Source category: Portland Cement
Plant name : Lone Star Industries, Inc.
Test date : 6/18 - 6/20/80
Process : dry

Date: 01/08/93
Location: Maryneal, TX
Ref. No.: 17
Basis for process rate : feed

Source	Type of control	Pollutant	Run No.	Emission rate, lb/hr	Process rate, ton/hr	Emission factor kg/Mg	Emission factor lb/ton	Volumetric flow rate, DSCFM	Concen %
rotary kiln with suspensio preheater (coal-fired) No. 1	fabric filter	SO_2	1	0	42.2	0.0000	0.0000		
		SO_2	2	0.23	42.3	0.00272	0.00544		
		SO_2	3	0	42.2	0.0000	0.0000		
					average	0.000906	0.001812	Rating :	B
		SO_3	1	0.47	42.2	0.00557	0.0111		
		SO_3	2	1.31	42.3	0.0155	0.0310		
		SO_3	3	0.59	42.2	0.00699	0.0140		
					average	0.00935	0.0187	Rating :	B
		CO_2	1	50,241	42.2	595	1,191	38,256	19.2
		CO_2	2	49,037	42.3	580	1,159	38,544	18.6
		CO_2	3	49,642	42.2	588	1,176	40,320	18.0
					average	588	1,175	Rating :	B
rotary kiln with suspensio preheater (coal-fired) No. 2	fabric filter	SO_2	1	0	42.2	0.0000	0.0000		
		SO_2	2	0	42.1	0.0000	0.0000		
		SO_2	3	0	42.2	0.0000	0.0000		
					average	0.0000	0.0000	Rating :	B
		SO_3	1	0.45	42.2	0.00533	0.0107		
		SO_3	2	0.28	42.1	0.00333	0.00665		
		SO_3	3	0.85	42.2	0.0101	0.0201		
					average	0.0062	0.0125	Rating :	B
		CO_2	1	45,364	42.2	537	1,075	39,477	16.8
		CO_2	2	46,906	42.1	557	1,114	40,339	17.0
		CO_2	3	41,653	42.2	494	987	40,597	15.0
					average	529	1,059	Rating :	B
rotary kiln with suspensio preheater (coal-fired) No. 3	fabric filter	SO_2	1	0	42.8	0.0000	0.0000		
		SO_2	2	0.52	42.2	0.00616	0.0123		
		SO_2	3	0.22	42.2	0.00261	0.00521		
					average	0.00292	0.00585	Rating :	B
		SO_3	1	0.27	42.8	0.00315	0.00631		
		SO_3	2	0.3	42.2	0.00355	0.00711		
		SO_3	3	0	42.2	0.00000	0.00000		
					average	0.00224	0.00447	Rating :	B
		CO_2	1	47,345	42.8	553	1,106	38,032	18.2
		CO_2	2	52,253	42.2	619	1,238	37,448	20.4
		CO_2	3	50,998	42.2	604	1,208	37,656	19.8
					average	592	1,184	Rating :	B

SUMMARY

PLANT: LONE [illegible] - MARYNEAL

LOCATION: [illegible] TEXAS

TEST/IDENTIFICATION 80-54 - EA795-09 DATE: [illegible] 1979

TESTING BY: MULLINS ENVIRONMENTAL - ECOLOGY AUDITS INC.

KILN/COOLER NO. 1-2-3

			PERFORMANCE		
Kiln Production	Ton/Hr.	....	21.4	@ 1.855	K.F. Factor
Kiln Feed Rate	Ton/Hr.	....	39.7		
Fuel Rate (Coal)	Ton/Hr.	....	3.8	@ 11,180	BTU/lb.
" " (Oil)	Gal/Hr.	....	–		
Fuel Ash	%	....	14.0		
Fuel Sulphur	%	....	0.6	@ 0.1	Kiln Feed S.

KILN (Stack)

				ALLOWABLE
Exhaust Gas Flow	DSCFM	....	58413/34865	
Part. Concen.	lb/SCF	....	[illegible]	
Emission Rate	lb/Ton	....	0.07/[illegible]	0.3/13.1 = 0.3(39.7 + 3.8)
SOX (Kiln) (Concentration)	PPM	....	[illegible]	
Emissi	lb/Ton	....	0.013/[illegible]	0.3/13.1
Emiss		....		
NOX ((Con			784	
Emis			.76/228.5 [illegible]	
COO				
Exh			–	
Pa			–	
Em			–	

Reference 34;

Delete!

SO_2/NO_x Only!

R [illegible] METHOD [illegible] 60

1-VOL @ TOP OF BAGHOUSE PLENUM

AS APP[illegible] [illegible] CFR, 40 PART 60

DSCF 58.413 = PARTICULATE SAMPLING DSCF 34865 = SOX SAMPLING

DIFFERENCE IN VOLUME DUE TO BLEED-IN OF AIR TO COOL GASES TO

BAG HOUSE.

Remarks on field data sheets indicate Orsat

MULLINS ENVIRONMENTAL TESTING CO., INC.
P.O. Box 598
Addison, Tx 75001
(214)980-1843

METCO

SOURCE EMISSIONS SURVEY
OF
LONE STAR INDUSTRIES, INC.
KILNS 1, 2, AND 3
MARYNEAL, TEXAS

JUNE 1980

FILE NUMBER 80-54

METCO
MULLINS ENVIRONMENTAL TESTING CO., INC.
P. O. Box 598
Addison, Texas 75001 • (214) 980-1843

July 29, 1980

Mr. Roy Blankenship
Lone Star Industries, Inc.
P.O. Box 1639
Sweetwater, TX 79556

Dear Mr. Blankenship:

Enclosed are four copies of the report of the Source Emissions Survey of Lone Star Industries, Inc.'s plant located in Maryneal, Texas, which was performed on June 18, 19 and 20, 1980.

Also, attached are the NO_x Emission Data taken from Kiln Number 2 Duct on June 20.

Mullins Environmental Testing Co., Inc. appreciates the opportunity to be of service to Lone Star Industries, Inc. If you have any questions, please contact me.

Very truly yours,

MULLINS ENVIRONMENTAL TESTING CO., INC.

Billy J. Mullins, Jr.

Billy J. Mullins, Jr., P.E.
President

BJM/vjr

Enclosures (4)
Attachment

cc: Mr. Roy Click (with one copy of report and attachment)

METCO

NO_x EMISSION DATA

Job Number 80-54

Client Lone Star Industries, Inc.

Date 6/20/80

Unit Tested Kiln Number 2 Duct

Run Number 1

Flask Number	1	2	3	4	Average
Time	1945	1947	1950	1952	
Initial Barometric Pressure, "Hg Abs.	27.41	27.41	27.41	27.41	
Initial Manometer Reading, "Hg Abs.	-26.10	-25.90	-25.90	-25.90	
P_I - Initial Pressure of Flask, "Hg Abs.	1.31	1.51	1.51	1.51	
T_I - Initial Temperature of Flask, °F	105	105	98	98	
V_F - Volume of Flask, ml	2028	2037	2050	2079	
Final Barometric Pressure, "Hg Abs.	29.27	29.27	29.27	29.27	
Final Manometer Reading, "Hg Abs.	-0.05	-0.30	-0.20	0.00	
P_F - Final Pressure of Flask, "Hg Abs.	29.22	28.97	29.07	29.27	
T_F - Final Temperature of Flask, °F	77	79	76	78	
μgNO_2 - micrograms of NO_2	2877.3	2475.8	3011.2	2676.6	[illegible]
V_s - Volume of sample at standard conditions*, ml	1841	1814	1841	1874	
ppm NO_2 - Concentration of NO_2, ppm	817.4	713.8	855.4	747.0	783.4
C_{NO_2} - Emission Rate of NO_2, lbs/dscf*	9.76×10^{-5}	8.52×10^{-5}	10.2×10^{-5}	8.92×10^{-5}	9.35×10^{-5}
* 68°F, 29.92 "Hg (20°C, 760 mm Hg) #/h.	231.2	206.2	248.5	228.6	228.[illegible]

[illegible]

$$V_s = \frac{528\,(V_F - 25)}{29.92}\left[\frac{P_F}{T_F + 460} - \frac{P_I}{T_I + 460}\right] = \text{ml}$$

$$ppmNO_2 = \frac{523 \times \mu gNO_2}{V_s} = \text{ppm}$$

$$C_{NO_2} = \frac{\mu gNO_2}{V_s} \times \frac{1\ \text{lb/ft}^3}{1.6 \times 10^4\ \mu\text{g/ml}} = 6.243 \times 10^{-5}\,\frac{\mu gNO_2}{V_s} = \text{lbs/dscf}$$

LONE STAR INDUSTRIES, INC.

Interoffice Memo

Mail: P. O. Box 12449, Dallas, Texas 75225

August 22, 1980

EB
R.S. / GM
GM / RS

TO: George Messinger

FROM: Roy Click, Jr.

SUBJECT: SO_2 Emissions Report - Maryneal

Dear George,

Enclosed is the SO_2 emissions survey report for your review.

This report indicates SO_2 emissions are far below the allowable.

Sincerely,

Roy

Roy Click, Jr.
Regional Environmentalist

RC:ss
Enclosures

LONE STAR INDUSTRIES, INC.

Cement & Construction Materials Group

Maryneal Plant
P. O. Box 1639
Sweetwater, Texas 79556
(915) 288-3511

November 13, 1979

Mr. Jim Kamrath
Texas Air Control Board
Permits Section
6330 Highway 290 East
Austin, Texas 78723

Dear Mr. Kamrath:

Re: Construction Permits C-5918B, C-5918C and C-5918D
Lone Star Industries, Inc., Maryneal, Texas

In accordance with special provisions of the aforementioned construction permits, the kilns located at Lone Star's cement plant at Maryneal were sampled while burning natural gas as a primary fuel and were again sampled after coal was used as a primary fuel. Ecology Audits of Austin, Texas performed said tests.

Revised calculations of the pre-coal tests as well as calculations of tests made after coal burning are enclosed.

Yours very truly,

LONE STAR INDUSTRIES, INC.

R. M. Blankenship, Jr.

R. M. Blankenship, Jr.
Plant Manager

RMB:ls

Enclosures

cc: G. Messenger - C. H.
S. P. Lathem - Dallas

TABLE OF CONTENTS

SOURCE EMISSIONS SURVEY
LONE STAR INDUSTRIES, INC.
KILNS 1, 2, AND 3
MARYNEAL, TEXAS
FILE NUMBER 80-54

INTRODUCTION

Mullins Environmental Testing Co., Inc., Dallas, Texas, conducted a source emissions survey for Lone Star Industries, Inc. in Maryneal, Texas, on June 18, 19 and 20, 1980. The purpose of these tests was to determine the concentrations of sulfur dioxide being emitted to the atmosphere via the exhaust ducts of Kilns Number 1, Number 2, and Number 3.

The sampling followed the procedures set forth in the Appendix to the Code of Federal Regulations, Title 40, Chapter I, Part 60 and in the "Compliance Sampling Manual, Texas State Department of Health, Air Pollution Control Services, October 1975."

SUMMARY OF RESULTS

The principal conclusions are as follows:

Kiln Number 1 Duct

1. The emissions of sulfur dioxide from the stack were equal to 0.08 pounds per hour, based on averaging the three tests.

2. The allowable sulfur dioxide emission rate as stated in the Texas Air Control Board Permit is equal to 31.3 pounds per hour. The actual emissions were 0.3 percent of the permitted emission rate.

Kiln Number 2 Duct

1. The emissions of sulfur dioxide from the stack were below the detectable limit of the method on all three tests.

2. The allowable sulfur dioxide emission rate as stated in the Texas Air Control Board Permit is equal to 31.3 pounds per hour. The actual emissions were 0.0 percent of the permitted emission rate.

Kiln Number 3 Duct

1. The emissions of sulfur dioxide from the stack were equal to 0.25 pounds per hour, based on averaging the three tests.

2. The allowable sulfur dioxide emission rate as stated in the Texas Air Control Board Permit is equal to 34.4 pounds per hour. The actual emissions were 0.7 percent of the permitted emission rate.

METCO

SUMMARY OF RESULTS

Kiln Number 1 Duct

Run Number	1	2	3
Stack Flow Rate - DSCFM*	38,256	38,544	40,320
% Water Vapor - % Vol.	6.8	6.8	6.1
% CO_2 - % Vol.	19.2	18.6	18.0
% O_2 - % Vol.	9.2	9.2	9.6
% Excess Air @ Sampling Point	94	93	100
Sulfur Dioxide Concentration - ppm	0.0	0.6	0.0
Sulfur Dioxide Emissions - lbs/hr	0.38 0.0	1.28 0.23	0.47 0.0
Allowable Emission Rate TACB - Reg. II - lbs/hr	31.3	31.3	31.3
Sulfur Trioxide Concentration - ppm	1.0	2.7	1.2
Sulfur Trioxide Emissions - lbs/hr	0.47	1.31	0.59

* 29.22 "Hg, 68°F

Avg = 9.92/6 = 1.10

Avg = 4.04/6 = 0.51 #/hr SO3

SUMMARY OF RESULTS

Kiln Number 2 Duct

Run Number	1	2	3
Stack Flow Rate - DSCFM*	39,477	40,339	40,597
% Water Vapor - % Vol.	6.2	5.4	5.4
% CO_2 - % Vol.	16.8	17.0	15.0
% O_2 - % Vol.	10.2	10.0	11.4
% Excess Air @ Sampling Point	111	107	141
Sulfur Dioxide Concentration - ppm	0.0	0.0	0.0
Sulfur Dioxide Emissions - lbs/hr	0.0	0.0	0.0
Allowable Emission Rate TACB - Reg. II - lbs/hr	31.3	31.3	31.3
Sulfur Trioxide Concentration - ppm	0.9	0.6	1.7
Sulfur Trioxide Emissions - lbs/hr	0.45	0.28	0.85

* 29.22 "Hg, 68^{o}F

0.85

METCO

SUMMARY OF RESULTS

Kiln Number 3 Duct

Run Number	1	2	3
Stack Flow Rate - DSCFM*	38,032	37,448	37,656
% Water Vapor - % Vol.	6.7	7.2	7.0
% CO_2 - % Vol.	18.2	20.4	19.8
% O_2 - % Vol.	8.0	8.2	8.8
% Excess Air @ Sampling Point	69	76	87
Sulfur Dioxide Concentration - ppm	0.0	1.4	0.6
Sulfur Dioxide Emissions - lbs/hr	0.0	0.52	0.22
Allowable Emission Rate TACB - Reg. II - lbs/hr	34.4	34.4	34.4
Sulfur Trioxide Concentration - ppm	0.6	0.6	0.0
Sulfur Trioxide Emissions - lbs/hr	0.27	0.30	0.0

* 29.22 "Hg, 68^{o}F

DISCUSSION OF RESULTS

Kiln Number 1 Duct

The three tests for sulfur dioxide appeared to be valid representations of the actual emissions during the tests. The indicative parameters calculated from the field data were in close agreement. The moisture percentages for the three tests were within 7.1 percent of the mean value. The measured flow rates (Q_s) for the tests were within 3.3 percent of the mean value.

The emissions of sulfur dioxide on the first and third tests were below the detectable limit of the sampling method. The emissions during the second test were only slightly above the detectable limit of the method.

Kiln Number 2 Duct

The three tests for sulfur dioxide appeared to be valid representations of the actual emissions during the tests. The indicative parameters calculated from the field data were in close agreement. The moisture percentages for the three tests were within 9.2 percent of the mean value. The measured flow rates (Q_s) for the tests were within 1.6 percent of the mean value.

The emissions of sulfur dioxide were below the detectable limit of the sampling method on all three tests.

Kiln Number 3 Duct

The three tests for sulfur dioxide appeared to be valid representations of the actual emissions during the tests. The indicative parameters calculated from the field data were in close agreement. The moisture percentages for the three tests were within 4.2 percent of the mean value. The measured flow rates (Q_s) for the tests were within 0.8 percent of the mean value.

The emissions of sulfur dioxide were below the detectable limit of the sampling method on the first test and only slightly above the detectable limit on the second and third tests.

DESCRIPTION OF PROCESS OPERATION

Lone Star's Maryneal Plant is classified as a dry-process preheater cement manufacturing facility; that is, all raw materials are ground and blended in the dry state.

Raw materials used to manufacture cement at Maryneal consist of limestone, clay, sand, and iron ore. These materials are then fed proportionally to a dry process ball mill and ground to a fine uniform powdered mixture called raw mix. This raw mix is then pumped to large silos where it is blended to a desired chemical composition which will produce a quality cement clinker. Once this process is complete, the raw mix is fed to a gas or coal-fired rotary kiln and suspension preheater system. Combustion gases pass through the slowly rotating kiln and suspension preheater counterflow to the raw materials entraining some of the smaller particles of raw materials. These combustion gases contain carbon dioxide, sulfur dioxide, and water vapor.

Inside the kiln, there are four main processes taking place at temperatures varying from 900°F at the feed end to 2800°F at the firing end. These processes are drying, calcination or decarbonation of limestone, clinkering-liquid formation to form cement compounds, and finally the cooling of clinker. The liquid, upon cooling, forms hard masses. These hard masses are called clinker; and when cooled by passing through a clinker cooler, they are conveyed to a storage area. These hard masses are eventually transferred to a ball mill where they are ground to a fine powder called cement.

The Maryneal Plant has three rotary kiln, preheater systems, each having a kiln feed rate between 35 and 45 tons per hour. Process data taken during the emission tests are included in Appendix G. These data show the raw kiln feed to approximately 42.2 tons per hour for each kiln, the coal feed varying from 3.75 to 3.9 tons per hour.

DESCRIPTION OF SAMPLING LOCATIONS

Kiln Number 1 Duct

The sampling location on the exhaust duct of Kiln Number 1 is approximately 25 feet above the ground. The sampling ports are located 16 feet 6 inches (4.20 equivalent stack diameters) downstream from the inlet to the duct and 7 feet 10 inches (1.99 equivalent stack diameters) upstream from the outlet of the duct.

Kiln Number 2 Duct

The sampling location on the exhaust duct of Kiln Number 2 is approximately 25 feet above the ground. The sampling ports are located 16 feet 6 inches (4.20 equivalent stack diameters) downstream from the inlet to the duct and 7 feet 10 inches (1.99 equivalent stack diameters) upstream from the outlet of the duct.

Kiln Number 3 Duct

The sampling location on the exhaust duct of Kiln Number 3 is approximately 25 feet above the ground. The sampling ports are located 16 feet 6 inches (4.20 equivalent stack diameters) downstream from the inlet to the duct and 7 feet 10 inches (1.99 equivalent stack diameters) upstream from the outlet of the duct.

SAMPLING AND ANALYTICAL PROCEDURES

The sampling followed the procedures outlined in the Appendix to the Code of Federal Regulations, Title 40, Chapter I, Part 60 and in the "Compliance Sampling Manual, Texas State Department of Health, Air Pollution Control Services, October 1975."

A preliminary velocity traverse was made at each of the three ports on each of the three kiln ducts in order to determine the uniformity and magnitude of the flow. Several traverse points were checked for cyclonic flow but none was found to be present. During the velocity traverses, twelve traverse points were sampled from each of the three ports on each duct for a total of thirty-six traverse points. During the sampling for sulfur dioxide, samples of thirty-minute duration were taken at the center of each duct using an EPA-type, heated, glass-lined probe.

On all tests the sampling train was leak-checked at the nozzle at 15 inches of mercury vacuum before each test, and leak-checked at the nozzle after each test at the highest vacuum reading recorded during the tests. This was done 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 manometer zeroed before each test.

