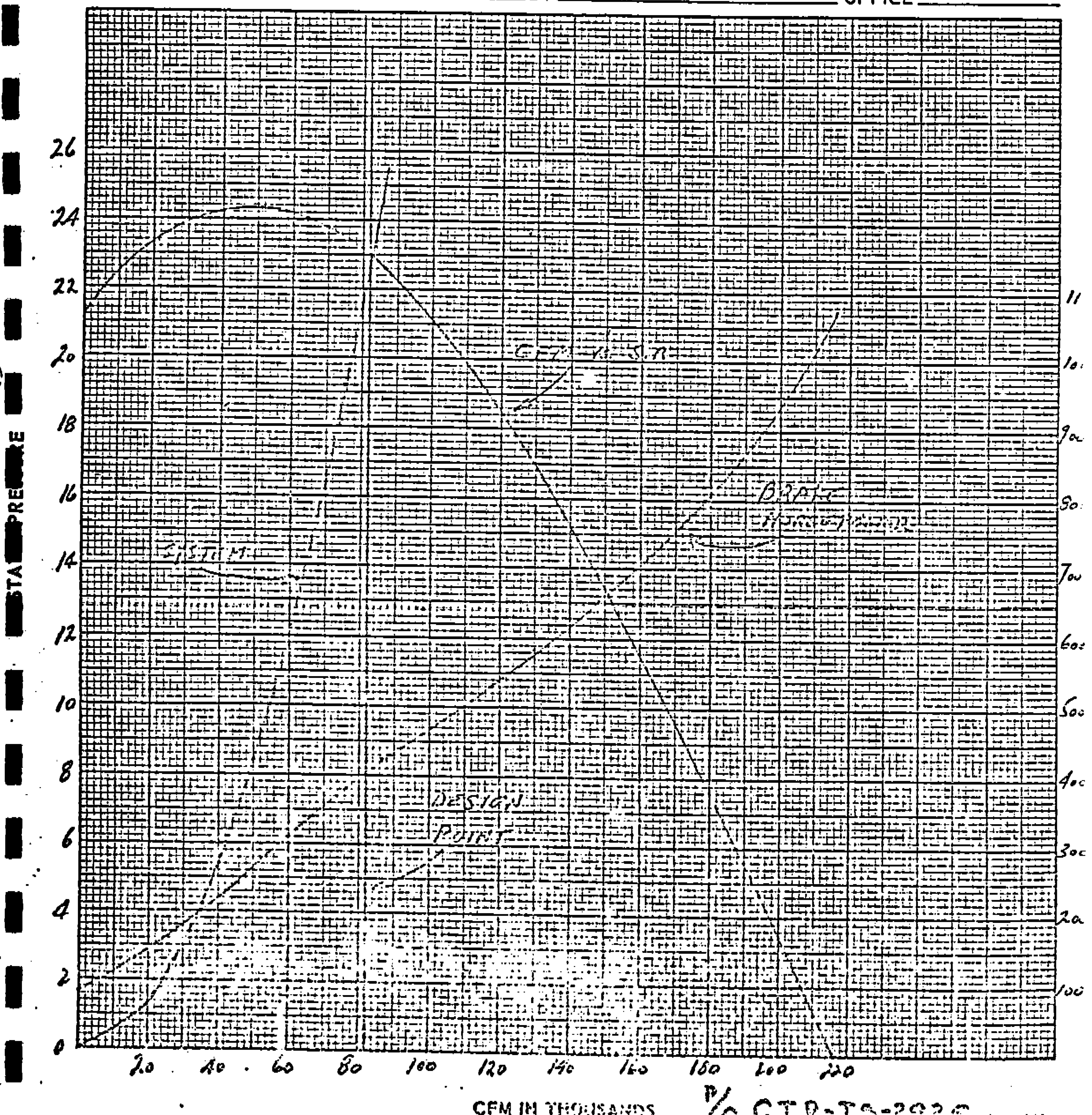
JOB PROJECT 821 - MARYNEAL

EQUIPMENT #7678 DESIGN 2005 "RB" FAN, ARRANGEMENT 3D2

SERVICE INDUCED DRAFT: KILNS #1, #2, #3

ORDER NUMBER 1188-TS-NY TEMP. 550 F DENSITY 0.0372

RPM 1120 BHP 401 BY H.T. WOERNER OFFICE NEW YORK



P/C CTP-TS-29

APPENDIX F

Particulate Analysis Data

H. Vol Weight gain — grams   LONESTAR - MARYNEAL, TX   795-09

	0.6047	32	0.5593
2	0.2083	33	0.5408
	1.3938	34	0.7596
4	0.7559		
	1.4330		
	0.2974		
7	0.6476		
8	0.2710 ~~0.0475~~		
	1.4732		
1	0.5503		
12	0.2408		
	0.4029		
1	0.3519		
16	0.7159		
	0.3355		
	0.3713		
2	0.8947		
1	0.3082		
	0.1597		
2	0.2534		
4	0.2106		
	0.4173		
2	0.7839		
30	0.7116		
	0.8977		

APPENDIX G

Chain of Custody

ECOLOGY AUDITS, INC.