The "back-half" of the EPA-type sampling train used on the three Kiln Exhaust Ducts contained an 80 percent isopropyl alcohol solution to absorb sulfur trioxide, a six percent hydrogen peroxide solution to absorb sulfur dioxide, and silica gel to absorb moisture. The isopropyl alcohol solution was checked for hydrogen peroxide contamination and none was found.

At the conclusion of each compliance test for sulfur dioxide, the sampling train was purged with two cubic feet of ambient air at the same rate at which the sample was taken.

DESCRIPTION OF TESTS

Personnel from Mullins Environmental Testing Co., Inc. arrived at the Lone Star Industries, Inc. plant in Maryneal, Texas at 8:15 a.m. on Wednesday, June 18, 1980. After meeting with plant personnel, scaffolding was set up on the Kiln Number 3 Duct. The sampling equipment was set up and the preliminary data were collected. Personnel then stood by while the Number 3 Kiln attained the desired operating load. When the kiln had reached the desired operating load, the equipment was prepared for testing and the first sulfur dioxide test on the Kiln Number 3 Duct began at 7:18 p.m. Testing continued until completion of the third test at 10:00 p.m. The samples were recovered and the equipment was moved off of the stack by 11:00 p.m.

On Thursday, June 19, work began at 8:30 a.m. The equipment was moved on to the Kiln Number 2 Duct and the preliminary data were collected. Personnel then stood by while the Number 2 Kiln attained the desired operating load. Plant personnel decided to delay testing until the following day, so the equipment was secured for the night at 5:30 p.m.

On Friday, June 20, work began at 7:15 a.m. Kiln Number 2 was still not up to load, so the equipment was moved off of the Kiln Number 2 Duct and moved on to the Kiln Number 1 Duct. The preliminary data were collected and the equipment was prepared for testing. The first sulfur dioxide test on the Kiln Number 1 Duct began at 10:03 a.m. Testing continued until completion of the third test at 1:08 p.m. The samples were recovered and the equipment was moved off of the Kiln Number 1 Duct. The equipment was then moved back on to the Kiln Number 2 Duct as the Number 2 Kiln had been brought up to load. The first sulfur dioxide test on the Kiln Number 2 Duct began at 4:24 p.m. Testing continued until completion of the third test at 7:26 p.m.

The equipment was moved off of the Number 2 Kiln Duct and loaded into the sampling van. The samples were recovered and taken to Mullins Environmental Testing Co.'s laboratory in Dallas, Texas for analysis and evaluation.

Operations at the Lone Star Industries, Inc. plant in Maryneal, Texas were completed at 9:00 p.m. on Friday, June 20, 1980.

Billy J. Mullins, Jr.

Billy J. Mullins, Jr., P.E.
President

APPENDICES

A. Location of Sampling Points

B. Source Emissions Calculations

C. Calibration of Equipment

D. Field Testing Data

E. Analytical Data

F. Chain of Custody

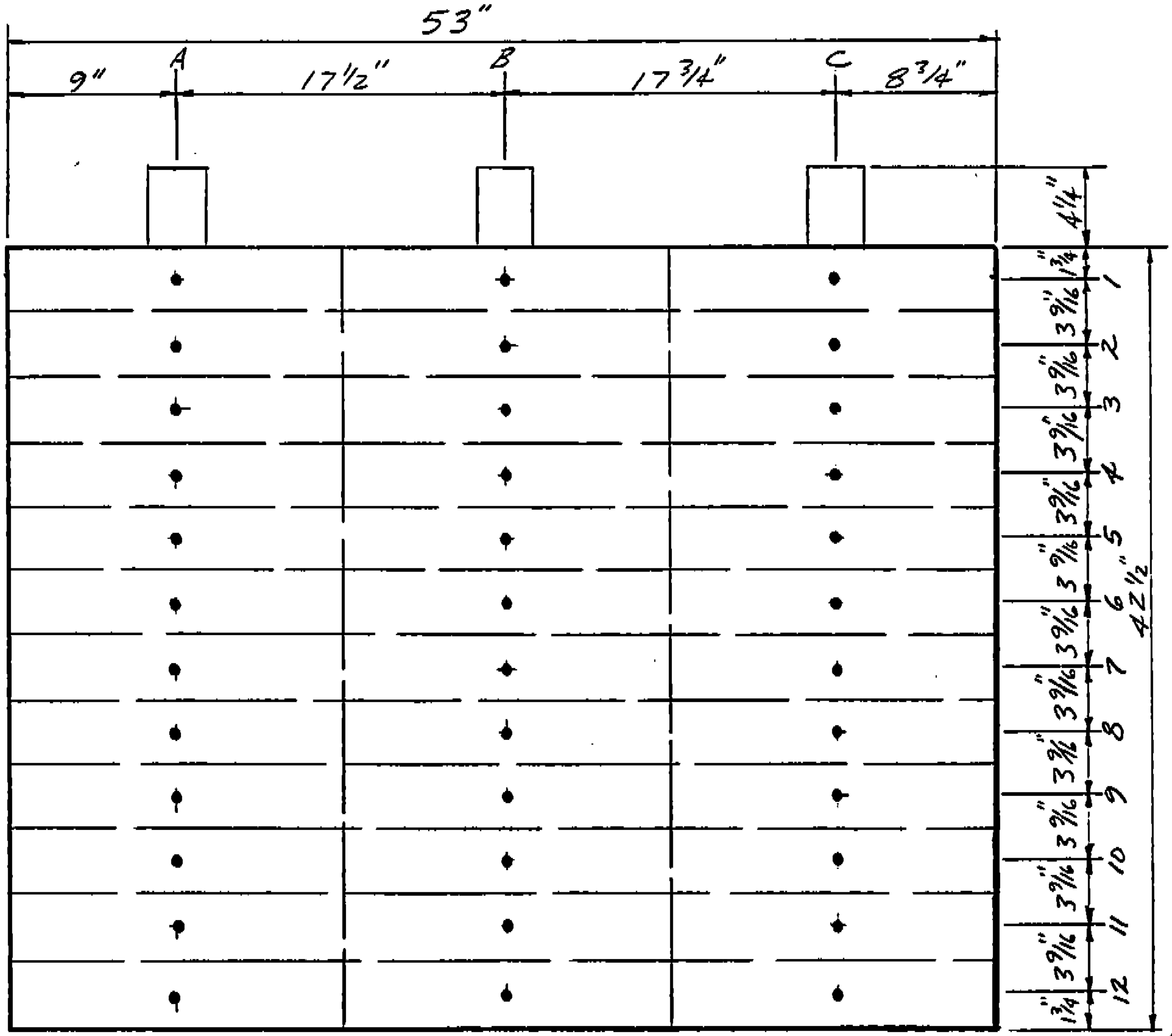
G. Plant Operational Data

H. Resumes of Test Personnel

APPENDIX A

Location of Sampling Points
Kiln Number 1 Duct

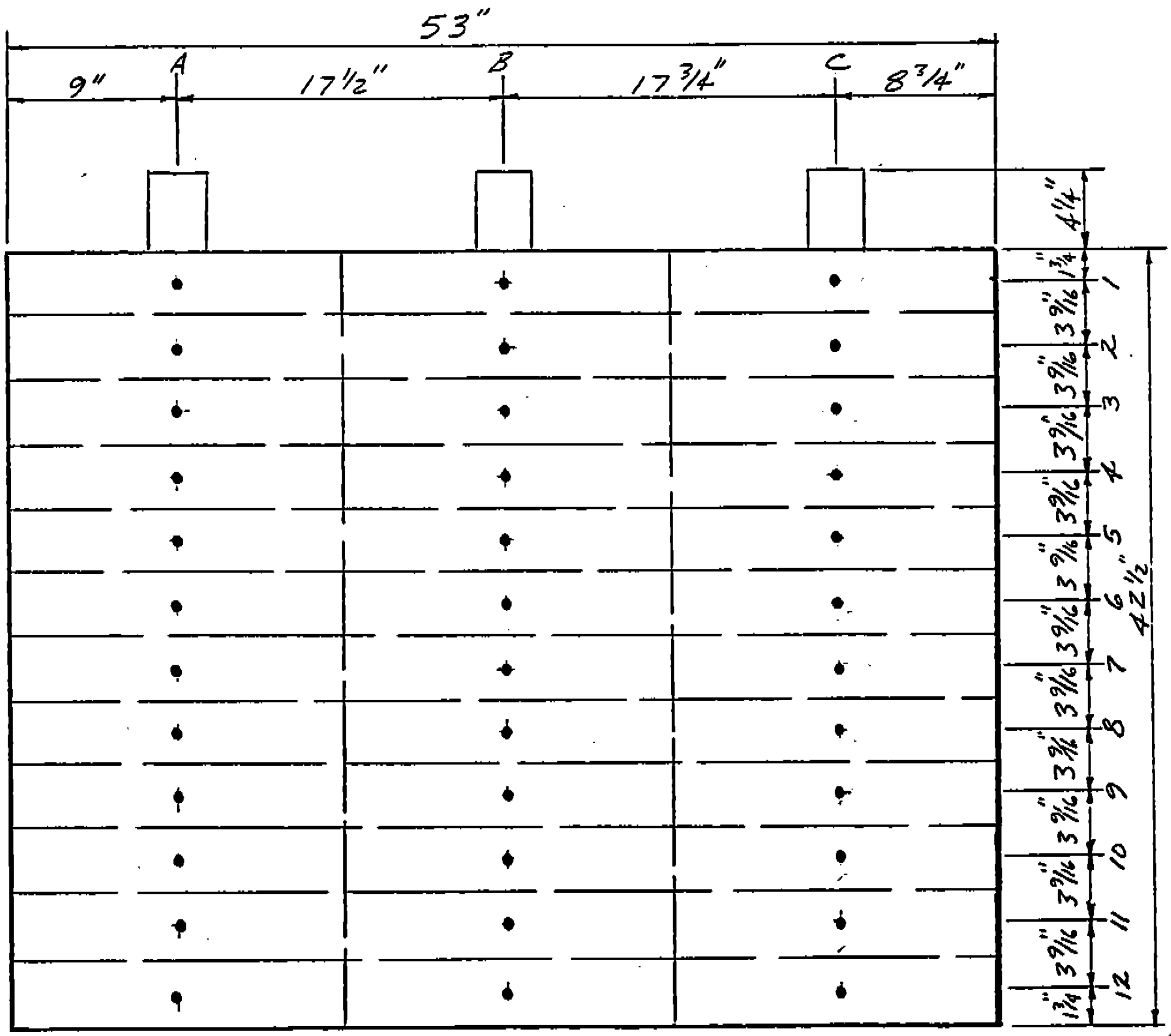
The sampling ports are located 16 feet 6 inches (4.20 equivalent stack diameters) downstream from the inlet to the duct and 7 feet 10 inches (1.99 equivalent stack diameters) upstream from the outlet of the duct. The locations of the sampling points are shown below:



APPENDIX A

Location of Sampling Points
Kiln Number 2 Duct

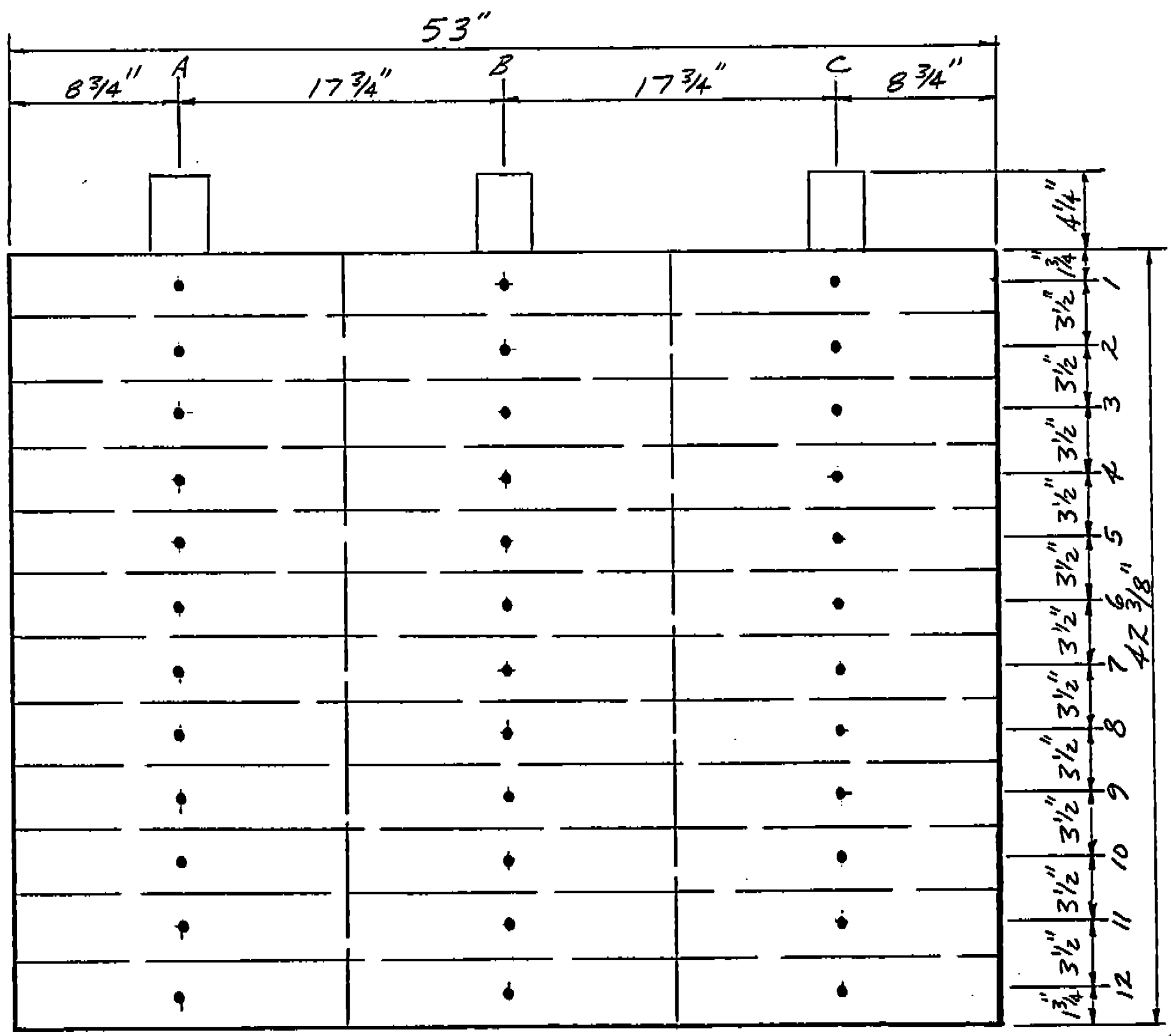
The sampling ports are located 16 feet 6 inches (4.20 equivalent stack diameters) downstream from the inlet to the duct and 7 feet 10 inches (1.99 equivalent stack diameters) upstream from the outlet of the duct. The locations of the sampling points are shown below:



APPENDIX A

Location of Sampling Points
Kiln Number 3 Duct

The sampling ports are located 16 feet 6 inches (4.20 equivalent stack diameters) downstream from the inlet to the duct and 7 feet 10 inches (1.99 equivalent stack diameters) upstream from the outlet of the duct. The locations of the sampling points are shown below:



APPENDIX B

Nomenclature and Equations
for
Calculation of Source Emissions

METCO

Nomenclature for Particulate Calculations

Symbol	English Units	Metric Units	Description
A_s	$in.^2$	m^2	Stack Area
C_{an}	gr/dscf	g/dscm	Particulate - probe, cyclone and filter
C_{ao}	gr/dscf	g/dscm	Particulate - total
C_{at}	gr/CF @ stack conditions	g/m^3	Particulate - probe, cyclone and filter
C_{au}	gr/CF @ stack conditions	g/m^3	Particulate - total
C_{aw}	lbs/hr	kg/hr	Particulate - probe, cyclone and filter
C_{ax}	lbs/hr	kg/hr	Particulate - total
C_p			Pitot Tube Calibration Factor
D_n	in.	m	Sampling Nozzle Diameter
%EA			Percent Excess Air at sampling point
g	32.2 ft/sec^2		Acceleration of gravity
%I			Percent isokinetic
%M			Percent moisture in the stack gas by volume
M_d			Mole fraction of dry gas
m_f	mg	mg	Particulate - probe, cyclone and filter
M_{H_2O}	18 lb/lb-mole		Molecular Weight of Water

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

METCO

Symbol	English Units	Metric Units	Description
m_t	mg	mg	Particulate - total
MW	lb/lb-mole	g/g-mole	Molecular Weight of stack gas
MW_{air}	28.95 lb/ lb-mole		Molecular Weight of air
MW_d	lb/lb-mole	g/g-mole	Molecular Weight of dry stack gas
P_b	"Hg Absolute	mm Hg	Barometric Pressure
P_m	"H_2O	mm H_2O	Orifice Pressure drop
P_s	"Hg Absolute	mm Hg	Stack Pressure
ΔP_s	"H_2O	mm H_2O	Velocity Head of stack gas
P_{std}	29.92 "Hg	760 mm Hg	Standard Barometric Pressure
Q_a	ACFM	m^3/hr	Stack Gas Volume at Actual Stack Conditions
Q_s	DSCFM	dscm/hr	Stack Gas Volume at 29.92 "Hg, 528°R, dry
R	21.83 "Hg-ft^3/lb-mole-°R		Universal Gas Constant
T_m	°F	°C	Average Gas Meter Temperature
T_t	min	min	Net time of test
T_s	°F	°C	Stack Temperature
T_{std}	528°R	293°K	Standard Temperature
V_m	ft^3	m^3	Volume of dry gas sampled @ meter conditions
$V_{m_{std}}$	dscf	dscm	Volume of dry gas sampled @ standard conditions
V_s	fpm	m/sec	Stack velocity @ stack conditions
V_w	ml	ml	Total Water Collected in Impingers and Silica Gel

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

METCO

Symbol	English Units	Metric Units	Description
$V_{w_{gas}}$	scf	scm	Volume of Water Vapor Collected @ standard conditions
ρ_{air}	0.0748 lbs/ft^3		Density of Air
ρ_{H_2O}	1 g/ml		Density of Water
ρ_{man}	51.63 lbs/ft^3		Density of Manometer Oil

Standard Conditions: 68°F, 29.92 "Hg (20°C, 760 mm Hg)

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

METCO

Example Particulate Calculations

1. Volume of dry gas sampled at standard conditions.*

$$V_{m_{std}} = V_m \left(\frac{T_{std}}{T_m + 460}\right) \left[\frac{P_b + \frac{P_m}{13.6}}{P_{std}}\right]$$

$$V_{m_{std}} = 17.65\ V_m \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = \text{dscf}$$

$$V_{m_{std}} = \text{dscf} \times 0.028317 = \text{dscm}$$

2. Volume of water vapor collected at standard conditions.*

$$V_{w_{gas}} = \frac{(V_w - \text{gms } SO_2 - \text{gms } H_2S)\ \rho_{H_2O}\ R\ T_{std}}{P_{std}\ M_{H_2O}\ 453.6}$$

$$V_{w_{gas}} = 0.0472\ (V_w - \text{gms } SO_2 - \text{gms } H_2S) = \text{scf}$$

$$V_{w_{gas}} = \text{scf} \times 0.028317 = \text{scm}$$

3. Percent moisture in stack gas.

$$\%M = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \%$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

METCO

4. Mole fraction of dry gas.

$$M_d = \frac{100 - \%M}{100}$$

5. Average molecular weight of dry stack gas.

$$MW_d = \left[\%CO_2 \times \frac{44}{100}\right] + \left[\%O_2 \times \frac{32}{100}\right] + \left[\%N_2 \times \frac{28}{100}\right] + \left[\%CO \times \frac{28}{100}\right] = \text{lb/lb-mole}$$

$$= \text{g/g-mole}$$

6. Molecular weight of stack gas.

$$MW = MW_d \times M_d + 18\ (1 - M_d) = \frac{\text{lb}}{\text{lb-mole}} = \text{g/g-mole}$$

7. Percent excess air at sampling point.

$$\%EA = \frac{100\ (\%O_2 - 0.5\%\ CO)}{0.265\ (\%N_2) - (\%O_2) + 0.5\ (\%CO)}$$

8. Stack Pressure.

$$P_s = P_b + \frac{\text{stack pressure "}H_2O}{13.6} = \text{"Hg Absolute}$$

$$P_s = \text{"Hg Abs.} \times 25.4 = \text{mm Hg}$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

9. Stack velocity at stack conditions.

$$V_s = C_p\ 60 \left[\frac{2g \times \rho_{man} \times P_{std} \times MW_{air} \times (T_s + 460) \times \Delta P_s}{12 \times \rho_{air} \times P_s \times MW \times T_{std}}\right]^{1/2}$$

$$V_s = 5123.8\ C_p \left[\frac{(T_s + 460) \times \Delta P_s}{P_s \times MW}\right]^{1/2} = \text{fpm}$$

$$V_s = \text{fpm} \times 0.00508 = \text{m/sec}$$

10. Dry stack gas volume at standard conditions.

$$Q_s' = \frac{1}{144} V_s \times A_s \times M_d \times \frac{T_{std}}{T_s + 460} \times \frac{P_s}{P_{std}}$$

$$Q_s = \frac{0.123\ V_s \times A_s \times M_d \times P_s}{T_s + 460} = \text{DSCFM}$$

$$Q_s = \text{DSCFM} \times 1.6990 = \text{dscm/hr}$$

11. Actual stack gas volume at stack conditions.

$$Q_a = \frac{V_s \times A_s}{144} = \text{ACFM}$$

$$Q_a = \text{ACFM} \times 1.6990 = \text{m}^3\text{/hr}$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

12. Percent isokinetic.

$$\%I = \frac{V_{m_{std}} \times (T_s + 460) \times P_{std} \times 100 \times 144}{M_d \times T_{std} \times P_s \times T_t \times V_s \times \frac{\pi D_n^2}{4}}$$

$$\%I = \frac{1039\ V_{m_{std}} \times (T_s + 460)}{M_d \times P_s \times T_t \times V_s \times D_n^2}$$

13. Particulate - probe, cyclone and filter.

$$C_{an} = \frac{m_f}{V_{m_{std}}} \times \frac{1\ gr}{64.8\ mg}$$

$$C_{an} = 0.0154\ \frac{m_f}{V_{m_{std}}} = gr/dscf$$

$$C_{an} = gr/dscf \times 2.290 = g/dscm$$

14. Particulate total.

$$C_{ao} = 0.0154 \times \frac{m_t}{V_{m_{std}}} = gr/dscf$$

$$C_{ao} = gr/dscf \times 2.290 = g/dscm$$

* 528° R, 29.92 "Hg (20°C, 760 mm Hg)

15. Particulate - probe, cyclone and filter at stack conditions.

$$C_{at} = C_{an} \times \frac{P_s}{P_{std}} \times \frac{(T_{std})}{(T_s + 460)} \times M_d$$

$$C_{at} = \frac{17.65 \times C_{an} \times P_s \times M_d}{T_s + 460} = \text{gr/CF}$$

$$C_{at} = \text{gr/CF} \times 2.290 = \text{g/m}^3$$

16. Particulate - total, at stack conditions.

$$C_{au} = \frac{17.65 \times C_{ao} \times P_s \times M_d}{T_s + 460} = \text{gr/CF}$$

$$C_{au} = \text{gr/CF} \times 2.290 = \text{g/m}^3$$

17. Particulate - probe, cyclone and filter.

$$C_{aw} = C_{an} \times Q_s \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{1 \text{ lb}}{7000 \text{ gr}}$$

$$C_{aw} = 0.00857 \times C_{an} \times Q_s = \text{lbs/hr}$$

$$C_{aw} = \text{lbs/hr} \times 0.4536 = \text{kg/hr}$$

18. Particulate - total.

$$C_{ax} = 0.00857 \times C_{ao} \times Q_s = \text{lbs/hr}$$

$$C_{ax} = \text{lbs/hr} \times 0.4536 = \text{kg/hr}$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

METCO

SOURCE EMISSIONS SURVEY
LONE STAR INDUSTRIES, INC.
MARYNEAL, TEXAS
FILE NUMBER 80-54

SOURCE EMISSIONS CALCULATIONS

Kiln Number 1 Duct

Symbol	Description	Units			
Run No.			1	2	3
Date			6/20/80	6/20/80	6/20/80
Begin			1003	1135	1238
End			1033	1205	1308
P_b	barometric pressure	"Hg Abs. (mm Hg)	27.41 (696)	27.41 (696)	27.41 (696)
P_m	orifice pressure drop	"H_2O (mm H_2O)	0.350 (8.9)	0.350 (8.9)	0.350 (8.9)
V_m	volume dry gas sampled @ meter conditions	$ft.^3$ (m^3)	10.578 (0.300)	10.585 (0.300)	10.198 (0.289)
T_m	avg. gas meter temp.	°F (°C)	81 (27)	89 (32)	95 (35)
$V_{m_{std}}$	volume dry gas sampled @ standard conditions*	dscf (dscm)	9.468 (0.268)	9.336 (0.264)	8.898 (0.252)
V_w	total H_2O collected, impingers & silica gel	ml	14.7	14.5	12.3
$V_{w_{gas}}$	volume water vapor collected @ standard conditions*	scf (scm)	0.694 (0.020)	0.684 (0.019)	0.581 (0.016)
%M	moisture in stack gas by volume	%	6.83	6.83	6.13

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

METCO

Source Emissions Calculations

Lone Star Industries, Inc.
Kiln Number 1 Duct
File Number 80-54

Symbol	Description	Units			
M_d	mol fraction of dry gas	---	0.9317	0.9317	0.9387
CO_2		%	19.2	18.6	18.0
O_2		%	9.2	9.2	9.6
N_2		%	71.6	72.2	72.4
%EA	excess air @ sampling point	%	94.1	92.6	100.1
MW_d	molecular weight of dry stack gas	lb/lb-mole (g/g-mole)	31.44 (31.44)	31.34 (31.34)	31.26 (31.26)
MW	molecular weight of stack gas	lb/lb-mole (g/g-mole)	30.52 (30.52)	30.43 (30.43)	30.45 (30.45)
ΔPs	velocity head of stack gas	"H_2O (mm H_2O)	1.376 (35.0)	1.399 (35.5)	1.541 (39.1)
T_s	stack temperature	°F (°C)	547 (286)	556 (291)	559 (293)
P_s	stack pressure	"Hg Abs. (mm Hg)	27.72 (704)	27.73 (704)	27.78 (706)
V_s	stack velocity @ stack conditions	fpm (m/sec)	5,385 (27.36)	5,472 (27.80)	5,688 (28.90)
A_s	stack area	$in.^2$ (m^2)	2,252 (1.45)	2,252 (1.45)	2,252 (1.45)
Q_s	dry stack gas volume @ standard conditions*	DSCFM (dscm/hr)	38,256 (64,997)	38,544 (65,486)	40,320 (68,504)
Q_a	actual stack gas volume @ stack conditions	ACFM (m^3/hr)	84,214 (143,080)	85,574 (145,390)	88,949 (151,124)

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

METCO

Source Emissions Calculations

Lone Star Industries, Inc.
Kiln Number 1 Duct
File Number 80-54

Symbol	Description	Units			
T_t	net time of test	min.	30	30	30
D_n	sampling nozzle diam.	in. (m)	---- (----)	---- (----)	---- (----)
%I	percent isokinetic	%	----	----	----
m_f	particulate - probe, cyclone and filter	mg	----	----	----
m_t	particulate - total	mg	----	----	----
C_{an}	particulate - probe, cyclone and filter	gr/dscf* (g/dscm)	---- (----)	---- (----)	---- (----)
C_{ao}	particulate - total	gr/dscf* (g/dscm)	---- (----)	---- (----)	---- (----)
C_{at}	particulate - probe, cyclone and filter @ stack conditions	gr/cf (g/m^3)	---- (----)	---- (----)	---- (----)
C_{au}	particulate total @ stack conditions	gr/cf (g/m^3)	---- (----)	---- (----)	---- (----)
C_{aw}	particulate - probe, cyclone and filter	lbs/hr (kg/hr)	---- (----)	---- (----)	---- (----)
C_{ax}	particulate - total	lbs/hr (kg/hr)	---- (----)	---- (----)	---- (----)

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

Client Lone Star Industries, Inc. SO_2 EMISSION DATA Job Number 80-54

[redacted]it Tested Kiln Number 1 Duct

[redacted]un Number	1	2	3			
[redacted]ate	6/20/80	6/20/80	6/20/80			
[redacted]ime	1003-1033	1135-1205	1238-1308			
[redacted] - normality of $BaCl_2$	0.0098	0.0098	0.0098			
[redacted]L_I - ml in impinger #1	----	----	----			
ML_I - ml in impinger #2	248	268	304			
[redacted]L_I - ml in impinger #3	288	287	334			
ML_A - ml in aliquot #1	----	----	----			
[redacted]L_A - ml in aliquot #2	10	10	10			
[redacted]L_A - ml in aliquot #3	10	10	10			
ML_B - ml of $BaCl_2$ to titrate #1	----	----	----			
[redacted]L_B - ml of $BaCl_2$ to titrate #2	0.05	0.10	0.05			
[redacted]L_B - ml of $BaCl_2$ to titrate #3	0.05	0.05	0.05			
ML_{BB} - ml of $BaCl_2$ to titrate blank	0.05	0.05	0.05			
[redacted] - average gas meter temp., °F	81	89	95			
V_m - volume of dry gas sampled @ meter conditions, $ft.^3$	10.578	10.585	10.198			
P_b - barometric pressure, "Hg Abs.	27.41	27.41	27.41			
[redacted]s - Stack gas volume dry @ standard conditions, *SCFM	38,256	38,544	40,320			
[redacted] - SO_2 in Impinger #1, mgs	----	----	----			
C_I - SO_2 in Impinger #2, mgs	0.0	0.4	0.0			
[redacted] - SO_2 in Impinger #3, mgs	0.0	0.0	0.0			
C_T - total SO_2 in Impingers, mgs	0.0	0.4	0.0			
[redacted]pm SO_2	0.0	0.6	0.0			
[redacted]$_{SO_2}$ - emission rate of SO_2, lbs/day	0.0	5.5	0.0			
C_s - emission rate of S, lbs/day	0.0	2.8	0.0			

[redacted] 68°F, 29.92 "Hg (20°C, 760 mm Hg)

[redacted] $$C_I = \frac{ML_I \times (ML_B - ML_{BB}) \times \underline{N} \times 32}{ML_A}$$

[redacted] $$C_T = C_I \#1 + C_I \#2 + C_I \#3$$

$$ppm\ SO_2 = \frac{0.7513 \times C_T \times (T_m + 460)}{V_m\ P_b}$$

$$C_{SO_2} = ppm\ SO_2 \times Q_s \times 239.2 \times 10^{-6}$$

$$C_s = \frac{C_{SO_2}}{2}$$

METCO

SULFUR TRIOXIDE EMISSION DATA

Job Number 80-54 Location Maryneal, TX

Job Name Lone Star Industries, Inc. Unit Tested Kiln Number 1 Duct

Run Number	1	2	3	
Date	6/20/80	6/20/80	6/20/80	
Time	1003-1033	1135-1205	1238-1308	
N - normality of $BaCl_2$	0.0098	0.0098	0.0098	
ML_I - ml in impinger	227	244	252	
ML_A - ml in aliquot	10	10	10	
ML_B - ml of $BaCl_2$ to titrate	0.15	0.30	0.15	
ML_{BB} - ml of $BaCl_2$ to titrate blank	0.05	0.05	0.05	
T_m - average gas meter temp., °F	81	89	95	
V_m - volume of dry gas sampled @ meter conditions, ft.^{3}	10.578	10.585	10.198	
P_b - barometric pressure, "Hg Abs.	27.41	27.41	27.41	
Q_s - stack gas volume dry @ standard conditions, *SCFM	38,256	38,544	40,320	
C_I - SO_3 in impinger, mgs	0.9	2.4	1.0	
ppm SO_3	1.0	2.7	1.2	
C_{SO_3} - emission rate of SO_3, lbs/day	11.4	31.4	14.2	
C_S - emission rate of S, lbs/day	4.6	12.6	5.7	

*68°F, 29.92 "Hg (20°C, 760 mm Hg)

$$C_I = \frac{ML_I \times ML_B \times N \times 40}{ML_A}$$

$$\text{ppm } SO_3 = \frac{0.6021 \times C_I \times (T_m + 460)}{V_m P_b}$$

$$C_{SO_3} = \text{ppm } SO_3 \times Q_s \times 299.1 \times 10^{-6}$$

$$C_S = \frac{C_{SO_3}}{2.5}$$

METCO

SOURCE EMISSIONS SURVEY
LONE STAR INDUSTRIES, INC.
MARYNEAL, TEXAS
FILE NUMBER 80-54

SOURCE EMISSIONS CALCULATIONS

Kiln Number 2 Duct

Symbol	Description	Units			
Run No.			1	2	3
Date			6/20/80	6/20/80	6/20/80
Begin			1624	1736	1856
End			1654	1806	1926
P_b	barometric pressure	"Hg Abs. (mm Hg)	27.41 (696)	27.41 (696)	27.41 (696)
P_m	orifice pressure drop	"H_2O (mm H_2O)	0.350 (8.9)	0.350 (8.9)	0.350 (8.9)
V_m	volume dry gas sampled @ meter conditions	$ft.^3$ (m^3)	9.969 (0.282)	10.760 (0.305)	10.684 (0.303)
T_m	avg. gas meter temp.	°F (°C)	103 (39)	104 (40)	102 (39)
$V_{m_{std}}$	volume dry gas sampled @ standard conditions*	dscf (dscm)	8.574 (0.243)	9.238 (0.262)	9.206 (0.261)
V_w	total H_2O collected, impingers & silica gel	ml	12.0	11.2	11.2
$V_{w_{gas}}$	volume water vapor collected @ standard conditions*	scf (scm)	0.566 (0.016)	0.529 (0.015)	0.529 (0.015)
%M	moisture in stack gas by volume	%	6.20	5.41	5.43

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

METCO

Source Emissions Calculations

Lone Star Industries, Inc.
Kiln Number 2 Duct
File Number 80-54

Symbol	Description	Units			
M_d	mol fraction of dry gas	---	0.9380	0.9459	0.9457
CO_2		%	16.8	17.0	15.0
O_2		%	10.2	10.0	11.4
N_2		%	73.0	73.0	73.6
%EA	excess air @ sampling point	%	111.5	107.0	140.7
MW_d	molecular weight of dry stack gas	lb/lb-mole (g/g-mole)	31.10 (31.10)	31.12 (31.12)	30.86 (30.86)
MW	molecular weight of stack gas	lb/lb-mole (g/g-mole)	30.28 (30.28)	30.41 (30.41)	30.16 (30.16)
ΔPs	velocity head of stack gas	"H_2O (mm H_2O)	1.425 (36.2)	1.469 (37.3)	1.469 (37.3)
T_s	stack temperature	°F (°C)	546 (286)	545 (285)	540 (282)
P_s	stack pressure	"Hg Abs. (mm Hg)	27.62 (702)	27.65 (702)	27.65 (702)
V_s	stack velocity @ stack conditions	fpm (m/sec)	5,534 (28.11)	5,596 (28.43)	5,605 (28.47)
A_s	stack area	$in.^2$ (m^2)	2,252 (1.45)	2,252 (1.45)	2,252 (1.45)
Q_s	dry stack gas volume @ standard conditions*	DSCFM (dscm/hr)	39,477 (67,071)	40,339 (68,536)	40,597 (68,974)
Q_a	actual stack gas volume @ stack conditions	ACFM (m^3/hr)	86,552 (147,052)	87,512 (148,683)	87,655 (148,926)

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

METCO

Source Emissions Calculations

Lone Star Industries, Inc.
Kiln Number 2 Duct
File Number 80-54

Symbol	Description	Units			
T_t	net time of test	min.	30	30	30
D_n	sampling nozzle diam.	in. (m)	---- (----)	---- (----)	---- (----)
%I	percent isokinetic	%	----	----	----
m_f	particulate - probe, cyclone and filter	mg	----	----	----
m_t	particulate - total	mg	----	----	----
C_{an}	particulate - probe, cyclone and filter	gr/dscf* (g/dscm)	---- (----)	---- (----)	---- (----)
C_{ao}	particulate - total	gr/dscf* (g/dscm)	---- (----)	---- (----)	---- (----)
C_{at}	particulate - probe, cyclone and filter @ stack conditions	gr/cf (g/m^3)	---- (----)	---- (----)	---- (----)
C_{au}	particulate total @ stack conditions	gr/cf (g/m^3)	---- (----)	---- (----)	---- (----)
C_{aw}	particulate - probe, cyclone and filter	lbs/hr (kg/hr)	---- (----)	---- (----)	---- (----)
C_{ax}	particulate - total	lbs/hr (kg/hr)	---- (----)	---- (----)	---- (----)

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

Client Lone Star Industries, Inc. SO_2 EMISSION DATA Job Number 80-54

[redacted]it Tested Kiln Number 2 Duct

[redacted]un Number	1	2	3			
[redacted]ate	6/20/80	6/20/80	6/20/80			
[redacted]me	1624-1654	1736-1806	1856-1926			
[redacted] - normality of $BaCl_2$	0.0098	0.0098	0.0098			
[redacted]L_I - ml in impinger #1	----	----	----			
ML_I - ml in impinger #2	280	282	262			
[redacted]L_I - ml in impinger #3	332	372	284			
ML_A - ml in aliquot #1	----	----	----			
[redacted]L_A - ml in aliquot #2	10	10	10			
[redacted]L_A - ml in aliquot #3	10	10	10			
ML_B - ml of $BaCl_2$ to titrate #1	----	----	----			
[redacted]L_B - ml of $BaCl_2$ to titrate #2	0.05	0.05	0.05			
[redacted]L_B - ml of $BaCl_2$ to titrate #3	0.05	0.05	0.05			
ML_{BB} - ml of $BaCl_2$ to titrate blank	0.05	0.05	0.05			
[redacted] - average gas meter temp., °F	103	104	102			
V_m - volume of dry gas sampled @ meter conditions, ft.^{3}	9.969	10.760	10.684			
[redacted]P_b - barometric pressure, "Hg Abs.	27.41	27.41	27.41			
[redacted]s - Stack gas volume dry @ standard conditions, *SCFM	39,477	40,339	40,597			
[redacted]I - SO_2 in Impinger #1, mgs	----	----	----			
[redacted]C_I - SO_2 in Impinger #2, mgs	0.0	0.0	0.0			
[redacted]I - SO_2 in Impinger #3, mgs	0.0	0.0	0.0			
C_T - total SO_2 in Impingers, mgs	0.0	0.0	0.0			
[redacted]pm SO_2	0.0	0.0	0.0			
[redacted]SO_2 - emission rate of SO_2, lbs/day	0.0	0.0	0.0			
C_s - emission rate of S, lbs/day	0.0	0.0	0.0			