Chain of Custody

Job Number 795-09

b Name LoneStar Ind.

cation Maryneal, Tx

Unit Tested Baghouse # 1, 2, 3

Date(s) Sampled 25 Sept - 28 Sept 79

No. of Tests 3 per baghouse

Sample Containers

Description	No. of Containers	Remarks
Front Wash		
ack Wash		
pinger No. 1		
Impinger No. 2		
inger No. 3		
Filter Container	27	Do not anal samples 1+2
		on baghouse # 3

Sample No. 3-5 Recovered by: Date: 26 Sept Time: — Location: BH # 3

Sample No. 1-3 Recovered by: Date: 27 Sept Time: — Location: BH # 1

Sample No. 2-~~3~~ Recovered by: Date: 28 Sept Time: — Location: BH # 2

mples Received by: for Transport Date: 29 Sept 79 Time: 0802

Samples Received at Lab by: Date: 10/1/79 Time: 1500

mples Analyzed by: Gary M. Smith Date: 10/3/79 Time: 1200am

ECOLOGY AUDITS, INC.

Analysis Request Form

Job Name LoneStar Ind

Job Number 795-09

Date Sampled 25 Sept - 28 Sept 79

Date Submitted 1 Oct 79

Sampled By T Rose, D Bushart

Results Needed by

Special Instruction

Analyzed by Gary M. Smith

Date Analysis Completed 10/3/79

SOURCE SAMPLES

	Units Tested	Parameters to be Analyzed	No. Tests/Unit
1	BH #3	Particulate	3
2	BH #1	"	3
3	BH #2	"	2
4			
5			

Gaseous	Impingers: #1	#2	#3	#4	#5	Run No.	Unit No.
SO_2							
H_2S							
H_2SO_4							
NO_x							
Cl							
Other							

Evaporate Front Half

Evaporate Back Half

Save Front Particulate

Save Back Particulate

Do Not Evaporate

Back Half But Save

AMBIENT AIR SAMPLES

	# Samples
Hi-Vol Filter Weights	27
NO_x Samples	
SO_2 Samples	
H_2S Samples	

		# Samples
Metals Analysis:		
Other:		

Special Instructions: Desiccate 24 hours minimum and weigh once. Remove all filter residue from bag To weigh with filters.

APPENDIX H

Resumes of Test Personnel

MARTIN LOUIS ZINSITZ, Stack Sampling Engineer

Education	B.S. 1977, University of Texas, Austin, Texas, Chemical Engineering major. Course training in process engineering block: chemical reactor design, distillation, chemical plant design, process analysis and simulation, polymer science, polymer processing, and air pollution control. B.A. 1977, Abilene Christian University, Abilene, Texas, Biblical Studies major. U.S. Army, Communications Technical Control, 28 weeks, 1971.
Technical Experience	Source sampling studies, responsible for the calibration of equipment and technical report writing. Experienced with most sampling equipment necessary to provide accurate field testing services. Two years technical experience in communications technical control: maintenance and quality control of voice and teletype circuits over tropospheric scatter and microwave systems.
Professional Membership	American Institute of Chemical Engineers.

DAVID B. BUSHART, Senior Environmental Field Technician

Education	B.S., 1978, Stephen F. Austin State University, Nacogdoches, Texas; Environmental Science (emphasis in chemistry). Environmental Protection Agency course training in source sampling for particulates.
Technical Experience	Source and ambient air studies with analytical laboratory analysis background in support of. Internship with the City of Nacogdoches Pollution Control Department. Work consisted primarily with water analysis.
Professional Membership	Air Pollution Control Association

TERRY L. ROE, Environmental Field Technician

Education	Three years education in Civil Engineering at Austin Community College and the University of Texas at Austin.
Technical Experience	Since joining Ecology Audits, Inc., in 1978, Mr. Roe has worked extensively in the areas of stack sampling and ambient air monitoring. He has participated in the sampling of stacks of asphalt batch plants, power plants and electrical component plants since joining the staff. He is assigned full-time to the source sampling division.