[redacted] 68°F, 29.92 "Hg (20°C, 760 mm Hg)

[redacted] $$C_I = \frac{ML_I \times (ML_B - ML_{BB}) \times \underline{N} \times 32}{ML_A}$$

[redacted] $$C_T = C_I \#1 + C_I \#2 + C_I \#3$$

$$\text{ppm } SO_2 = \frac{0.7513 \times C_T \times (T_m + 460)}{V_m P_b}$$

$$C_{SO_2} = \text{ppm } SO_2 \times Q_s \times 239.2 \times 10^{-6}$$

$$C_s = \frac{C_{SO_2}}{2}$$

METCO

SULFUR TRIOXIDE EMISSION DATA

Job Number 80-54 | Location Maryneal, TX

Job Name Lone Star Industries, Inc. | Unit Tested Kiln Number 2 Duct

Run Number	1	2	3	
Date	6/20/80	6/20/80	6/20/80	
Time	1624-1654	1736-1806	1856-1926	
N - normality of $BaCl_2$	0.0098	0.0098	0.0098	
ML_I - ml in impinger	224	251	248	
ML_A - ml in aliquot	10	10	10	
ML_B - ml of $BaCl_2$ to titrate	0.10	0.10	0.20	
ML_{BB} - ml of $BaCl_2$ to titrate blank	0.05	0.05	0.05	
T_m - average gas meter temp., °F	103	104	102	
V_m - volume of dry gas sampled @ meter conditions, $ft.^3$	9.969	10.760	10.684	
P_b - barometric pressure, "Hg Abs.	27.41	27.41	27.41	
Q_s - stack gas volume dry @ standard conditions, *SCFM	39,477	40,339	40,597	
C_I - SO_3 in impinger, mgs	0.4	0.5	1.5	
ppm SO_3	0.9	0.6	1.7	
C_{SO_3} - emission rate of SO_3, lbs/day	10.7	6.8	20.5	
C_S - emission rate of S, lbs/day	4.3	2.7	8.2	

*68°F, 29.92 "Hg (20°C, 760 mm Hg)

$$C_I = \frac{ML_I \times ML_B \times N \times 40}{ML_A}$$

$$\text{ppm } SO_3 = \frac{0.6021 \times C_I \times (T_m + 460)}{V_m P_b}$$

$$C_{SO_3} = \text{ppm } SO_3 \times Q_s \times 299.1 \times 10^{-6}$$

$$C_S = \frac{C_{SO_3}}{2.5}$$

SOURCE EMISSIONS SURVEY
LONE STAR INDUSTRIES, INC.
MARYNEAL, TEXAS
FILE NUMBER 80-54

SOURCE EMISSIONS CALCULATIONS

Kiln Number 3 Duct

Symbol	Description	Units			
Run No.			1	2	3
Date			6/18/80	6/18/80	6/18/80
Begin			1918	2024	2130
End			1948	2054	2200
P_b	barometric pressure	"Hg Abs. (mm Hg)	27.32 (694)	27.32 (694)	27.32 (694)
P_m	orifice pressure drop	"H_2O (mm H_2O)	0.350 (8.9)	0.350 (8.9)	0.350 (8.9)
V_m	volume dry gas sampled @ meter conditions	ft^3 (m^3)	10.751 (0.304)	10.570 (0.299)	10.458 (0.296)
T_m	avg. gas meter temp.	°F (°C)	105 (41)	104 (40)	102 (39)
$V_{m_{std}}$	volume dry gas sampled @ standard conditions*	dscf (dscm)	9.184 (0.260)	9.045 (0.256)	8.981 (0.254)
V_w	total H_2O collected, impingers & silica gel	ml	13.9	14.8	14.4
$V_{w_{gas}}$	volume water vapor collected @ standard conditions*	scf (scm)	0.656 (0.019)	0.699 (0.020)	0.680 (0.019)
%M	moisture in stack gas by volume	%	6.67	7.17	7.04

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

METCO

Source Emissions Calculations

Lone Star Industries, Inc.
Kiln Number 3 Duct
File Number 80-54

Symbol	Description	Units			
M_d	mol fraction of dry gas	---	0.9333	0.9283	0.9296
CO_2		%	18.2	20.4	19.8
O_2		%	8.0	8.2	8.8
N_2		%	73.8	71.4	71.4
%EA	excess air @ sampling point	%	69.2	76.5	86.9
MW_d	molecular weight of dry stack gas	lb/lb-mole (g/g-mole)	31.23 (31.23)	31.59 (31.59)	31.52 (31.52)
MW	molecular weight of stack gas	lb/lb-mole (g/g-mole)	30.35 (30.35)	30.62 (30.62)	30.57 (30.57)
ΔPs	velocity head of stack gas	"H_2O (mm H_2O)	1.383 (35.1)	1.383 (35.1)	1.383 (35.1)
T_s	stack temperature	°F (°C)	573 (301)	582 (306)	576 (302)
P_s	stack pressure	"Hg Abs. (mm Hg)	27.72 (704)	27.64 (702)	27.66 (703)
V_s	stack velocity @ stack conditions	fpm (m/sec)	5,497 (27.92)	5,505 (27.97)	5,492 (27.90)
A_s	stack area	$in.^2$ (m^2)	2,246 (1.45)	2,246 (1.45)	2,246 (1.45)
Q_s	dry stack gas volume @ standard conditions*	DSCFM (dscm/hr)	38,032 (64,616)	37,448 (63,624)	37,656 (63,978)
Q_a	actual stack gas volume @ stack conditions	ACFM (m^3/hr)	85,745 (145,681)	85,862 (145,880)	85,653 (145,524)

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

Source Emissions Calculations

Lone Star Industries, Inc.
Kiln Number 3 Duct
File Number 80-54

Symbol	Description	Units			
T_t	net time of test	min.	30	30	30
D_n	sampling nozzle diam.	in. (m)	---- (----)	---- (----)	---- (----)
%I	percent isokinetic	%	----	----	----
m_f	particulate - probe, cyclone and filter	mg	----	----	----
m_t	particulate - total	mg	----	----	----
C_{an}	particulate - probe, cyclone and filter	gr/dscf* (g/dscm)	---- (----)	---- (----)	---- (----)
C_{ao}	particulate - total	gr/dscf* (g/dscm)	---- (----)	---- (----)	---- (----)
C_{at}	particulate - probe, cyclone and filter @ stack conditions	gr/cf (g/m^3)	---- (----)	---- (----)	---- (----)
C_{au}	particulate total @ stack conditions	gr/cf (g/m^3)	---- (----)	---- (----)	---- (----)
C_{aw}	particulate - probe, cyclone and filter	lbs/hr (kg/hr)	---- (----)	---- (----)	---- (----)
C_{ax}	particulate - total	lbs/hr (kg/hr)	---- (----)	---- (----)	---- (----)

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

Client Lone Star Industries, Inc. SO_2 EMISSION DATA Job Number 80-54

[redacted]it Tested Kiln Number 3 Duct

[redacted]un Number	1	2	3			
[redacted]ate	6/18/80	6/18/80	6/18/80			
[redacted]ime	1918-1948	2024-2054	2130-2200			
[redacted] - normality of $BaCl_2$	0.0098	0.0098	0.0098			
[redacted]L_I - ml in impinger #1	----	----	----			
ML_I - ml in impinger #2	287	276	257			
[redacted]L_I - ml in impinger #3	313	328	322			
[redacted]L_A - ml in aliquot #1	----	----	----			
ML_A - ml in aliquot #2	10	10	10			
[redacted]L_A - ml in aliquot #3	10	10	10			
ML_B - ml of $BaCl_2$ to titrate #1	----	----	----			
[redacted]L_B - ml of $BaCl_2$ to titrate #2	0.05	0.10	0.10			
[redacted]L_B - ml of $BaCl_2$ to titrate #3	0.05	0.10	0.05			
ML_{BB} - ml of $BaCl_2$ to titrate blank	0.05	0.05	0.05			
[redacted] - average gas meter temp., °F	105	104	102			
V_m - volume of dry gas sampled @ meter conditions, $ft.^3$	10.751	10.570	10.458			
P_b - barometric pressure, "Hg Abs.	27.32	27.32	27.32			
[redacted] - Stack gas volume dry @ standard conditions, *SCFM	38,032	37,448	37,656			
[redacted] - SO_2 in Impinger #1, mgs	----	----	----			
C_I - SO_2 in Impinger #2, mgs	0.0	0.4	0.4			
[redacted] - SO_2 in Impinger #3, mgs	0.0	0.5	0.0			
C_T - total SO_2 in Impingers, mgs	0.0	0.9	0.4			
[redacted]pm SO_2	0.0	1.4	0.6			
[redacted]SO_2 - emission rate of SO_2, lbs/day	0.0	12.4	5.4			
C_s - emission rate of S, lbs/day	0.0	6.2	2.7			

[redacted] 68°F, 29.92 "Hg (20°C, 760 mm Hg)

[redacted] $$C_I = \frac{ML_I \times (ML_B - ML_{BB}) \times \underline{N} \times 32}{ML_A}$$

[redacted] $$C_T = C_I \#1 + C_I \#2 + C_I \#3$$

$$\text{ppm } SO_2 = \frac{0.7513 \times C_T \times (T_m + 460)}{V_m P_b}$$

$$C_{SO_2} = \text{ppm } SO_2 \times Q_s \times 239.2 \times 10^{-6}$$

$$C_s = \frac{C_{SO_2}}{2}$$

METCO

SULFUR TRIOXIDE EMISSION DATA

Job Number 80-54 Location Maryneal, TX

Job Name Lone Star Industries, Inc. Unit Tested Kiln Number 3 Duct

Run Number	1	2	3	
Date	6/18/80	6/18/80	6/18/80	
Time	1918-1948	2024-2054	2130-2200	
$\underline{N}$ - normality of $BaCl_2$	0.0098	0.0098	0.0098	
ML_I - ml in impinger	254	280	243	
ML_A - ml in aliquot	10	10	10	
ML_B - ml of $BaCl_2$ to titrate	0.10	0.10	0.05	
ML_{BB} - ml of $BaCl_2$ to titrate blank	0.05	0.05	0.05	
T_m - average gas meter temp., °F	105	104	102	
V_m - volume of dry gas sampled @ meter conditions, $ft.^3$	10.751	10.570	10.458	
P_b - barometric pressure, "Hg Abs.	27.32	27.32	27.32	
Q_s - stack gas volume dry @ standard conditions, *SCFM	38,032	37,448	37,656	
C_I - SO_3 in impinger, mgs	0.5	0.5	0.0	
ppm SO_3	0.6	0.6	0.0	
C_{SO_3} - emission rate of SO_3, lbs/day	6.6	7.2	0.0	
C_S - emission rate of S, lbs/day	2.6	2.9	0.0	

*68°F, 29.92 "Hg (20°C, 760 mm Hg)

$$C_I = \frac{ML_I \times ML_B \times N \times 40}{ML_A}$$

$$\text{ppm } SO_3 = \frac{0.6021 \times C_I \times (T_m + 460)}{V_m P_b}$$

$$C_{SO_3} = \text{ppm } SO_3 \times Q_s \times 299.1 \times 10^{-6}$$

$$C_S = \frac{C_{SO_3}}{2.5}$$

APPENDIX C

Calibration of Equipment

Equipment	Calibration Factor	Calibration Date
Pitot Tube #6	0.829	5/ 7/80
Dry Gas Meter #1	1.016	5/20/80
Stack Unit Orifice #1		5/21/80
Digital Temperature Indicator #1		5/21/80
Post Test Dry Gas Meter Calibration	1.022	6/27/80

PITOT TUBE CALIBRATION

Date: 5/7/80

Time: 1415

Pitot No. 6

P_b: 29.27 "Hg P_s: 0.04 "H_2O

T_s: 81 °F C_{pstd}: 0.99

Motor Setting	fps mark	CALIBRATOR STANDARD START	CALIBRATOR STANDARD END	$\sqrt{\text{STANDARD AVERAGE}}$	HIGH	$\sqrt{\text{HIGH}}$	CAL. FACTOR	LOW	$\sqrt{\text{LOW}}$	CAL. FACTOR
31	10	—	—	—	—	—	—	—	—	—
39	20	0.10	0.10	0.316	0.14	0.374	0.837	0.15	0.~~308~~387	0.808
48	30	0.24	0.24	0.490	0.34	0.583	0.832	0.35	0.592	0.820
55	40	0.37	0.37	0.608	0.54	0.735	0.819	0.55	0.742	0.812
63	50	0.60	0.60	0.775	0.87	0.932	0.822	0.89	0.943	0.813
70	60	0.85	0.85	0.922	1.20	1.095	0.833	1.20	1.095	0.833
76	70	1.10	1.15	1.061	1.60	1.265	0.830	1.60	1.265	0.830
84	80	1.70	1.70	1.304	2.40	1.549	0.833	2.40	1.549	0.833
100	90	1.80	1.80	1.342	2.60	1.612	0.824	2.60	1.612	0.824
Average							0.829			0.822

Summary of Results:

Normal high side calibration factor 0.829
variation -1.0, +1.2

Normal low side calibration factor 0.822
variation -1.7, +1.3

Signature of Calibrator

METCO

DRY GAS METER CALIBRATION

Meter Number: 7

Calibrator: [signature]

Date: 5/20/90

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No: 4

P_b: 29.41 "Hg

Control Module Vacuum 8.0 "Hg

	Wet Test Meter				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1042	5.500 cf	74 °F	-0.40 "H_2O	73.277 cf	84 °F	81 °F	0.50 "H_2O
Start	1027	0.000 cf	74 °F	-0.40 "H_2O	67.772	86	91	0.50 "H_2O
		cf	°F	"H_2O	5.505 cf	°F	°F	"H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 5.500 \left(\frac{29.41 + \frac{-0.40}{13.6}}{74 + 460}\right) \times \underset{(C_f)}{1.019} = 5.443 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 5.505 \left(\frac{29.41 + \frac{0.50}{13.6}}{83 + 460}\right) = 5.269 \text{ dscf}$$

$$C_{DG} = \frac{5.443}{5.269} = \boxed{1.033}$$

DRY GAS METER CALIBRATION

Meter Number: 1 Calibrator: Don C Alexander

Date: 20 MAY 80

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No: 5 P_b: 29.41 "Hg

Control Module Vacuum 7.0 "Hg

	Wet Test Meter				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1011	11.251 cf	75 °F	0.50 "H_2O	85.231 cf	83 °F	81 °F	1.00 "H_2O
Start	1050	0.000 cf	75 °F	0.50 "H_2O	73.900	82	91	1.00 "H_2O
		11.251 cf	°F	"H_2O	11.331 cf	°F	°F	"H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 11.251 \left(\frac{29.41 + \frac{0.50}{13.6}}{75 + 460} \right) \times \underset{(C_f)}{1.019} = 11.110 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 11.331 \left(\frac{29.41 + \frac{1.00}{13.6}}{82 + 460} \right) = 10.879 \text{ dscf}$$

$$C_{DG} = \frac{11.110}{} = \boxed{1.021}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 1

Calibrator: Don C Alexander

Date: 20 MAY 80

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No: 6

P_b: 29.41 "Hg

Control Module Vacuum 7.0 "Hg

	Wet Test Meter: Time	Wet Test Meter: Meter Reading	Wet Test Meter: Temp.	Wet Test Meter: P_m	Dry Gas Meter: Meter Reading	Dry Gas Meter: Temp. In	Dry Gas Meter: Temp. Out	Dry Gas Meter: P_m
End	1132	10.006 cf	75 °F	-0.60 "H_2O	96.318 cf	84 °F	81 °F	1.50 "H_2O
Start	1117	0.000 cf	75 °F	-0.60 "H_2O	86.201	82	81	1.50 "H_2O
		10.006 cf	75 °F	0.60 "H_2O	10.117 cf	82 °F	°F	1.50 "H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 10.006 \left(\frac{29.41 + \frac{-0.60}{13.6}}{75 + 460}\right) \times 1.019 \; (C_f) = 9.878 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 10.117 \left(\frac{29.41 + \frac{1.50}{13.6}}{82 + 460}\right) = 9.726 \text{ dscf}$$

$$C_{DG} = \frac{9.878}{9.726} = \boxed{1.016}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 1 Calibrator: Don Alford

Date: 20 MAY 80

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No: 7

P_b: 29.41 "Hg

Control Module Vacuum 10.0 "Hg

	Wet Test Meter				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End		11.006 cf	75 °F	-0.80 "H_2O	109.180 cf	84 °F	81 °F	2.00 "H_2O
Start	1124	0.000 cf	75 °F	-0.70 "H_2O	98.003	83	81	2.00 "H_2O
		11.006 cf	°F	"H_2O	11.177 cf	°F	°F	2.00 "H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 11.006 \left(\frac{29.41 + \frac{-0.80}{13.6}}{75 + 460} \right) \times 1.019\ (C_f) = 10.860 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 11.117 \left(\frac{29.41 + \frac{2.00}{13.6}}{82 + 460} \right) = \quad \text{dscf}$$

$$C_{DG} = \frac{10.860}{10.700} = \boxed{1.015}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 1 Calibrator: [signature]

Date: 20 MAY 80

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No: 8

P_b: 29.41 "Hg

Control Module Vacuum 9.2 "Hg

	Wet Test Meter				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1204	9.004 cf	75 °F	-1.00 "H_2O	119.018 cf	84 °F	82 °F	3.00 "H_2O
Start	1154	0.000 cf	75 °F	-1.00 "H_2O	109.~~803~~ 899	83	81	3.00 "H_2O
		9.004 cf	°F	"H_2O	9.119 cf	°F	°F	"H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 9.004 \left(\frac{29.41 + \frac{-1.00}{13.6}}{75 + 460} \right) \times 1.019 \; (C_f) = \cancel{8.855}\ 8.880 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 9.119 \left(\frac{29.41 + \frac{3.00}{13.6}}{83 + 460} \right) = 8.783 \text{ dscf}$$

$$C_{DG} = \frac{8.880}{8.783} = \boxed{1.011}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 1

Calibrator: [signature]

Date: 20 MAY 80

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No: 9

P_b: 29.40 "Hg

Control Module Vacuum 7.0 "Hg

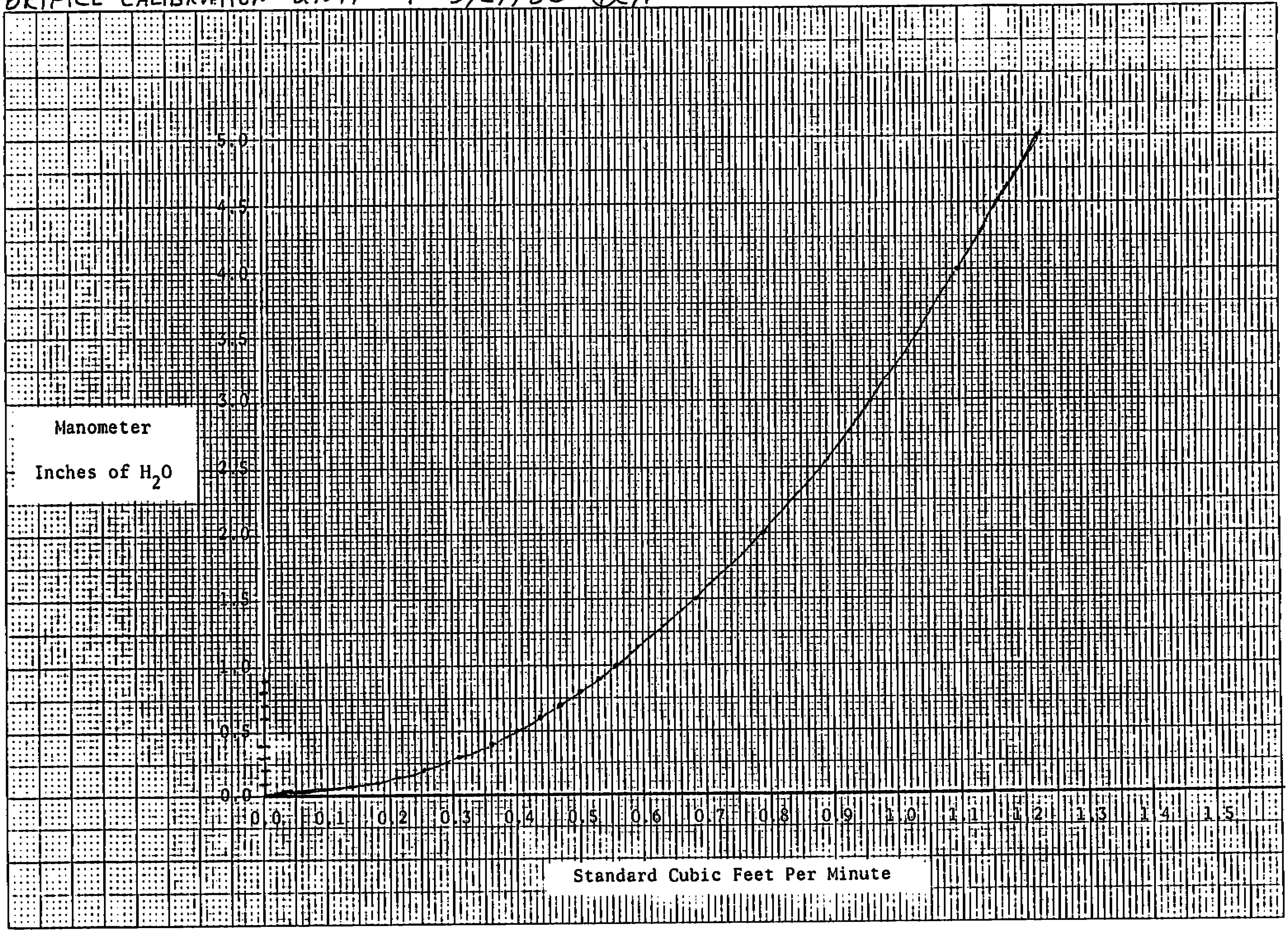
	Wet Test Meter			Dry Gas Meter			
Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End 1330	11.010 cf	76 °F	-1.40 "H_2O	133.152 cf	83 °F	80 °F	4.00 "H_2O
Start 1320	0.000 cf	76 °F	-1.40 "H_2O	122.003	80	80	~~0.400~~ 4.00 "H_2O
	11.010 cf	76 °F	-1.40 "H_2O	11.149 cf	81 °F	°F	4.00 "H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 11.010 \left(\frac{29.40 + \frac{-1.40}{13.6}}{76 + 460} \right) \times \underset{(C_f)}{1.019} = 10.823 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 11.149 \left(\frac{29.40 + \frac{4.00}{13.6}}{81 + 460} \right) = \qquad \text{dscf}$$

$$C_{DG} = \frac{10.823}{10.801} = \boxed{1.002}$$

ORIFICE CALIBRATION UNIT #1 5/21/80 JCA



METCO

DIGITAL TEMPERATURE INDICATOR NO. 1

CALIBRATION DATA

Date: 5/21/80

Media	Time	Mercury Thermometer(°F)	DTI(°F)	% Errc
Ice Bath	1102	32	32	
Ambient Air	0830	74	74	0.0
Boiling Water	1110	210	210	0.0
Oven	0930	271	271	0.0
Oven	1005	318	317	0.3
Oven	1015	330	328	0.6
Oven	1050	400	396	1.0

Meter Adjusted? Yes______ No ✓

Signature of Calibrator

METCO

DRY GAS METER CALIBRATION

Meter Number: 1 Calibrator: DCA

Date: 27 JUNE 80

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No: 1 P_b: 29.21 "Hg

Control Module Vacuum N.O "Hg

	Wet Test Meter				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1418	5.509 cf	76 °F	-0.40 "H_2O	544.088 cf	84 °F	82 °F	0.49 "H_2O
Start	1400	0.00 cf	76 °F	-0.40 "H_2O	538.598	83	81	0.50 "H_2O
		5.509 cf	°F	"H_2O	5.490 cf	°F	°F	"H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 5.509 \left(\frac{29.21 + \frac{-0.40}{13.6}}{76 + 460} \right) \times \underset{(C_f)}{1.028} = 5.441 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 5.490 \left(\frac{29.21 + \frac{0.495}{13.6}}{82 + 460} \right) = \text{ dscf}$$

$$C_{DG} = \frac{5.441}{5.279} = \boxed{1.041}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 1

Calibrator:

Date: 27 June 80

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No: 2

P_b: 29.20 "Hg

Control Module Vacuum 14.5 "Hg

	Wet Test Meter				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1432	6.255 cf	76 °F	-0.50 "H_2O	551.079 cf	84 °F	82 °F	1.00 "H_2O
Start	1422	0.00 cf	76 °F	-0.50 "H_2O	544.802	84	82	1.00 "H_2O
		6.255 cf	°F	"H_2O	6.277 cf	°F	°F	"H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 6.255 \left(\frac{29.20 + \frac{-0.50}{13.6}}{76.83 + 460} \right) \times \underset{(C_f)}{1.028} = 6.175 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 6.277 \left(\frac{29.20 + \frac{1.00}{13.6}}{83 + 460} \right) = \text{ dscf}$$

$$C_{DG} = \frac{6.175}{5.973} = \boxed{1.034}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 1 Calibrator: DCA

Date: 27 JUNE 80

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No: 3 P_b: 29.21 "Hg

Control Module Vacuum 13.5 "Hg

	Wet Test Meter				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1450	10.009 cf	76 °F	-0.70 "H_2O	561.900	85 °F	83 °F	1.40 "H_2O
Start	1440	0.00 cf	76 °F	-0.70 "H_2O	551.800	84	83	1.50 "H_2O
		10.009 cf	°F	"H_2O	10.100 cf	°F	°F	1.45 "H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 10.009 \left(\frac{29.21 + \frac{-0.70}{13.6}}{76 + 460}\right) \times \underset{(C_f)}{9.025} = 9.879 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 10.100 \left(\frac{29.21 + \frac{1.45}{13.6}}{84 + 460}\right) = 9.607 \text{ dscf}$$

$$C_{DG} = \frac{9.879}{9.607} = \boxed{1.028}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 1 Calibrator: DCA

Date: 27 JUNE 80

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No: 4 P_b: 29.21 "Hg

Control Module Vacuum 13.5 "Hg

	Wet Test Meter				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1455	10.500 cf	76 °F	-0.80 "H_2O	572.907 cf	85 °F	84 °F	2.00 "H_2O
Start	1504	0.000 cf	76 °F	0.80 "H_2O	562.251	85	83	2.00 "H_2O
		10.500 cf	°F	"H_2O	10.656 cf	°F	°F	"H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 10.500 \left(\frac{29.21 + \frac{\cancel{2.00}\ -0.80}{13.6}}{76\ \cancel{84} + 460} \right) \times \underset{(C_f)}{1.028} = 10.361 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 10.656 \left(\frac{29.21 + \frac{2.00}{13.6}}{84 + 460} \right) = \quad \text{dscf}$$

$$C_{DG} = \frac{10.361}{10.150} = \boxed{1.021}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 1

Calibrator: DCA

Date: 27 JUNE 80

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No: 5

P_b: 29.20 "Hg

Control Module Vacuum 9.0 "Hg

	Wet Test Meter				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1507	13.013 cf	76 °F	-1.10 "H_2O	586.518 cf	85 °F	84 °F	3.00 "H_2O
Start	1520	0.000 cf	76 °F	-1.00 "H_2O	573.194	85	84	3.00 "H_2O
		13.013 cf	°F	"H_2O	13.324 cf	°F	°F	"H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 13.013 \left(\frac{29.20 + \frac{-1.05}{13.6}}{76 + 460} \right) \times \underset{(C_f)}{1.028} = \quad \text{dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 13.324 \left(\frac{29.20 + \frac{3.00}{13.6}}{84 + 460} \right) = 12.718 \text{ dscf}$$

$$C_{DG} = \frac{12.829}{12.718} = \boxed{1.009}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 1 Calibrator: DCA

Date: 27 JUNE 80

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No: 6

P_b: 29.20 "Hg

Control Module Vacuum 9.5 "Hg

	Wet Test Meter				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End		11.005 cf	76 °F	-1.30 "H_2O	599.353 cf	85 °F	84 °F	4.10 "H_2O
Start		0.000 cf	76 °F	-1.40 "H_2O	588.003	85	84	4.00 "H_2O
		11.005 cf	°F	"H_2O	11.350 cf	°F	°F	4.05 "H_2O

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 11.005 \left(\frac{29.20 + \frac{-1.35}{13.6}}{76 + 460} \right) \times \underset{(C_f)}{1.028} = \quad \text{dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 11.350 \left(\frac{29.20 + \frac{4.05}{13.6}}{84 + 460} \right) = 10.863 \text{ dscf}$$

$$C_{DG} = \frac{10.841}{10.863} = \boxed{0.998}$$

APPENDIX D

Field Testing Data

MU[illegible]NS [illegible]RON[illegible]AL [illegible]TIN[illegible]

[redacted] Job No. 80-54 [redacted] 5[redacted] F[redacted] DATA

Job Name LONE STAR CEMENT
Run No. 1
Location Kiln #1 Duct
Date 20 JUNE 80
Operator Alexander, Saathoff
Sample Box No. 4 Meter Box No. 1

Read and record at the start of each test point.

Purge to: 455.600
Purge time: 1035-1041

Ambient Temp. °F 84
Assumed Moisture % 6
Probe Length 3
C Factor — — to reference
Initial Leak @ 15.0 "Hg = 0.002 cfm
Final Leak @ 4.5 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O (ΔP_s)	Orifice ΔH in. H_2O (P_m) Desired	Orifice ΔH in. H_2O Actual	Pump Vacuum In. Hg Gauge	Stack Temp. °F (T_s)	Probe Temp. °F	Oven Temp. °F	Effluent Temp. °F	Dry Gas Temp. °F (T_m) Inlet	Dry Gas Temp. °F Outlet	Remarks
A 1	1003	443.154	—	0.35	0.35	2.0	547	275	239	82	80	78	
1	1008	444.94	—	0.35	0.35	2.0	544	280	252	71	81	79	
1	1013	446.700	—	0.35	0.55	2.0	542	244	260	70	82	79	
1	1018	448.50	—	0.35	0.35	2.0	547	274	266	70	83	80	orsat
1	1023	450.09	—	0.35	0.35	2.0	551	251	264	71	84	80	
1	1028	451.90	—	0.35	0.35	2.2	550	244	262	72	84	81	
END	1033	453.565	—	—	—	—	—	—	—	—	—		
Au													

Pitot Tube Calibration Factor C_p —
Volume Collected V_m 10.578 ft^3
Water Collected V_w 14.7 ml
Time of Test T_t 30 min.
Stack Pressure P_s +4.2 "H_2O

Baro. Press. P_b ~~29.40~~ 27.41 "Hg
Probe Tip Dia. D_n — in.
% CO_2 19.2 % CO 0.0
% O_2 9.2 % N_2 71.6
Area Stack A_s 2252 in^2

Pitot Tube No. —
Probe Tip No. —

V_m = Dry Gas Meter Calibration Factor 1.016 X 10.411

[Dry Gas Meter Reading ____ ft^3 - (T_t ____ min X Leak Rate ____ cfm)]

M_F = ____ M_T = ____

Impinger Box No. 4

Impinger 1	Final Weight	655.5	**Water Weight Gain** Impinger 1	-4.8
	Initial Weight	660.3	Impinger 2	14.2
	Increase	-4.8		
Impinger 2	Final Weight	706.2	Impinger 3	1.2
	Initial Weight	692.0	Impinger 4	1.0
	Increase	14.2		
Impinger 3	Final Weight	674.3	Impinger 5	3.1
	Initial Weight	673.1	Impinger 6	
	Increase	1.2		
Impinger 4	Final Weight	485.8	Total	14.7 = V_w
	Initial Weight	484.8		
	Increase	1.0		
Impinger 5	Final Weight	749.2		
	Initial Weight	746.1		
	Increase	3.1		
Impinger 6	Final Weight			
	Initial Weight			
	Increase			
Filter #	Final Weight			
	Initial Weight			
	Increase			

P_b = 27.41		$\%CO_2$ = 19.2	
V_m = 10.578		$\%O_2$ = 9.2	
V_w = 14.7		$\%CO$ = 0.0	
P_m = 0.35		$\%N_2$ = 71.6	
Avg ΔP = —		A_s = 2252	
Avg $\sqrt{\Delta P}$ = -		D_n = -	
C_p = —		T_t = 30	
P_s = +4.2 "H_2O	27.72 "Hg		
T_m = 81 °F	541 °R		
T_s = 547 °F	1007 °R		

Moisture Content: %M = 6.83 M_d = 0.9317 MW_d = 31.440 MW = 30.52

$$V_{m_{std}} = 17.65\, V_m \left(\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right) = 17.65 \times 10.578 \left(\frac{27.41 + \frac{0.350}{13.6}}{81 + 460}\right) = 9.468 \text{ sft}^3$$

0.316 scfm

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 14.7 = 0.694 \text{ sft}^3$$

$$\text{Moisture} = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \frac{0.694}{9.468 + 0.694} \times 100 = 6.83\ \%$$

V_s = 5123.8 x ______ $\sqrt{\frac{\quad}{\ \ x\ \ }}$ x ______ = ______ fpm

ACFM: ______

$I = \frac{1039 \times \qquad \times}{\times \qquad \times \qquad \times \qquad \times (\qquad)^2}$ = ______ %

SCFM: ______

%EA: 94.1

[redacted] No. 80-54

PRELIMINARY VELOCITY TRAVERSE DATA
AND
SAMPLING LOCATION DATA

RUN #1

Jo[redacted] Name Lone Star Cement

[redacted]cation Kiln #1 Duct

D[redacted]e 20JUNE80 Time 0910-0925

Port & Inside Diameter 46 3/4, 46, 46 in.

[redacted]t & Wall Thickness A 4 1/4, B 3 1/2, C 3 1/2 in.

In[redacted]side Stack Diameter 42 1/2 in.

Stack Temperature Start ______ °F

End ______ °F

Sampling ports are ~~139~~ 178" / 4.14 downstream of disturbance

Sampling ports are 94" upstream of disturbance

[redacted]int No.	Percent Diameter	Distance from Inside Wall in.	Distance from Ref. Point in.	$\Delta P/\sqrt{\Delta P}$ Port A	$\Delta P/\sqrt{\Delta P}$ Port B	$\Delta P/\sqrt{\Delta P}$ Port C	$\Delta P/\sqrt{\Delta P}$ Port D
1				0.89 /	~~0.88~~ 0.75 /	1.10 /	/
2				1.30 /	1.00 /	1.20 /	/
3				1.50 /	1.10 /	1.30 /	/
4				1.50 /	1.40 /	1.30 /	/
5				1.60 /	1.55 /	1.35 /	/
6				1.70 /	1.60 /	1.35 /	/
7				1.80 /	1.80 /	1.30 /	/
8				1.80 /	1.65 /	1.05 /	/
9				1.95 /	1.40 /	1.05 /	/
10				1.95 /	1.10 /	1.05 /	/
11				2.10 /	0.86 /	~~0.90~~ 1.05 /	/
12				2.30 /	0.76 /	1.10 /	/
13				/	/	/	/
14				/	/	/	/
15				/	/	/	/
16				/	/	/	/
17				/	/	/	/
18				/	/	/	/
19				/	/	/	/
20				/	/	/	/
21				/	/	/	/
22				/	/	/	/
23				/	/	/	/
24				/	/	/	/
			Average $\Delta P/\sqrt{\Delta P}$	/	/	/	/

P[redacted]t Tube No. 636

[redacted] = +4.2 " H_2O 29.71 " Hg

C_p = 0.829

[redacted] = 29.40 " Hg

.75 2252

1.376 / 1.162

MU[redacted]NS E[redacted]RONMENTAL TESTING CO., INC.

[redacted]

Job No. [redacted] | [redacted] DATA

Job Name LONE STAR CEMENT

Run No. 2

Location Kiln #1 Duct

Date 20 JUNE 80

Operator Alexander, Scathoff

Sample Box No. 5 Meter Box No. 1

Read and record at the start of each test point.

Purge to: 468.500

Purge time: 1208-1214

Ambient Temp. °F 91

Assumed Moisture % 6

Probe Length 3

C Factor — — to reference

Initial Leak @ 16.0 "Hg = 0.000 cfm

Final Leak @ 6.0 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O (ΔP_s)	Orifice ΔH in. H_2O (P_m) Desired	Orifice ΔH in. H_2O (P_m) Actual	Pump Vacuum In. Hg Gauge	Stack Temp. °F (T_s)	Probe Temp. °F	Oven Temp. °F	Effluent Temp. °F	Dry Gas Temp. °F (T_m) Inlet	Dry Gas Temp. °F (T_m) Outlet	Remarks
A1	1135	455.967	—	0.35	0.35	4.2	549	266	261	100	88	86	
1	1140	457.79	—	0.35	0.35	4.2	558	270	264	93	89	86	
1	1145	459.54	—	0.35	0.35	4.2	556	252	261	90	90	87	
1	1150	461.27	—	0.35	0.35	4.2	559	244	258	88	92	87	
1	1155	462.97	—	0.35	0.35	4.2	554	248	256	88	93	88	
1	1200	464.64		0.35	0.35	4.2	558	245	252	85	93	89	orsat
END	1205	~~466.385~~	—	—	—	—	—	—	—	—	—	—	
AW		~~466~~.385											
		66											

Pitot Tube Calibration Factor C_p —

Volume Collected V_m 10.585 ft^3

Water Collected V_w 14.5 ml

Time of Test T_t 30 min.

Stack Pressure P_s + 4.4 "H_2O

Baro. Press. P_b ~~29.40~~ 27.41 "Hg

Probe Tip Dia. D_n — in.

% CO_2 18.6 % CO 0.0

% O_2 98.2 % N_2 72.2

Area Stack A_s 2252 in^2

Pitot Tube No. —

Probe Tip No. —

V_m = Dry Gas Meter Calibration Factor 1.016 x 10.418

[Dry Gas Meter Reading ____ ft^3 - (T_t ____ min X Leak Rate ____ cfm)]

M_F = ____ M_T = ____

Impinger Box No. 5

Impinger 1	Final Weight	644.1	
	Initial Weight	646.5	
	Increase	-2.4	
Impinger 2	Final Weight	691.3	
	Initial Weight	679.3	
	Increase	12.0	
Impinger 3	Final Weight	696.7	
	Initial Weight	695.4	
	Increase	1.3	
Impinger 4	Final Weight	489.4	
	Initial Weight	488.6	
	Increase	0.8	
Impinger 5	Final Weight	749.2	
	Initial Weight	746.4	
	Increase	2.8	
Impinger 6	Final Weight		
	Initial Weight		
	Increase		

Filter # ____ Final Weight ____ Initial Weight ____ Increase ____

Water Weight Gain

Impinger 1	-2.4
Impinger 2	12.0
Impinger 3	1.3
Impinger 4	0.8
Impinger 5	2.8
Impinger 6	
Total	14.5 ✓ = V_w

P_b =	27.41 ✓	$\%CO_2$ =	18.6 ✓
V_m =	10.585 ✓	$\%O_2$ =	9.2 ✓
V_w =	14.5 ✓	$\%CO$ =	0.0 ✓
P_m =	0.350 ✓	$\%N_2$ =	72.2 ✓
Avg ΔP =	—	A_s =	2252 ✓
Avg $\sqrt{\Delta P}$ =	—	D_n =	—
C_p =	—	T_t =	30 ✓

P_s = +4.4 ✓ "H_2O 27.73 ✓ "Hg ✓

T_m = 89 ✓ °F 549 °R ✓

T_s = 556 ✓ °F 1016 °R ✓
540

Moisture Content: %M = 6.83 ✓ M_d = 0.9317 ✓ MW_d = 31.344 ✓ MW = 30.43 ✓

$$V_{m_{std}} = 17.65\ V_m \left(\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right) = 17.65 \times 10.585 \left(\frac{27.41 + \frac{0.35}{13.6}}{89 + 460}\right) = 9.336\ \text{sft}^3$$

0.311 ✓ scfm

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 14.5 = 0.684\ \text{sft}^3$$

$$\%\ \text{Moisture} = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \frac{0.684}{9.336 + 0.684} \times 100 = 6.83\ \%$$

V_s = 5123.8 x ____ $\sqrt{\_\_\_\_ \text{ x } \_\_\_\_}$ x ____ = ____ fpm

ACFM: ____

SCFM: ____

%I = $\frac{1039 \text{ x } \_\_\_\_ \text{ x } \_\_\_\_}{\text{x} \quad \text{x} \quad \text{x} \quad \text{x}(\quad)^2}$ = ____ %

%EA: 92.6 ✓

[redacted] No. 80-54

PRELIMINARY VELOCITY TRAVERSE DATA AND SAMPLING LOCATION DATA

Run #2 & #3

J[redacted] Name LONE STAR CEMENT

[redacted]ation Kiln #1 Duct

[redacted]e 6/20/80 Time 1100-1115

Port & Inside Diameter ________ in.

[redacted]t & Wall Thickness ________ in.

I[redacted]ide Stack Diameter ________ in.

Stack Temperature Start ______ °F

End ______ °F

Sampling ports are ______ downstream of disturbance

Sampling ports are ______ upstream of disturbance

[redacted]int No.	Percent Diameter	Distance from Inside Wall in.	Distance from Ref. Point in.	$\Delta P/\sqrt{\Delta P}$ Port A	$\Delta P/\sqrt{\Delta P}$ Port B	$\Delta P/\sqrt{\Delta P}$ Port C	$\Delta P/\sqrt{\Delta P}$ Port D
1				1.10 /	0.75 /	0.90 /	/
2				1.30 /	0.90 /	1.15 /	/
3				1.45 /	1.20 /	1.25 /	/
4				1.70 /	1.30 /	1.30 /	/
5				1.75 /	1.65 /	1.30 /	/
6				1.85 /	1.80 /	1.30 /	/
7				1.80 /	1.80 /	1.40 /	/
8				1.80 /	1.70 /	1.25 /	/
9				1.70 /	1.60 /	1.15 /	/
10				1.55 /	1.70 /	1.10 /	/
11				1.30 /	1.80 /	0.95 /	/
12				1.20 /	1.75 /	0.85 /	/
13				/	/	/	/
14				/	/	/	/
15				/	/	/	/
16				/	/	/	/
17				/	/	/	/
18				/	/	/	/
19				/	/	/	/
20				/	/	/	/
21				/	/	/	/
22				/	/	/	/
23				/	/	/	/
24				/	/	/	/
			Average $\Delta P/\sqrt{\Delta P}$	/	/	/	/

Pi t Tube No. 6

[redacted]s = +4.4 " H_2O 29.72 " Hg

C_p = 0.829

[redacted] = ~~27.40~~ 27.41 " Hg

1.399 / 1.174

[redacted] DATA

[redacted] 80-[redacted]4 [redacted] SO2 [redacted]

Job Name LONE STAR CEMENT

Run No. 3

Location Kiln No. 1 Dust

Date 20 JUNE 80

Operator Alexander, Saathoff

Sample Box No. 4 Meter Box No. 1

Read and record at the start of each test point.

Purge to: 480.900

Purge time: 1310-1316

Ambient Temp. °F 95

Assumed Moisture % 6.5

Probe Length 3

C Factor — — to reference

Initial Leak @ 15.0 "Hg = 0.000 cfm

Final Leak @ 6.0 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O (ΔP_s)	Orifice ΔH in. H_2O (P_m)		Pump Vacuum In. Hg Gauge	Stack Temp. °F (T_s)	Probe Temp. °F	Oven Temp. °F	Effluent Temp. °F	Dry Gas Temp. °F (T_m)		Remarks
				Desired	Actual						Inlet	Outlet	
1	1238	469.845	—	0.35	0.35	4.0	562	272	240	110	94	92	
1	1243	470.39	—	0.35	0.35	3.9	561	259	262	102	96	92	
1	1248	472.05	—	0.35	0.35	3.8	558	256	282	95	97	93	
1	1253	473.75	—	0.35	0.35	3.8	559	258	276	94	98	94	
1	1258	475.44	—	0.35	0.35	3.8	557	260	271	95	99	94	[illegible]
1	1303	477.15	—	0.35	0.35	3.8	557	259	262	94	100	95	
END	1308	478.882	—	—	—	—	—	—	—	—	—	—	
ALL													

Pitot Tube Calibration Factor C_p —

Volume Collected V_m 10.198 ft^3

Water Collected V_w 12.3 ml

Time of Test T_t 30 min.

Stack Pressure P_s +5.1 "H_2O

Baro. Press. P_b ~~29.40~~ 27.41 "Hg

Probe Tip Dia. D_n — in.

% CO_2 18.9 % CO 0.0

% O_2 9.6 % N_2 ~~73~~ 72.4

Area Stack A_s 2252 in^2

Pitot Tube No. —

Probe Tip No. —

V_m = Dry Gas Meter Calibration Factor 1.06 X

[Dry Gas Meter Reading ____ ft^3 - (T_t ____ min X Leak Rate ____ cfm)].

M_F = ________ M_T = ________

Impinger Box No. 6

Impinger 1	Final Weight	648.1	
	Initial Weight	651.2	
	Increase	-3.1	
Impinger 2	Final Weight	699.8	
	Initial Weight	688.7	
	Increase	11.1	
Impinger 3	Final Weight	696.5	
	Initial Weight	695.1	
	Increase	1.4	
Impinger 4	Final Weight	487.1	
	Initial Weight	486.7	
	Increase	0.4	
Impinger 5	Final Weight	775.5	
	Initial Weight	773.0	
	Increase	2.5	
Impinger 6	Final Weight		
	Initial Weight		
	Increase		

Filter # ____ Final Weight ____ Initial Weight ____ Increase ____

Water Weight Gain

Impinger 1	-3.1 ✓
Impinger 2	11.1 ✓
Impinger 3	1.4 ✓
Impinger 4	0.4 ✓
Impinger 5	2.5 ✓
Impinger 6	
Total	12.3 ✓ = V_w

P_b =	27.41 ✓	$\%CO_2$ =	18.0 ✓
V_m =	10.198 ✓	$\%O_2$ =	9.6 ✓
V_w =		$\%CO$ =	0.0 ✓
P_m =	0.350 ✓	$\%N_2$ =	72.4 ✓
Avg ΔP =	—	A_s =	2252 ✓
Avg $\sqrt{\Delta P}$ =	—	D_n =	- ✓
C_p =	— ✓	T_t =	30 ✓
P_s =	~~4.451~~ "H_2O	27.78 "Hg ✓	
T_m =	95 ✓ °F	~~555~~ °R ✓	
T_s =	559 ✓ °F	1019 °R ✓	

Moisture Content: %M = 6.13 ✓ M_d = 0.9387 ✓ MW_d = 31.264 ✓ MW = 30.45 ✓

$$V_{m_{std}} = 17.65\ V_m \left(\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right) = 17.65 \times 10.198 \left(\frac{27.41 + \frac{.350}{13.6}}{95 + 460}\right) = 8.898\ \text{sft}^3 \checkmark$$

0.297 scfm ✓

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 12.3 = 0.581 \checkmark\ \text{sft}^3$$

$$\text{Moisture} = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \frac{0.581}{8.898 + 0.581} \times 100 = 6.13 \checkmark\ \%$$

$$V_s = 5123.8 \times \_\_\_\_ \sqrt{\frac{\quad}{x}} \times \_\_\_\_ = \_\_\_\_\ \text{fpm}$$

ACFM: ____

$$I = \frac{1039 \times \qquad \times}{x \qquad x \qquad x \qquad x(\qquad)^2} = \_\_\_\_\ \%$$

SCFM: ____

%EA: 100.1 ✓

Job No. *80-54*

PRELIMINARY VELOCITY TRAVERSE DATA
AND
SAMPLING LOCATION DATA *Run #3*

Job Name *Lone Star Cement*

Location *Kiln #1 Dust*

Date *20 June 80* Time *1330–1345*

Port & Inside Diameter ________ in.

Port & Wall Thickness ________ in.

Inside Stack Diameter ________ in.

Stack Temperature Start ______ °F

End ______ °F

Sampling ports are ______ downstream of disturbance

Sampling ports are ______ upstream of disturbance

Point No.	Percent Diameter	Distance from Inside Wall in.	Distance from Ref. Point in.	$\Delta P/\sqrt{\Delta P}$ Port A	$\Delta P/\sqrt{\Delta P}$ Port B	$\Delta P/\sqrt{\Delta P}$ Port C	$\Delta P/\sqrt{\Delta P}$ Port D
1				0.75/	0.90/	1.05/	/
2				1.05/	1.10/	1.15/	/
3				1.25/	1.25/	1.30/	/
4				1.60/	1.50/	1.30/	/
5				1.90/	1.55/	1.50	/
6				2.00/	1.70/	1.40/	/
7				2.15/	1.70/	1.30/	/
8				2.40/	1.70/	1.25/	/
9				2.50	1.50/	1.25/	/
10				2.90/	1.40/	1.20/	/
11				3.10/	1.05/	1.05/	/
12				3.10/	0.85/	0.83/	/
13				/	/	/	/
14				/	/	/	/
15				/	/	/	/
16				/	/	/	/
17				/	/	/	/
18				/	/	/	/
19				/	/	/	/
20				/	/	/	/
21				/	/	/	/
22				/	/	/	/
23				/	/	/	/
24				/	/	/	/
			Average $\Delta P/\sqrt{\Delta P}$	/	/	/	/

1.541 / 1.220

Pitot Tube No. *6*

P_s = *5.1* " H_2O ________ " Hg

C_p = *0.829*

P_b = ~~*29.40*~~ " Hg *27.41*

[redacted] Jo[redacted]o. [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] . [redacted] LD DATA [redacted] M[redacted]NS [redacted] RON [redacted] CAL [redacted] TIN [redacted]) [redacted]

Job Name LONE STAR CEMENT

Run No. 1

Location Kiln Duct #2 Duct

Date 20 JUNE 80

Operator Alexander, Seehoff

Sample Box No. 4 Meter Box No. 1

Read and record at the start of each test point.

Purge to: 493.220

Purge time: ~~1702~~-1708

Ambient Temp. °F 98

Assumed Moisture % 6

Probe Length 3

C Factor — — to reference

Initial Leak @ 15.0 "Hg = 0.002 cfm

Final Leak @ 3.5 "Hg = 0.002 cfm

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O (ΔP_s)	Orifice ΔH in. H_2O (P_m) Desired	Orifice ΔH in. H_2O (P_m) Actual	Pump Vacuum In. Hg Gauge	Stack Temp. °F (T_s)	Probe Temp. °F	Oven Temp. °F	Effluent Temp. °F	Dry Gas Temp. °F (T_m) Inlet	Dry Gas Temp. °F (T_m) Outlet	Remarks
1	1624	481.383	—	0.35	0.35	2.0	545	249	267	105	102	101	
1	1629	483.15	—	0.35	0.35	2.0	546	272	272	100	102	101	
1	1634	484.85	—	0.35	0.35	2.0	545	281	275	98	103	102	
1	1639	486.60	—	0.35	0.35	2.0	546	261	270	94	104	102	
1	1644	488.38	—	0.35	0.35	2.2	547	257	260	90	105	103	
1	1649	490.14	—	0.35	0.35	2.2	546	255	252	90	105	103	
END	1654	491.195	—	—	—	—	—	—	—	—	—	—	
AH													

Pitot Tube Calibration Factor C_p —

Volume Collected V_m 9.969 ft^3

Water Collected V_w 12.0 ml

Time of Test T_t 30 min.

Stack Pressure P_s 62.9 "H_2O

Baro. Press. P_b ~~29.40~~ 27.41 "Hg

Probe Tip Dia. D_n — in.

% CO_2 16.8 % CO 0.0

% O_2 10.2 % N_2 73.0

Area Stack A_s 2252 in^2

Pitot Tube No. ____

Probe Tip No. ____

V_m = Dry Gas Meter Calibration Factor 1.016 x 9.812

[Dry Gas Meter Reading ____ ft^3 - (T_t ____ min X Leak Rate ____ cfm)]

M_F = ____ M_T = ____

Impinger Box No. 4

Impinger 1	Final Weight	646.6	**Water Weight Gain**	Impinger 1 -10.9
	Initial Weight	657.5		
	Increase	-10.9		Impinger 2 18.0
Impinger 2	Final Weight	718.0		Impinger 3 1.1
	Initial Weight	700.0		
	Increase	18.0		Impinger 4 0.8
Impinger 3	Final Weight	676.4		Impinger 5 3.0
	Initial Weight	675.3		
	Increase	1.1		Impinger 6 ____
Impinger 4	Final Weight	487.0		Total 12.0 = V_w
	Initial Weight	486.2		
	Increase	0.8		
Impinger 5	Final Weight	751.9		
	Initial Weight	748.9		
	Increase	3.0		
Impinger 6	Final Weight	____		
	Initial Weight	____		
	Increase			
Filter # ____	Final Weight	____		
	Initial Weight	____		
	Increase	____		

P_b = 27.41		$\%CO_2$ = 16.8	
V_m = 9.969		$\%O_2$ = 10.2	
V_w = 12.0		$\%CO$ = 0.0	
P_m = 0.350		$\%N_2$ = 73.0	
Avg ΔP = —		A_s = 2252	
Avg $\sqrt{\Delta P}$ = —		D_n = —	
C_p = —		T_t = 30	
P_s = +2.8 "H_2O	27.62 "Hg		
T_m = 103 °F	563 °R		
T_s = 546 °F	1006 °R		

Moisture Content: %M = 6.20 M_d = 0.9380 MW_d = 31.096 MW = 30.28

$$V_{m_{std}} = 17.65\ V_m \left(\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right) = 17.65 \times 9.969 \left(\frac{27.41 + \frac{0.35}{13.6}}{103 + 460}\right) = 8.574\ \text{sft}^3$$

0.286 scfm

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 12.0 = 0.566\ \text{sft}^3$$

$$\%\ \text{Moisture} = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \frac{0.566}{8.574 + 0.566} \times 100 = 6.20\ \%$$

V_s = 5123.8 x ____ $\sqrt{\frac{\quad}{x}}$ x ____ = ____ fpm   ACFM: ____

SCFM: ____

%I = $\frac{1039 \times \quad \times}{x \quad x \quad x \quad x(\quad)^2}$ = ____ %   %EA: 111.5

[redacted] No. 80-54

PRELIMINARY VELOCITY TRAVERSE DATA AND SAMPLING LOCATION DATA

Run #1

Job Name LONE STAR CEMENT

[redacted]ation Kiln #2 Duct

[redacted]e 20 JUNE 80 Time 1600-1610

Port & Inside Diameter 46 3/4 in.

[redacted]t & Wall Thickness 4 1/4 in.

I[redacted]ide Stack Diameter 42 1/2 in.

Stack Temperature Start ______ °F

End ______ °F

Sampling ports are ~~149~~ 176 / 4.14 downstream of disturbance

Sampling ports are 94 upstream of disturbance

[redacted]int No.	Percent Diameter	Distance from Inside Wall in.	Distance from Ref. Point in.	$\Delta P/\sqrt{\Delta P}$ Port A	$\Delta P/\sqrt{\Delta P}$ Port B	$\Delta P/\sqrt{\Delta P}$ Port C	$\Delta P/\sqrt{\Delta P}$ Port D
1				1.40/	0.80/	1.45/	/
2				1.60/	0.80/	1.60/	/
3				1.50/	1.20/	1.75/	/
4				1.60/	1.40/	1.60/	/
5				1.70/	1.50/	1.60/	/
6				1.80/	1.60/	1.55/	/
7				1.75/	1.60/	1.60/	/
8				1.70/	1.60/	1.50/	/
9				1.60/	1.50/	1.45/	/
10				1.40/	1.30/	1.10/	/
11				1.30/	1.30/	0.94/	/
12				1.10/	1.20/	0.90/	/
13				/	/	/	/
14				/	/	/	/
15				/	/	/	/
16				/	/	/	/
17				/	/	/	/
18				/	/	/	/
19				/	/	/	/
20				/	/	/	/
21				/	/	/	/
22				/	/	/	/
23				/	/	/	/
24				/	/	/	/
			Average $\Delta P/\sqrt{\Delta P}$	/	/	/	/

Pi[illegible]t Tube No. 6

[redacted]s = +2.8 " H_2O ________ " Hg

C_p = 0.829

[redacted] = 29.40 " Hg

ΔP 1.425

√ΔP 1.188

[redacted] [redacted] [redacted] [redacted] [redacted] [redacted] I [redacted] DATA [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted]

MU NS RON TAL TIN

Job No. [redacted] 70 [redacted] 4 | 502

Job Name LONE STAR CEMENT

Run No. 2

Location Kiln #2 Duct

Date 20 JUNE 80

Operator Alexander, Seathoff

Sample Box No. 5 Meter Box No. 1

Read and record at the start of each test point.

Purge to: 506.52

Purge time: 1809–1815

Ambient Temp. °F 100

Assumed Moisture % —

Probe Length 3

C Factor — — to reference

Initial Leak @ 15.0 "Hg = 0.000 cfm

Final Leak @ 6.0 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O (ΔP_s)	Orifice ΔH in. H_2O (P_m) Desired	Orifice ΔH in. H_2O Actual	Pump Vacuum In. Hg Gauge	Stack Temp. °F (T_s)	Probe Temp. °F	Oven Temp. °F	Effluent Temp. °F	Dry Gas Temp. °F (T_m) Inlet	Dry Gas Temp. °F Outlet	Remarks
1	1736	493.517	—	0.35	0.35	4.0	543	258	237	111	104	103	
1	1741	495.34	—	0.35	0.35	4.0	544	278	252	101	104	103	
1	1746	497.12	—	0.35	0.35	4.0	545	237	262	97	104	103	
1	1751	498.85	—	0.35	0.35	4.0	545	256	266	95	105	104	
1	1756	500.60	—	0.35	0.35	4.0	546	252	270	94	105	104	
1	1801	502.40	—	0.35	0.35	4.0	548	247	265	94	106	104	
END ALL	1806	504.108	—	—	—	—	—	—	—	—	—	—	

Pitot Tube Calibration Factor C_p —

Volume Collected V_m 10.760 ft^3

Water Collected V_w 11.2 ml

Time of Test T_t 30 min.

Stack Pressure P_s +3.2 "H_2O

Baro. Press. P_b ~~29.40~~ 27.41 "Hg

Probe Tip Dia. D_n — in.

% CO_2 17.0 % CO 0.0

% O_2 10.0 % N_2 73.0

Area Stack A_s 2252 in^2

Pitot Tube No. —

Probe Tip No. —

V_m = Dry Gas Meter Calibration Factor 1.016 x 10.591

[Dry Gas Meter Reading ____ ft^3 - (T_t ____ min X Leak Rate ____ cfm)]

M_F = ____ M_T = ____

Impinger Box No. 5

Impinger 1	Final Weight	638.0
	Initial Weight	642.7
	Increase	−4.7
Impinger 2	Final Weight	693.3
	Initial Weight	681.4
	Increase	11.9
Impinger 3	Final Weight	692.8
	Initial Weight	691.9
	Increase	0.9
Impinger 4	Final Weight	490.0
	Initial Weight	489.5
	Increase	0.5
Impinger 5	Final Weight	751.8
	Initial Weight	749.2
	Increase	2.6
Impinger 6	Final Weight	
	Initial Weight	
	Increase	

Filter # ____ Final Weight ____ Initial Weight ____ Increase ____

Water Weight Gain

Impinger 1	−4.7
Impinger 2	11.9
Impinger 3	0.9
Impinger 4	0.5
Impinger 5	2.6
Impinger 6	
Total	11.2 $= V_w$

P_b = 27.41 ✓		$\%CO_2$ = 17.0 ✓	
V_m = 10.760 ✓		$\%O_2$ = 10.0 ✓	
V_w = 11.2 ✓		$\%CO$ = 0.0 ✓	
P_m = 0.350 ✓		$\%N_2$ = 73.0 ✓	
Avg ΔP = — ✓		A_s = 2252 ✓	
Avg $\sqrt{\Delta P}$ = — ✓		D_n = — ✓	
C_p = — ✓		T_t = 30 ✓	
P_s = +3.2 ✓ "H_2O	27.65 "Hg ✓		
T_m = 104 ✓ °F	564 °R ✓		
T_s = 545 ✓ °F	1005 °R ✓		

Moisture Content: %M = 5.41 ✓ M_d = 0.9459 ✓ MW_d = 31.120 ✓ MW = 30.41 ✓

$$V_{m_{std}} = 17.65\ V_m \left(\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right) = 17.65 \times 10.760 \left(\frac{27.41 + \frac{0.35}{13.6}}{104 + 460}\right) = 9.238 \text{ sft}^3 \checkmark$$

0.308 scfm ✓

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 11.2 = 0.529 \text{ sft}^3 \checkmark$$

$$\text{Moisture} = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \frac{0.529}{9.238 + 0.529} \times 100 = 5.41\ \% \checkmark$$

$$V_s = 5123.8 \times \underline{\quad\quad} \sqrt{\frac{\quad}{\quad \times \quad}} \times \underline{\quad\quad} = \underline{\quad\quad} \text{ fpm}$$

$$I = \frac{1039 \times \quad\quad \times}{\times \quad \times \quad \times \quad \times(\quad)^2} = \underline{\quad\quad}\ \%$$

ACFM: ____

SCFM: ____

%EA: 107.0 ✓

[redacted] No. 80-54

PRELIMINARY VELOCITY TRAVERSE DATA
AND
SAMPLING LOCATION DATA Run #2 & 3

[redacted] Name LONE STAR CEMENT

[redacted]ation Kiln #2 Duct

[redacted]e 6/20/80 Time 1830-1840

Port & Inside Diameter ________ in.

[redacted]rt & Wall Thickness ________ in.

I[redacted]ide Stack Diameter ________ in.

Stack Temperature Start ______ °F

End ______ °F

Sampling ports are ______ downstream of disturbance

Sampling ports are ______ upstream of disturbance

[redacted]int No.	Percent Diameter	Distance from Inside Wall in.	Distance from Ref. Point in.	$\Delta P/\sqrt{\Delta P}$ Port A	$\Delta P/\sqrt{\Delta P}$ Port B	$\Delta P/\sqrt{\Delta P}$ Port C	$\Delta P/\sqrt{\Delta P}$ Port D
1				1.40 /	0.85 /	1.10 /	/
2				1.50 /	0.92 /	1.30 /	/
3				1.70 /	0.95 /	1.45 /	/
4				1.70 /	1.20 /	1.45 /	/
5				1.80 /	1.40 /	1.50 /	/
6				1.85 /	1.75 /	1.45 /	/
7				1.75 /	1.60 /	1.40 /	/
8				1.90 /	1.65 /	1.40 /	/
9				1.90 /	1.60 /	1.30 /	/
10				1.90 /	1.60 /	1.30 /	/
11				1.85 /	1.30 /	1.05 /	/
12				1.80 /	1.50 /	0.81 /	/
13				/	/	/	/
14				/	/	/	/
15				/	/	/	/
16				/	/	/	/
17				/	/	/	/
18				/	/	/	/
19				/	/	/	/
20				/	/	/	/
21				/	/	/	/
22				/	/	/	/
23				/	/	/	/
24				/	/	/	/
Average $\Delta P/\sqrt{\Delta P}$				/	/	/	/

Pi[illegible]t Tube No. 6

[redacted] = ±3.2 " H_2O ________ " Hg

C_p = 0.829

[redacted] = 29.40 " Hg

ΔP 1.469

$\sqrt{\Delta P}$ 1.205

MU[redacted]NS [redacted]RON[redacted]AL [redacted]TING [redacted]

[redacted] .o. [redacted] [redacted] I [redacted] DATA

Job Name LONE STAR CEMENT
Run No. 3
Location Kiln #2 Duct
Date 20 JUNE 80
Operator Alexander Seafold
Sample Box No. 6 Meter Box No. 1

Read and record at the start of each test point.

Purge to: 519.471
Purge time: 1928 - 1934

Ambient Temp. °F 95
Assumed Moisture % 5
Probe Length 3
C Factor — — to reference
Initial Leak @ 15.0 "Hg = 0.000 cfm
Final Leak @ 6.0 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O (ΔP_s)	Orifice ΔH in. H_2O (P_m) Desired	Orifice ΔH in. H_2O Actual	Pump Vacuum In. Hg Gauge	Stack Temp. °F (T_s)	Probe Temp. °F	Oven Temp. °F	Effluent Temp. °F	Dry Gas Temp. °F (T_m) Inlet	Dry Gas Temp. °F Outlet	Remarks
B 1'	1856	506.882	—	0.35	0.35	3.8	535	260	247	107	102	102	
1	1901	508.62	—	0.35	0.35	3.8	538	256	264	92	102	102	
1	1906	510.43	—	0.35	0.35	3.9	541	256	272	89	103	102	
1	1911	512.15	—	0.35	0.35	3.8	541	250	279	87	103	102	
1	1916	513.90	—	0.35	0.35	3.8	542	252	274	86	103	102	
1	1921	515.65	—	0.35	0.35	3.8	545	255	271	85	103	102	
END	1926	517.398	—	—	—	—	—	—	—	—	—	—	
ALL													

Pitot Tube Calibration Factor C_p —
Volume Collected V_m 10.684 ft^3
Water Collected V_w 11.2 ml
Time of Test T_t 30 min.
Stack Pressure P_s +3.2 "H_2O

Baro. Press. P_b ~~29.40~~ 27.41 "Hg
Probe Tip Dia. D_n — in.
% CO_2 15.0 % CO 0.0
% O_2 11.4 % N_2 73.6
Area Stack A_s 2252 in^2

Pitot Tube No. —
Probe Tip No. —

V_m = Dry Gas Meter Calibration Factor 1.016 X 10.516

[Dry Gas Meter Reading ____ ft^3 - (T_t ____ min X Leak Rate ____ cfm)]

M_F = ____ M_T = ____

Impinger Box No. 6

Impinger 1	Final Weight 641.3 Initial Weight 644.7 Increase -3.4	**Water Weight Gain**	Impinger 1	-3.4
Impinger 2	Final Weight 703.6 Initial Weight 692.6 Increase 11.0		Impinger 2	11.0 ✓
Impinger 3	Final Weight 688.1 Initial Weight 686.9 Increase 1.2		Impinger 3	1.2 ✓
Impinger 4	Final Weight 487.0 Initial Weight 487.0 Increase 0.0		Impinger 4	0.0 ✓
Impinger 5	Final Weight 778.0 Initial Weight 775.6 Increase 2.4		Impinger 5	2.4
Impinger 6	Final Weight ____ Initial Weight ____ Increase		Impinger 6	____
			Total	11.2 ✓ = V_w

Filter # ____ Final Weight ____ Initial Weight ____ Increase ____

P_b = 27.41 ✓
V_m = 10.684 ✓
V_w = 11.2 ✓
P_m = 0.350 ✓
Avg ΔP = — ✓
Avg $\sqrt{\Delta P}$ = — ✓
C_p = — ✓
P_s = ~~2.8~~ 3.2 ✓ "H_2O 27.65 "Hg ✓
T_m = 102 ✓ °F 562 °R ✓
T_s = 540 ✓ °F 1000 °R ✓

$\%CO_2$ = 15.0 ✓
$\%O_2$ = 11.4 ✓
$\%CO$ = 0.0 ✓
$\%N_2$ = 73.6 ✓
A_s = 2252 ✓
D_n = — ✓
T_t = 30 ✓

Moisture Content: %M = ~~5.34~~ 5.43 ✓ M_d = ~~0.9466~~ 0.9457 ✓ MW_d = 30.856 ✓ MW = 30.16 ✓

$$V_{m_{std}} = 17.65\ V_m \left(\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right) = 17.65 \times 10.684 \left(\frac{27.41 + \frac{0.35}{13.6}}{102 + 460}\right) = 9.\cancel{373}\,206 \text{ sft}^3 \quad 0.3\cancel{72}\,07 \text{ scfm}$$

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 11.2 = 0.529 \text{ sft}^3$$

$$\text{Moisture} = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \frac{0.529}{9.\cancel{373}\,206 + 0.529} \times 100 = 5.\cancel{34}\,43\ \%$$

V_s = 5123.8 x ____ $\sqrt{\frac{\quad}{\quad x \quad}}$ x ____ = ____ fpm

$I = \frac{1039 \text{ x } \quad \text{x}}{\text{x} \quad \text{x} \quad \text{x} \quad \text{x}(\quad)^2}$ = ____ %

ACFM: ____
SCFM: ____
%EA: 140.7 ✓

[redacted] MU NS [redacted] RON [redacted] TAL [redacted] TIN [redacted]

[redacted] Job No. 80-54 [redacted] 802 [redacted] FIELD DATA

Job Name	LONESTAR CEMENT
Run No.	1
Location	Kiln Duct #3
Date	19 JUNE 80
Operator	Alexander, Seathoff
Sample Box No.	4
Meter Box No.	1

Read and record at the start of each test point.

Purge to: 416.649

Purge time: 1951–1957

Ambient Temp. °F 109

Assumed Moisture % 5

Probe Length ~~6~~ 3

C Factor — — to reference

Initial Leak @ 15.0 "Hg = 0.004 cfm

Final Leak @ 3.0 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O (ΔP_s)	Orifice ΔH in. H_2O (P_m) Desired	Orifice ΔH in. H_2O (P_m) Actual	Pump Vacuum In. Hg Gauge	Stack Temp. °F (T_s)	Probe Temp. °F	Oven Temp. °F	Effluent Temp. °F	Dry Gas Temp. °F (T_m) Inlet	Dry Gas Temp. °F (T_m) Outlet	Remarks
1	1918	403.972	—	0.35	0.35	2.0	577	282	274	110	104	104	
1	1923	405.73	—	0.35	0.35	1.8	572	263	279	91	103	105	
1	1928	407.47	—	0.35	0.35	2.0	570	257	273	85	105	105	
1	1932	409.21	—	0.35	0.35	2.0	573	254	266	84	105	105	
1	1938	410.95	—	0.35	0.35	2.0	571	253	264	83	106	105	orsat
1	1942	412.62	—	0.35	0.35	2.0	574	252	259	85	106	105	
END	1948	414.554	—	—	—	—	—	—	—	—	—	—	

Pitot Tube Calibration Factor C_p 0.929

Volume Collected V_m 10.751 ft^3

Water Collected V_w 13.9 ml

Time of Test T_t 30 min.

Stack Pressure P_s +5.95 "H_2O

Baro. Press. P_b 2~~8~~7.32 "Hg

Probe Tip Dia. D_n — in.

% CO_2 ~~13.8~~ 18.2 % CO ~~0.0~~ 0.0

% O_2 ~~12.0~~ 8.0 % N_2 ~~74.2~~ 73.8

Area Stack A_s 2246 in^2

Pitot Tube No. —

Probe Tip No. —

V_m = Dry Gas Meter Calibration Factor 1.016 X 10.582

[Dry Gas Meter Reading ____ ft^3 - (T_t ____ min X Leak Rate ____ cfm)]

M_F = ____ M_T = ____

Impinger Box No. 4

Impinger 1	Final Weight	653.3	Water Weight Gain Impinger 1	-3.5
	Initial Weight	656.8	Impinger 2	12.4
	Increase	-3.5	Impinger 3	1.1
Impinger 2	Final Weight	705.5	Impinger 4	0.2
	Initial Weight	693.1	Impinger 5	3.7
	Increase	12.4	Impinger 6	
Impinger 3	Final Weight	668.1	Total	13.9 = V_w
	Initial Weight	667.0		
	Increase	~~0.9~~ 1.1		
Impinger 4	Final Weight	485.6		
	Initial Weight	485.4		
	Increase	0.2		
Impinger 5	Final Weight	745.5		
	Initial Weight	741.8		
	Increase	3.7		
Impinger 6	Final Weight			
	Initial Weight			
	Increase			

Filter # ____ Final Weight ____ Initial Weight ____ Increase ____

P_b = ~~29.31~~ 27.32 | $\%CO_2$ = 18.2
V_m = 10.751 | $\%O_2$ = 8.0
V_w = 13.9 | $\%CO$ = 0.0
P_m = 0.350 | $\%N_2$ = 73.8
Avg ΔP = – | A_s = 22346
Avg $\sqrt{\Delta P}$ = – | D_n = –
C_p = – | T_t = 30
P_s = + ~~5.5~~ + 5.45 "H_2O | ~~29.71~~ 27.72 "Hg
T_m = 105 °F | 565 °R
T_s = 573 °F | 1033 °R

Moisture Content: %M = ~~6.24~~ 6.67 M_d = ~~0.9376~~ 0.9333 MW_d = 31.232 MW = ~~30.44~~ 30.35

$$V_{m_{std}} = 17.65\ V_m \left(\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right) = 17.65 \times 10.751 \left(\frac{\cancel{29.31}\ 27.32 + \frac{0.350}{13.6}}{105 + 460}\right) = \cancel{9.852}\ 9.184 \text{ sft}^3$$

~~0.328~~ 0.306 scfm

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 13.9 = 0.656 \text{ sft}^3$$

$$\%\text{ Moisture} = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \frac{0.656}{9.582 + 0.656} \times 100 = \cancel{6.24}\ 6.67\ \%$$

V_s = 5123.8 x ____ $\sqrt{\frac{\quad}{x}}$ x ____ = ____ fpm   ACFM: ____

SCFM: ____

%I = $\frac{1039 \times \quad \times}{\times \quad \times \quad \times \quad \times(\quad)^2}$ = ____ %   %EA: 69.2

MU[illegible]NS [illegible]RON[illegible]AL [illegible]TIN[illegible]

Job No. 80-54 SO$_2$ [illegible] DATA

Job Name LONE STAR

Run No. 2

Location Kiln Duct No. 3

Date 19 JUNE 80

Operator Alexander, Seathoff

Sample Box No. 5 Meter Box No. 1

Read and record at the start of each test point.

Purge to: 429.500

Purge time: 2056–2102

Ambient Temp. °F 102

Assumed Moisture % —

Probe Length 3

C Factor — — to reference

Initial Leak @ 15.0 "Hg = 0.002 cfm

Final Leak @ 6.0 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O (ΔP_s)	Orifice ΔH in. H_2O (P_m) Desired	Orifice ΔH in. H_2O Actual	Pump Vacuum In. Hg Gauge	Stack Temp. °F (T_s)	Probe Temp. °F	Oven Temp. °F	Effluent Temp. °F	Dry Gas Temp. °F (T_m) Inlet	Dry Gas Temp. °F Outlet	Remarks
1	2024	417.052	—	0.35	0.35	4.2	584	252	243	105	104	104	
1	2029	418.90	—	0.35	0.35	4.0	585	263	250	86	104	104	
1	2034	420.65	—	0.35	0.35	3.8	582	274	258	83	104	104	
1	2039	422.35	—	0.35	0.35	3.8	582	269	269	82	105	104	orsat
1	2044	424.05	—	0.35	0.35	3.9	583	269	272	77	105	104	
1	2049	425.76	—	0.35	0.35	4.0	579	271	274	75	105	104	
END	2054	427.456	—	—	—	—	—	—	—	—	—	—	

Pitot Tube Calibration Factor C_p —

Volume Collected V_m 10.570 ft^3

Water Collected V_w 14.8 ml

Time of Test T_t 30 min.

Stack Pressure P_s +4.3 "H_2O

Baro. Press. P_b 27.32 "Hg

Probe Tip Dia. D_n — in.

% CO_2 20.4 % CO 0.0

% O_2 8.2 % N_2 71.4

Area Stack A_s 2246 in^2

Pitot Tube No. —

Probe Tip No. —

V_m = Dry Gas Meter Calibration Factor 1.016 x 10.404

[Dry Gas Meter Reading ____ ft^3 - (T_t ____ min X Leak Rate ____ cfm)]

M_F = ____ M_T = ____

Impinger Box No. 5

			Water Weight Gain	
Impinger 1	Final Weight	642.2	Impinger 1	-0.4 ✓
	Initial Weight	642.6		
	Increase	-0.4	Impinger 2	11.0 ✓
Impinger 2	Final Weight	688.9	Impinger 3	1.2 ✓
	Initial Weight	677.9		
	Increase	11.0	Impinger 4	0.5 ✓
Impinger 3	Final Weight	692.6	Impinger 5	2.5 ✓
	Initial Weight	691.4		
	Increase	1.2	Impinger 6	
Impinger 4	Final Weight	488.8	Total	14.8 ✓ = V_w
	Initial Weight	488.3		
	Increase	0.5		
Impinger 5	Final Weight	745.7		
	Initial Weight	743.2		
	Increase	2.5		
Impinger 6	Final Weight			
	Initial Weight			
	Increase			

Filter # ____ Final Weight ____ Initial Weight ____

Increase ____

P_b = ~~29.31~~ 27.32 ✓		$\%CO_2$ = 20.4 ✓	
V_m = 10.570 ✓		$\%O_2$ = 8.2 ✓	
V_w = 14.8 ✓		$\%CO$ = 0.0 ✓	
P_m = 0.350 ✓		$\%N_2$ = 71.4 ✓	
Avg ΔP = — ✓		A_s = 2246 ✓	
Avg $\sqrt{\Delta P}$ = — ✓		D_n = — ✓	
C_p = — ✓		T_t = 30 ✓	
P_s = +4.3 ✓ "H_2O		~~29.63~~ 27.64 "Hg ✓	
T_m = 104 ✓ °F		564 ✓ °R	
T_s = 582 ✓ °F		1042 ✓ °R	

oisture Content: %M = ~~7.20~~ 7.17 ✓ M_d = ~~0.9328~~ 0.9283 ✓ MW_d = 31.592 ✓ MW = 30.68 (2) ✓

$$_{m_{std}} = 17.65\ V_m \left(\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right) = 17.65 \times 10.570 \left(\frac{\cancel{29.31}\ 27.32 + \frac{0.350}{13.6}}{104 + 460}\right) = \cancel{9.704}\ 9.045\ sft^3$$

$\cancel{0.323}$ 0.302 ✓ scfm

$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 14.8 = 0.699$ ✓ sft^3

$$\%\ Moisture = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \frac{0.699}{\cancel{9.704}\ 9.045 + 0.699} \times 100 = \cancel{6.\ 7.20}\ 7.17\ \%$$

$_s$ = 5123.8 x ______ $\sqrt{\frac{\qquad}{x}}$ x ______ = ______ fpm

ACFM: ______

SCFM: ______

$I = \frac{1039 \times \qquad \times}{\times \qquad \times \qquad \times \qquad \times (\qquad)^2}$ = ______ %

%EA: 76.49 (5) ✓

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Job No. 80-34 [redacted] DATA [redacted]

Job Name LONE STAR CEMENT
Run No. 3
Location Kiln Duct No. 3
Date 18 JUNE 80
Operator Alexander Seatboff
Sample Box No. 6 Meter Box No. 1

Read and record at the start of each test point.
Purge to: 442.300
Purge time: 2202–2208

Ambient Temp. °F 98
Assumed Moisture % —
Probe Length 3
C Factor — — to reference
Initial Leak @ 15.0 "Hg = 0.000 cfm
Final Leak @ 6.0 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O (ΔP_s)	Orifice ΔH in. H_2O (P_m) Desired	Orifice ΔH in. H_2O Actual	Pump Vacuum In. Hg Gauge	Stack Temp. °F (T_s)	Probe Temp. °F	Oven Temp. °F	Effluent Temp. °F	Dry Gas Temp. °F (T_m) Inlet	Dry Gas Temp. °F Outlet	Remarks
C1	2130	429.936	—	0.35	0.35	3.5	575	241	244	87	102	102	
1	2135	431.68	—	0.35	0.35	3.5	576	253	277	86	102	102	
1	2140	433.30	—	0.35	0.35	3.5	577	257	277	84	103	102	
1	2145	435.06		0.35	0.35	3.5	576	263	270	85	103	102	
1	2150	436.81		0.35	0.35	3.5	577	261	264	85	103	102	
1	2155	438.50		0.35	0.35	4.2	572	264	260	84	103	102	
END	2200	440.129	—	—	—	—	—	—	—	—	—	—	

Pitot Tube Calibration Factor C_p —
Volume Collected V_m 10.458 ft^3
Water Collected V_w 14.4 ml
Time of Test T_t 30 min.
Stack Pressure P_s -4.6 "H_2O

Baro. Press. P_b ~~29.31~~ 27.32 "Hg
Probe Tip Dia. D_n — in.
% CO_2 19.8 % CO 0.0
% O_2 8.8 % N_2 71.4
Area Stack A_s 2246 in^2

Pitot Tube No. —
Probe Tip No. —

V_m = Dry Gas Meter Calibration Factor 1.016 X 10.293

[Dry Gas Meter Reading ____ ft^3 - (T_t ____ min X Leak Rate ____ cfm)]

M_F = ____ M_T = ____

ML_A

$C_T = C_I\ \#1 + C_I\ \#2 + C_I\ \#3$

C_{SO_2} = ppm SO_2 X Q_s X 239.2 X 10^{-6}

$C_s = \frac{C_{SO_2}}{2}$

METCO

SULFUR TRIOXIDE EMISSION DATA

Job Number 80-54 Location Maryneal Tx

Job Name Lone STAR Cem Unit Tested Kiln Duct #2

Run Number	1	2	3	
Date	6-20-80	6-20-80	6-20-80	
Time	1624–1654	1736–1806	1856–1926	
N - normality of $BaCl_2$	0.0098	0.0098	0.0097	
ML_I - ml in impinger	224	251	248	
ML_A - ml in aliquot	10	10	10	
ML_B - ml of $BaCl_2$ to titrate	0.10	0.10	0.20	
ML_{BB} - ml of $BaCl_2$ to titrate blank	0.05	0.05	0.05	
T_m - average gas meter temp., °F	103	104	102	
V_m - volume of dry gas sampled @ meter conditions, ft.^{3}	9.969	10.760	10.684	
P_b - barometric pressure, "Hg Abs.	27.41	27.41	27.41	
Q_s - stack gas volume dry @ standard conditions, *SCFM	39,477	40,339	40,597	
C_I - SO_3 in impinger, mgs	0.4	0.5	1.5	
ppm SO_3	0.9	0.6	1.7	
C_{SO_3} - emission rate of SO_3, lbs/day	10.7	6.8	20.5	
C_S - emission rate of S, lbs/day	4.3	2.7	8.2	

*68°F, 29.92 "Hg (20°C, 760 mm Hg)

$$C_I = \frac{ML_I \times ML_B \times N \times 40}{ML_A}$$

$$\text{ppm } SO_3 = \frac{0.6021 \times C_I \times (T_m + 460)}{V_m P_b}$$

$$C_{SO_3} = \text{ppm } SO_3 \times Q_s \times 299.1 \times 10^{-6}$$

$$C_S = \frac{C_{SO_3}}{2.5}$$

Client Lone Star Cem | SO_2 EMISSION DATA | Job Number 80-541

Unit Tested Kiln Duct #3

Run Number	1	2	3			
Date	6-18-80	6-18-80	6-18-80			
Time	1918-1948	2024-2054	2130-2200			
$\underline{N}$ - normality of $BaCl_2$	0.0098	0.0098	0.0098			
ML_I - ml in impinger #1	—	—	—			
ML_I - ml in impinger #2	287	276	257			
ML_I - ml in impinger #3	313	328	322			
ML_A - ml in aliquot #1	—	—	—			
ML_A - ml in aliquot #2	10	10	10			
ML_A - ml in aliquot #3	10	10	10			
ML_B - ml of $BaCl_2$ to titrate #1	—	—	—			
ML_B - ml of $BaCl_2$ to titrate #2	0.05	0.10	0.10			
ML_B - ml of $BaCl_2$ to titrate #3	0.05	0.10	0.05			
ML_{BB} - ml of $BaCl_2$ to titrate blank	0.05	0.05	0.05			
T_m - average gas meter temp., °F	105	104	102			
V_m - volume of dry gas sampled @ meter conditions, ft.^{3}	10.751	10.570	10.458			
P_b - barometric pressure, "Hg Abs.	27.32	27.32	27.32			
Q_s - Stack gas volume dry @ standard conditions, *SCFM	38,032	37,448	37,656			
C_I - SO_2 in Impinger #1, mgs	—	—	—			
C_I - SO_2 in Impinger #2, mgs	0.0	0.4	0.4			
C_I - SO_2 in Impinger #3, mgs	0.0	0.5	0.0			
C_T - total SO_2 in Impingers, mgs	0.0	0.9	0.4			
ppm SO_2	0.0	1.4	0.6			
C_{SO_2} - emission rate of SO_2, lbs/day	0.0	12.4	5.4			
C_s - emission rate of S, lbs/day	0.0	6.2	2.7			

*68°F, 29.92 "Hg (20°C, 760 mm Hg)

$$C_I = \frac{ML_I \times (ML_B - ML_{BB}) \times \underline{N} \times 32}{ML_A}$$

$$C_T = C_I\ \#1 + C_I\ \#2 + C_I\ \#3$$

$$\text{ppm } SO_2 = \frac{0.7513 \times C_T \times (T_m + 460)}{V_m\ P_b}$$

$$C_{SO_2} = \text{ppm } SO_2 \times Q_s \times 239.2 \times 10^{-6}$$

$$C_s = \frac{C_{SO_2}}{2}$$

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SULFUR TRIOXIDE EMISSION DATA

Job Number 80-54 Location Maryneal Tx

Job Name Lone Star Cem Unit Tested Kiln Duct #3

Run Number	1	2	3	
Date	6-18-80	6-18-80	6-18-80	
Time	1918-1948	2024-2054	2130-2200	
$\underline{N}$ - normality of $BaCl_2$	0.0098	0.0098	0.0098	
ML_I - ml in impinger	254	280	243	
ML_A - ml in aliquot	10	10	10	
ML_B - ml of $BaCl_2$ to titrate	0.10	0.10	0.05	
ML_{BB} - ml of $BaCl_2$ to titrate blank	0.05	0.05	0.05	
T_m - average gas meter temp., °F	105	104	102	
V_m - volume of dry gas sampled @ meter conditions, ft.^{3}	10.751	10.570	10.458	
P_b - barometric pressure, "Hg Abs.	27.32	27.32	27.32	
Q_s - stack gas volume dry @ standard conditions, *SCFM	38,032	37,448	37,656	
C_I - SO_3 in impinger, mgs	0.5	0.5	0.0	
ppm SO_3	0.6	0.6	0.0	
C_{SO_3} - emission rate of SO_3, lbs/day	6.6	7.2	0.0	
C_S - emission rate of S, lbs/day	2.6	2.9	0.0	

*68°F, 29.92 "Hg (20°C, 760 mm Hg)

$$C_I = \frac{ML_I \times ML_B \times N \times 40}{ML_A}$$

$$\text{ppm } SO_3 = \frac{0.6021 \times C_I \times (T_m + 460)}{V_m P_b}$$

$$C_{SO_3} = \text{ppm } SO_3 \times Q_s \times 299.1 \times 10^{-6}$$

$$C_S = \frac{C_{SO_3}}{2.5}$$

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APPENDIX G

Plant Operational Data

Lone Star Industries
Plant - Maryneal

Kiln Operating Data
During
Kiln Emission Tests
Nos 1 & 2 Kiln

Date: June 20, 1980

Time	Raw Kiln Feed Tons/Hr	Coal Feed Tons/Hr.	O_2 %
8:20 AM	42.1	3.75	1.1
8:55	42.2	3.60	2.4
10:00	42.2	3.70	1.1
10:18	42.2	3.80	1.0
10:33	42.1	3.9	2.2
10:48	42.2	3.94	1.3
11:00	42.4	3.92	1.5
11:15	42.4	3.93	1.5
11:30	42.3	3.91	1.5
11:45	42.3	3.92	1.4
12:00 Noon	42.1	3.93	1.3
12:15 PM	42.4	3.92	1.2
12:30	42.2	3.93	1.2
12:45	42.2	3.94	1.5
1:00	42.2	3.93	1.5
1:15	42.1	3.92	1.4
1:30	42.4	3.92	1.3
1:45	42.2	3.93	1.6
Average	42.2	3.88	1.4

No. 2 Kiln

3:55	42.0	3.6	1.0
4:10	42.5	3.6	1.1
4:30	42.1	3.9	1.5
4:45	42.2	4.0	1.2
5:00	42.4	4.0	1.1
5:15	42.1	3.8	1.2
5:30	42.1	3.7	1.8
5:45	42.2	3.9	2.3
6:00	42.0	4.1	1.3
6:15	42.2	4.1	1.3
6:30	42.2	4.1	2.3
6:45	42.1	4.1	1.5
7:00	42.2	4.0	2.2
7:15	42.2	4.0	2.0
7:30	42.2	3.8	1.0
7:45	42.2	3.6	2.4
Average	42.2	3.9	1.6

Lone Star Industries
Plant - Maryneal

Kiln Operating Data
During
Kiln Emission Tests
No. 3 Kiln

Date: June 18, 1980

Time	Raw Kiln Feed Tons/Hr.	Coal Feed Tons/Hr.	O_2 %
5:55 PM	42.0	3.8	1.8
6:25	42.0	3.85	1.5
7:00	42.0	3.85	1.1
7:15	43.4	3.85	1.2
7:30	42.2	3.85	1.1
7:45	42.8	3.85	1.1
8:00	42.4	3.85	1.1
8:15	42.2	3.8	1.4
8:30	42.2	3.8	1.1
8:45	42.2	3.8	1.1
9:00	42.1	3.8	1.1
9:15	42.4	3.8	1.1
9:30	42.2	3.75	1.1
9:45	42.1	3.75	1.3
10:00 PM	42.3	3.6	1.3
Average	42.3	3.75	1.2

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APPENDIX H

Resumes of Test Personnel

MULLINS ENVIRONMENTAL TESTING CO., INC.
P.O. Box 598
Addison, Tx 75001
(214)980-1843

METCO

BILLY J. MULLINS, JR., President

Education

Post Graduate Study in Environmental Engineering at Southern Methodist University, Dallas, Texas, 1970.

M.S. 1969, New York University, New York, New York, in Civil Engineering (Air Resources).

B.S. 1968, Texas Tech University, Lubbock, Texas, in Civil Engineering (Water Resources).

Studies in Engineering at U.S. Naval Academy, Annapolis, Maryland, 1963-1964.

Professional Training Courses

Attended Short Course on Air Pollution Engineering at the University of Texas at Austin, February 1970.

Attended four-week management course presented by the American Management Association, 1976.

Certification

Registered Professional Engineer
Certified Visible Emissions Evaluator
Certified Fallout Shelter Analyst
Licensed Private Pilot (Single Engine-Land)

Professional Memberships

Air Pollution Control Association - Past Chairman, Southwest Section
Source Evaluation Society
American Society of Civil Engineers
Texas Society of Professional Engineers
National Society of Professional Engineers
American Management Association
Technical Association of the Pulp and Paper Industry

Technical Experience

Directed and performed stack sampling on over 600 sources of which over 60 were sampled simultaneously using more than one sampling train at several points in the flue gas stream. 1972-present.

Directed and performed over 70 short-term ambient air studies using mobile sampling vans and various ambient air sampling equipment. 1972-present.

Designed, directed and operated over 20 permanent ambient air networks of various size and duration for a variety of parameters. 1972-present.

Designed surface and underground drainage systems for residential subdivisions, public works projects, and shopping centers. 1969-1972.

Designed several residential subdivisions including lot layout, street design, drainage design, and utility design. 1969-1972.

Research Projects

Supervised and conducted a study made by the Hawaiian Sugar Planters' Association to characterize the emissions for several bagasse-fired boilers. April-May 1976.

Supervised and conducted a study made by the Rio Grande Valley Sugar Growers, Inc. to determine the area affected by the burning of sugarcane fields prior to harvesting. November 1974-April 1975.

Supervised and conducted a study by a lightweight aggregate manufacturer to develop a material balance around the process through sampling and analysis of several parameters. November 1973.

Conducted a study in New York City to attempt to develop a correlation in the ambient air between carbon dioxide and sulfur dioxide to provide a tool for predicting air pollution episodes. January-May 1969.

Publications

Co-authored "Sulfur Compound Emissions of the Petroleum Production Industry," December 1974.

Co-authored "Field Procedure for Stabilizing Hydrogen Sulfide Samples to be Analyzed Using Modified Methylene Blue Technique," presented at the Conference on Ambient Air Quality Measurements, Austin, Texas, March 1975.

Co-authored "Atmospheric Emissions Survey of the Sour Gas Industry," October 1975.

Co-authored "Technique for Insuring the Validity of Samples for High Concentrations of Sulfur Dioxide Using the EPA Method 5 Sampling Train," presented at the Third National Conference on Energy and the Environment, College Corner, Ohio, September 1975.

Teaching Experience

Served as a lecturer in the Environmental Protection Agency's training course number 450, "Source Sampling for Particulate Pollutants" for two years from January 1974 to October 1975.

Conducted a two-day training course entitled "Technical Assistance in Source Sampling" at Iowa State University, Ames, Iowa for the Environmental Protection Agency, October 1974.

Conducted EPA's training course number 450, "Source Sampling for Particulate Pollutants" for the EPA at Research Triangle Park, North Carolina, September 1975.

Conducted a two-day short course entitled "Performing and Observing Source Sampling" at Dallas, Texas, July 1976, May 1977, October 1977; at Lake Charles, Louisiana, May 1977; and at Casper, Wyoming, May 1977.

Served as a lecturer in the Environmental Protection Agency's two-day seminar entitled "Asphalt Industry Environmental Solutions," presented in Dallas, Texas on March 21 and 22, 1979.

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DON C. ALEXANDER, Field Technician

<u>Education</u> B.S. 1978, Angelo State University, San Angelo, Texas, in Biology with a minor in Chemistry.

<u>Technical Experience</u> Participated in the sampling of over 150 sources, including several which were sampled simultaneously using more than one sampling train.

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METCO

DOUGLAS RAY SAATHOFF, Environmental Technician

Education	B.S. 1978, The University of Texas at Austin, Austin, Texas, in Biology with a minor in Chemistry.
Technical Experience	Research Assistant at The University of Texas at Port Aransas, Summers 1976 and 1977.
	Laboratory Technician for The Texas State Department of Health, Dallas, Texas.
	Participated in the sampling and analysis of several sources with EPA and Texas Air Control Board methods of both source and ambient air samples for particulates, SO_3, H_2SO_4, H_2S, HCl, Cl_2, and NO_x. Both laboratory and on-site field analysis performed.

SUMMARY

PLANT: LONE [illegible] - MARYNEAL

LOCATION: [illegible], TEXAS

TEST/IDENTIFICATION 80-54 - EA795-09 DATE: [illegible] 1979

TESTING BY: MULLINS ENVIRONMENTAL - ECOLOGY AUDITS INC.

KILN/COOLER NO. 1-2-3

			PERFORMANCE		ALLOWABLE
Kiln Production	Ton/Hr.	....	31.4	@ 1.853 K.F. Factor	
Kiln Feed Rate	Ton/Hr.	....	39.7		
Fuel Rate (Coal)	Ton/Hr.	....	5.5	@ 11,180 BTU/lb.	
" " (Oil)	Gal/Hr.	....	—		
Fuel Ash	%	....	14.0		
Fuel Sulphur	%	....	0.6	@ 0.1 Kiln Feed S.	
KILN (Stack)					
Exhaust Gas Flow	DSCFM	....	58413/34865		
Part. Concen.	lb/SCF	....	[illegible]		
Emission Rate	lb/Ton	....	0.07/2.[illegible]		0.3/13.1 = 0.3(39.7 ÷ 3.8)
SOX (Kiln) (Concentration)	PPM	....	[illegible]		
Emission Rate	lb/Ton	....	0.013/0.5 #/hr		0.3/13.1
Emission Rate	lb/MMBTU	....			
NOX (Kiln) (Concentration)	PPM	....	784		
Emission Rate	lb/Ton	....	5.76/228.5 #/hr		
COOLER (Stack)					
Exhaust Gas Flow	DSCFM	....	—		
Part. Concen.	lb/SCF	....	—		
Emission Rate	lb/Ton	....	—		

REMARKS: SOX MEASUREMENT BY [illegible] METHOD [illegible] 60

PARTICULATE SAMPLING BY HI-VOL @ TOP OF BAGHOUSE PLENUM

AS APPROVED BY TACB AND [illegible] CFR, 40 PART 60

DSCF 58.413 = PARTICULATE SAMPLING; DSCF 34865 = SOX SAMPLING

DIFFERENCE IN VOLUME DUE TO BLEED-IN OF AIR TO COOL GASES TO

BAGHOUSE.